SAPIENZA
UNIVERSITÀ DI ROMA

Environmental Emotion Regulation: Validation of the "Location Selection in Nature" Scale and Experimental Evidence from 2D Video and VR Interventions with Natural and Urban Settings

PhD programme in Social Psychology, Developmental Psychology and Educational Research
Curriculum in Social Psychology
XXXVII cycle

Department of Psychology of Development and Socialisation Processes
Sapienza University of Rome

PhD Candidate: Valeria Vitale

Supervisor
Prof. Marino Bonaiuto

Co-supervisor
Prof. Mathew White

INDEX

ABSTRACT

The interplay between nature and human well-being has garnered increasing attention in both academic research and public discourse, particularly in light of rising urbanization and the growing disconnection from natural spaces. This thesis explores the impact of natural environments on emotion regulation—a crucial psychological process influencing mental health and adaptive functioning. Drawing on existing literature supporting nature's benefits, this research addresses a critical knowledge gap by exploring emotion regulation processes as a potential mechanism through which diverse environmental contexts impact affective outcomes.

Preliminarily, two systematic reviews were conducted on nature's role in emotion regulation (Review 1) and emotion elicitation through virtual reality (Review 2), aiming to identify gaps in prior literature. Building on these findings, the thesis introduces the novel category of location selection within the Process Model of Emotion Regulation, emphasizing how environmental context shapes emotional responses and management. A scale to measure location selection in natural environments was developed and validated in English (S_1-S_2), adapted into Italian (S_3), and implemented with specific stimuli of natural environments images (S_4). Two experimental studies used 2D videos (S_5) and virtual reality scenarios (S_6) to assess emotional outcomes after negative mood induction, finding that nature significantly reduced negative emotions, with more complex effects on emotion regulation. Collectively, these findings deepen the understanding of how natural environments affect emotion regulation processes, providing important theoretical, empirical, and practical contributions to the field.

EXECUTIVE SUMMARY

The interplay between nature and human well-being has long been a subject of interest, both within academic research and popular discourse. Recent decades have seen a growing body of evidence supporting the positive effects of nature on mental, physical, and emotional health, with particular attention to how natural environments influence emotional processes. As urbanization increases and people become more disconnected from natural spaces, understanding the role of nature in promoting well-being has gained renewed importance.

The present work aims to investigate the impact of natural environments, both physical and simulated, on emotion regulation—a key psychological process that influences mental health and adaptive functioning.

Emotion regulation refers to the ways individuals manage and alter their emotional responses to align with personal goals, situational demands, and social expectations. Effective emotion regulation is linked to better mental health, while poor regulation is associated with various psychological disorders. Understanding how nature influences these processes offers valuable insights for therapeutic practices and health interventions; as well as evidence-based support for healthier lifestyles and habits in the interest of the wider population and of preventive practices for the benefit of the human well-being. Of course, this can bear wider implications for economics, politics, culture, etcetera.

This thesis is organized into five chapters.

Chapter 1 introduces the key concepts of interest for this project, beginning with the definition and types of nature and nature experience, followed by a summary of its known benefits, including physiological, psychological, and social outcomes. It then provides an overview of emotion theories, emotion regulation strategies, and their relevance to psychological health.

Chapter 2 presents a systematic rapid review of the literature, synthesizing empirical evidence on how nature affects emotion regulation processes. Review 1 explores the characteristics of studies in this area, assesses how nature and emotion regulation are measured in prior studies, and identifies gaps for future research.

Chapter 3 shifts the focus to virtual reality technologies, reviewing studies that utilize virtual natural environments to evoke emotions and experience nature. With advancements in technology, simulated environments provide a controlled and immersive way to explore nature's effects on emotional experiences. Review 2 looks at the current state of research in this emerging field and highlights unresolved questions and gaps in the literature that warrant further investigation.

Chapter 4 introduces and conceptualizes the novel category of "location selection" within the Process Model of Emotion Regulation. This newly proposed concept highlights how environmental contexts, particularly natural settings, influence emotion regulation, offering an innovative framework for understanding how different environments facilitate or hinder effective emotional responses and emotional management. Building on this, the chapter details the development and validation of a scale specifically designed to measure location selection in natural environments. The scale's creation is outlined step by step, covering its development, empirical validation, and translation into Italian (i.e., the linguistic and cultural context in which most of the empirical sections of this thesis are situated). Four studies were conducted to achieve these goals. The first study (N_{S1} = 292) focused on developing and preliminarily validating the English version of the scale, starting with an initial set of 20 items. The second study (N_{S2-T1} = 302) examined a shortened version of the scale, testing its reliability and validity (including convergent and discriminant validity), as well as test-retest reliability and predictive validity through a follow-up survey (N_{S2-T2} = 125). This process resulted in a final version of the scale consisting of 12 items, organized into two factors: up-regulation and down-regulation of emotions. The third study (N_{S3} = 308) adapted the scale for Italian speakers, confirming the two-factor structure and its validity. Across the three validation studies, alternative models for the scale structure were tested, and the two-correlated-factor model representing up-regulation and down-regulation consistently provided the best fit to the data. The fourth study (N_{S4} = 200) developed an adapted shortened version of the scale to explore its practical application by evaluating specific environmental stimuli (i.e., images) in an experimental study, demonstrating its versatility in assessing the emotional impact of various environments. Furthermore, measurement invariance across these experimental images was confirmed, highlighting the scale's robustness and consistency across experimental conditions.

Chapter 5 presents two experimental studies that examine how mediated virtual exposure to natural and urban environments influences emotion regulation processes following negative mood induction procedures. The first study (N_{S5} = 56) employs a within-subject design using 2D video stimuli depicting nature, urban street, and urban centre settings. It assesses how these different environments affect emotional recovery and the specific emotion regulation strategies utilized in each condition. Additionally, this study tests a theoretical model that posits a relationship between environmental context, perceived place restorativeness, the use of adaptive and maladaptive emotion regulation strategies, and subsequent emotional recovery. Four alternative models were tested to further confirm the hypothesized pathways and explore other potential relationships among the variables. Building on these findings, the second experiment (N_{S6} = 79) adopts a between-subject design that focuses on immersive virtual reality technology to investigate the impact of various virtual scenarios, including four natural and one urban environment, on emotion regulation and emotional responses. This study pursues similar objectives and hypotheses as Study 5, while also examining the influence of location selection variables on emotional recovery across different conditions. A second phase of the experiment further explores potential differences across scenarios in perceived restorativeness and location selection for emotional up-regulation and down-regulation using a within-subject design.

Together, these chapters provide insights on how natural environments affect emotion regulation processes, offering theoretical, empirical, and practical contributions to the field.

CHAPTER 1.

Introduction: Nature and Emotion Regulation

1.1. Definition of nature and overview of its benefits

Nature is frequently regarded as a powerful restorative environment, offering a range of benefits for human health and well-being. However, it is essential to recognize the complexities and nuances that shape this perspective. This section delves into the conceptualization of nature, examining both environmental and individual factors that influence its impact. It provides a comprehensive overview of the benefits associated with exposure to nature, outlines the primary theoretical frameworks that explain these positive effects, and explores additional explanatory mechanisms identified in the existing literature.

1.1.1 Natural environments and types of nature experience

The concept of natural environments in research is multifaceted and lacks a singular definition. A flexible definition of nature was adopted for this research, based on Bratman et al. (2012), who defined nature as "areas containing elements of living systems that include plants and nonhuman animals across a range of scales and degrees of human management, from a small urban park through to relatively 'pristine wilderness'" (p. 120).

This definition encompasses a broad spectrum of environments with varying levels of human intervention, including minimally managed areas (e.g., forests) and those shaped by human activity (e.g., urban parks). Crucially, it serves to distinguish nature from entirely human-made environments lacking such living systems, framing 'urban' as a "place-based characteristic that encompasses elements of population density, social and economic organization, and the transformation of the natural environment into a built environment" (Weeks, 2010).

Based on this, nature includes a diverse range of environments, spanning from green spaces (Lee & Maheswaran, 2011; van Dillen et al., 2012) to blue areas (Grellier et al., 2017; White et al., 2010). Green spaces broadly refer to areas with vegetation, such as urban parks, gardens, and forests (Maas et al., 2006; van Dillen et al., 2012). In contrast, blue spaces are defined as aquatic environments, including oceans, lakes, rivers, and smaller water features like fountains and streams (Grellier et al., 2017; White et al., 2010). While these categories share similarities, such as cooling effects and biodiversity (White et al., 2021), each also possesses distinct characteristics and advantages. Green spaces, for instance, are valued for their diverse sensory experiences (Southon et al., 2018), including the visual richness of vegetation and the opportunities they provide for physical activities like walking and hiking (Hunter et al., 2015; Mytton et al., 2012). They have been widely studied for their restorative properties, which promote relaxation and cognitive recovery through exposure to nature's sights and sounds (Grahn & Stigsdotter, 2010; Maas et al., 2006; Zeng et al., 2021). Green spaces also support a variety of ecosystems, contributing to both physical health and ecological sustainability (Jennings et al., 2016; Kruize et al., 2019; Tzoulas et al., 2007). On the other hand, blue spaces also offer unique psychological and aesthetic benefits tied to water (McDougall et al., 2020). These environments are often favoured for their calming qualities, with the sound and movement of water, such as wave motion and light reflections, enhancing feelings of tranquillity, attractiveness and restorative qualities (Elliott et al., 2018; Roe & Aspinall, 2012; Völker & Kistemann, 2015). In addition, blue spaces facilitate leisure activities like swimming and water sports, which provide distinct recreational and physical benefits (White et al., 2013). Research has demonstrated that blue spaces can significantly improve mood, reduce stress, and promote restoration (Roe & Aspinall, 2012; Völker & Kistemann, 2011), highlighting their peculiar contributions to health and well-being (Bell et al., 2021; Völker & Kistemann, 2013).

It is also important to note that green and blue spaces are not always easily separable. For example, research often categorizes blue spaces as part of green spaces or as features within green environments (Grilli et al., 2020). Additionally, terrestrial elements around blue spaces, such as well-maintained paths and accessible waterside areas, typically include green vegetation that enhances the overall quality of these spaces (Mcdougall et al., 2020). Mixed environments, known as blue-green spaces, combine both water bodies and vegetation, offering superior environmental quality and benefits compared to solely green or blue spaces (Luo et al., 2023). Similarly, research on Nature-Based Solutions (NBS) highlights the superior effectiveness of combining green and blue NBS, such as noise barriers that integrate vegetation and water features, in reducing noise complaints compared to barriers that are solely green or blue, as well as artificial alternatives. Findings indicate that these hybrid solutions provide additive buffering effects, significantly alleviating individuals' annoyance related to noise pollution (Leung et al., 2017).

Further, this binary categorization—green versus blue—does not fully capture the diverse therapeutic landscapes. Emerging research has also recognized other types of natural environments, such as "white spaces" (e.g., snow-covered landscapes), "brown spaces" (e.g., deserts), and "red nature" (e.g., volcanoes), each with unique potential benefits (Brooke & Williams, 2021; Nazif-Munoz et al., 2020). In summary, while the distinction between green and blue spaces provides a useful framework, the full spectrum of natural environments includes additional categories that contribute to well-being in diverse ways.

Evidence increasingly supports the idea that the positive impacts of nature exposure also vary by characteristics of the exposure, including duration and frequency of visits (Shanahan et al., 2016; White et al., 2017, 2019) and patterns of human-nature interaction (Kahn et al., 2010; Kahn et al., 2018), as well as the characteristics of the environments, including biodiversity (Cameron et al., 2020; Marselle et al., 2021), landscape type (Wheeler et al., 2015), tree canopy density (Jiang et al., 2014), location (Wyles et al., 2019), and other factors (Barnes et al., 2019). Nonetheless, studies on nature experience have also highlighted the relevance of considering the quality of natural environment as a fundamental predictors of positive health outcomes, that indirectly influence the relationship between contact with nature and health-related outcomes. In particular, the quality of green and blue spaces has been evaluated by a variety of environmental characteristics, such as accessibility, facilities and services, aesthetics and attractions, air quality, noise and smell, perceived safety and incivilities (Ayala-Azcárraga et al., 2019; Hajrasoulih et al., 2018; Knobel et al., 2019). In accordance with that, a previous longitudinal work found a causal relationship between improvements to the quality and accessibility of natural environments and levels of active use of these spaces (Ward Thompson & Aspinall, 2011). Moreover, the specific characteristics of natural spaces can facilitate the effects of particular interactions and offer various opportunities for physical activities, relaxation, and engagement (van Dillen et al., 2012).

In this regard, a relevant aspect pertains to the notion of *affordance*, defined by Gibson (1979) as the dynamic interaction between an individual and the environment. Gibson's ecological theory (1979) highlighted that environments possess functional characteristics for use and offer specific opportunities for action to individuals. The concept of affordance not only refers to opportunities for physical actions but has also been extended to include opportunities for a variety of human behaviours, including those in the social, cognitive, and emotional domains (Brymer & Davids, 2014). Particularly relevant to the focus of the present work is the concept of emotional affordance, defined as the likelihood that a situation will elicit a specific emotion (Schutte et al., 2008), along the dimensions of pleasure/displeasure and activation/relaxation (Roe & Aspinall, 2011).

The literature suggests that the effects of exposure to nature also vary depending on the type of human-nature interaction (Kahn et al., 2018) and the characteristics of the exposure, including the duration and frequency of visits to natural environments (Shanahan et al., 2016). A relevant difference may refer to the type of contact.

There are many forms of nature contact, varying by spatial scale, proximity, the sensory pathway through which nature is experienced (visual, auditory, etc.), the individual's activities and level of awareness while in a natural setting, and other factors. However, little research has examined nature contact in greater depth, for example examining the role of types, doses, and interactions with nature (Holland et al., 2021) and results are still mixed. Passive relationships with nature are those where activities take place in a natural environment which itself is not actively integrated or consciously used in an activity. In contrast to this approach, there are several activities and therapies where nature plays an important active role (Norwood et al., 2019). Also, previous literature has mostly investigated three main types of interaction: indirect, incidental, and intentional (Keniger et al., 2013). Indirect interactions do not require a person to be physically present in nature and can include such activities as viewing an image or motion picture of nature or having a view of nature through a window. Incidental interactions occur when a person is physically present in nature, but where the interaction is an unintended result of another activity, such as encountering vegetation whilst walking somewhere. Intentional interactions are those in which a person has a specific intent to interact with nature, such as viewing wildlife, gardening or hiking in a national park.

Most studies on the health effects of nature have focused on comparing natural and urban environments (Velarde et al., 2007). Research in this field is typically conducted through a variety of methods, such as field experiments (e.g., Berman et al., 2008; Hartig et al., 2003), films depicting natural scenes (e.g., Laumann et al., 2003; van den Berg et al., 2003), or pictorial stimuli (e.g., Berto, 2005). While mediated experiences of nature, like nature films or images, may not replicate the full benefits of real-world exposure (Kahn et al., 2009), even brief exposure to simulated nature has been found to positively impact attentional resources (Berto, 2005), as well as on stress relief and emotional arousal (for a meta-analysis: Li et al., 2023).

Prior research has consistently suggested that virtually any form of exposure to nature, regardless of scale, has measurable benefits, often captured by the notion "*the greener, the better*". In sum, even minimal or less remarkable forms of nature have been shown to be valuable for well-being (Kuo, 2013).

1.1.2. Benefits of nature experience

Numerous studies have explored the positive effects of natural environments on human health and well-being, demonstrating the increasing importance of spending time in nature or in contact with natural elements. Exposure to natural settings has been linked to a wide range of health benefits, including physiological, psychological, and social improvements. From a physiological perspective, nature effectively mitigates some of the harmful effects of environmental stressors prevalent in urban areas, by alleviating the physiological impacts of stress, promoting relaxation and improving immune function. Psychologically, contact with nature enhances well-being, increases positive emotions, facilitates cognitive restoration, and serves as a protective factor against the development of mental health disorders. Moreover, studies have shown that nature exposure has positive effect on cognitive ability and function. On a social level, research highlights how natural spaces foster social interactions and strengthen social cohesion within communities.

This section provides an overview of these effects.

Physiological Benefits. Urbanization has led to a reduction in nature exposure, leaving individuals overstimulated by the noise, crowding, and visual complexity typical of city's mainly built environments. This constant exposure to urban stressors, combined with the challenges of modern life, can result in chronic stress marked by heightened alertness, muscle tension, increased blood pressure, and elevated cortisol levels (Grahn & Stigsdotter, 2003). In response to these stressors, research has increasingly focused on the role of natural environments as a remedy (along the principles of the Nature Based Solution, NBS, approach). Studies have consistently shown that exposure to nature reduces physiological stress markers, including decreased heart rate, stabilized blood pressure, lower muscle tension, and reduced cortisol levels after time spent in green settings (Hartig et al., 1991; Laumann et al., 2003; Tsunetsugu et al., 2007; Van den Berg & Custers, 2011). Moreover, nature-based activities, such as gardening, have been found to alleviate stress more effectively than indoor activities like reading, with participants exhibiting significantly lower cortisol levels following time spent gardening outdoors (Van den Berg & Custers, 2011). Further, growing evidence suggests that natural environments promote physiological relaxation by enhancing parasympathetic activity. Research indicates that exposure to nature—whether in real settings or through virtual experiences—can significantly influence autonomic regulation, as measured by heart rate variability (HRV). For instance, studies demonstrate that such exposure leads to increased HRV, reflecting a reduction in sympathetic activity (i.e., the part of the autonomic nervous system that prepares the body for 'fight or flight' responses) and a corresponding enhancement in parasympathetic nervous activity (i.e., the part of the autonomic nervous system that promotes relaxation and recovery) (Lee et al., 2009; Gladwell et al., 2012; Park et al., 2008; Park et al., 2010).

Regular use of urban green spaces has also been linked to improved long-term health outcomes. Individuals who frequent green areas show reduced rates of cardiovascular disease (e.g., Mitchell & Popham, 2008), diabetes, and respiratory illnesses compared to those who do not (Richardson & Mitchell, 2010; Tamosiunas et al., 2014). Research has also explored the connection between nature and healing. For example, Ulrich (1984) found that post-operative cholecystectomy patients with a window view of nature recovered more quickly, required fewer painkillers, and experienced fewer complications compared to those with a view of a brick wall.

Similarly, Bennett and colleagues (1998) demonstrated that an outdoor therapeutic camping trip significantly reduced relapse rates in recovering substance abusers.

Additionally, certain practices, such as Japan's "*shinrin-yoku*", also called as forest bathing, exemplify how regular interaction with nature can lead to both psychological and physiological restoration. Forest bathing has been associated with reduced stress indicators such as cortisol, systolic blood pressure, and noradrenaline, while boosting immune function and overall well-being (Li, 2010; Park et al., 2010). Furthermore, forest environments have shown a stronger effect on reducing stress-related physiological markers, including salivary amylase activity, compared to urban settings (Yamaguchi et al., 2006). Research also suggests that these benefits may be linked to phytoncides—natural compounds released by trees that enhance immune function (Li, 2010). Recent research has also shown that even brief exposure to natural environments, such as a one-hour walk in a forest, can lead to structural changes in the brain, specifically increasing subiculum volume—a hippocampal region involved in stress inhibition—and reducing rumination, with no comparable effects observed after urban walks (Sudimac & Kühn, 2024).

These findings highlight the potential for nature to provide physiological restoration and underscore the importance of regular contact with natural environments for maintaining physical health.

Psychological benefits. Interacting with natural environments has also been widely associated with various psychological well-being benefits. Nature exposure can reduce stress, improve mood (Berman et al., 2012), and contribute to overall mental health and psychological well-being (e.g., Hartig et al., 2003; White et al., 2017, 2021) with positive effects on emotions and behaviour.

These effects are not limited to direct, immersive experiences; even incidental interactions, such as viewing natural scenes, can promote mental relaxation and reduce anxiety (e.g., Chang & Chen, 2005; Kaplan, 2001). Studies have also shown that interacting with nature helps decrease anger and frustration, while fostering a sense of calm and psychological well-being (Cackowski & Nasar, 2003; Kuo & Sullivan, 2001). The mental health benefits of nature are observed across different demographics, including children and adults, with evidence suggesting that early experiences in natural settings may positively influence emotional well-being and foster a stronger connection to nature later in life (Lohr & Pearson-Mims, 2005; Vitale et al., 2022). Growing up with access to natural environments, such as green spaces, blue spaces, and agricultural areas, has been linked to positive mental health outcomes and lower rates of psychiatric disorders (Engemann et al., 2020). Research also suggests that access to green spaces may support cognitive development in children, including enhanced attention and cognitive skills (Dadvand et al., 2015, 2017; Gascon et al., 2015; McCormick, 2017; Tillmann et al., 2018; Vanaken & Danckaerts, 2018), as well as a lower risk of developing ADHD (Thygesen et al., 2020).

One specific area where nature demonstrates a significant impact is exercise. Several studies have explored the psychological benefits of exercising in natural environments, often referred to as "green exercise". Pretty and colleagues (2007) found that individuals who engaged in exercise within natural spaces experienced notable improvements in mood and self-esteem. Running while exposed to natural landscapes, whether in person or via visual stimuli, has been shown to enhance emotional well-being more than exercising in urban settings (Pretty et al., 2005). However, some research suggests that the act of exercise itself can improve mental health regardless of location. For example, Bodin and Hartig (2001) found that while exercise reduced anxiety and depression, there was no substantial difference between urban and park environments in terms of emotional outcomes. Nonetheless, the combination of physical activity and exposure to nature appears to amplify the mental health benefits of exercise, offering a valuable approach to improving psychological well-being.

Natural environments have also been extensively recognized for their restorative effects on cognitive processes, particularly through attentional restoration and the reduction of mental fatigue. For instance, studies have demonstrated that exposure to nature improves attentional recovery (e.g., Bodin & Hartig, 2001; Han, 2010; Hartig et al., 1991, Herzog et al., 1997), leading to enhanced cognitive performance. The complexity and biodiversity of natural environments further amplify these benefits, as more diverse natural settings seem to contribute to greater mental recovery (e.g., Fuller et al., 2007).

The benefits of nature extend beyond attentional recovery to broader cognitive improvements, particularly in children. Research has shown that exposure to green spaces improves academic performance and learning opportunities (Browning & Rigolon, 2019; Clayton, 2007; Fjeld et al., 1998), as well as productivity in adults (Bringslimark et al., 2007; Kaplan, 1998). A longitudinal study by Wells (2000) demonstrated that children who moved to homes surrounded by vegetation exhibited improved cognitive function, highlighting the importance of natural environments in childhood development. Additionally, even indirect interactions with nature, such as viewing images of green spaces or being in environments with indoor plants, have been linked to improved task performance and cognitive function (Han, 2009). These findings underscore the multifaceted cognitive benefits of natural environments, particularly for tasks that require sustained attention and (Amicone et al., 2018; 2023).

Social benefits. Urban environments often exacerbate problems such as individual isolation, lack of social support, and increased crime rates. However, the availability of urban parks, gardens, and natural spaces can help alleviate these issues and improve social cohesion (Aldous, 2007; Kingsley & Townsend, 2006), offering essential social benefits by providing areas where individuals can escape the demands of city life and engage with others.

Interacting with nature has been shown to encourage social interaction among both adults and children (Kuo & Sullivan, 2001), promote social empowerment (Westphal, 2003) and facilitate interracial interactions (Shinew et al., 2004).

These spaces not only improve personal well-being but also enhance community dynamics, particularly in areas facing issues like social isolation, crime, and civic disengagement (Gomez et al., 2015). Indeed, urban areas with ample green space generally experience lower crime rates and reduced instances of violent behaviour compared to those with limited greenery (Kuo & Sullivan, 2001; Moore et al., 2007). Furthermore, access to high-quality public green spaces has been associated with greater social cohesion, fostering shared values and a sense of belonging, and enhancing social capital, which refers to the resources gained through interpersonal relationships (Jennings & Bamkole, 2019).

Green spaces near residential buildings, especially public housing, tend to attract larger, more diverse groups of people, facilitating social interaction and fostering a sense of community (Coley et al., 1997). One successful example of community-building through green spaces is the implementation of community gardens. These initiatives encourage environmental stewardship by involving the public in activities that transform vacant lots into usable green spaces. Studies of community garden dynamics have shown that working together toward a common goal—creating green areas—fosters a sense of neighbourhood belonging and strengthens social bonds (Glover, 2004; Roe, 2018).

Given the well-documented benefits of nature on human health, there is growing interest in integrating Nature-Based Interventions (NBIs) into mental health care. Health professionals and policymakers are increasingly advocating for the use of NBIs alongside traditional drug and psychological therapies to address mental health challenges (e.g., Bragg & Atkins, 2016; Lovell et al., 2018).

NBIs are defined as "*programmes, activities or strategies that aim to engage people in nature-based experiences with the specific goal of achieving improved health and wellbeing*" (Shanahan et al., 2019; pp. 2) through prevention of illness, promotion of general well-being or treatment of specific health issues.

Nature-based interventions encompass a variety of practices aimed at leveraging the therapeutic potential of natural environments. These interventions can be broadly categorized into two main types (Shanahan et al., 2019): 1) those primarily focused on modifying the physical environment where people live, work, learn, or heal (e.g., planting trees to reduce urban heat, restoring wetlands to enhance biodiversity, or creating rooftop gardens in residential areas), and 2) those explicitly designed to change individual behaviours, such as encouraging physical activity or direct engagement with nature (e.g., forest therapy walks, outdoor exercise programs, or educational program). While interventions in the first category may indirectly influence behavior by changing the surrounding environment, their key aim is environmental modification to create conditions conducive to well-being. Conversely, interventions in the second category mostly target behavior change through structured and intentional engagement with nature.

Within the realm of nature-based interventions, there are several types, each with distinct goals. In this context, NBIs can be further classified into three categories based on their focus and design: targeted, therapeutic and incidental interventions (Garside et al., 2020). Targeted interventions are designed to address specific mental health conditions or cater to particular groups, such as elderly individuals or those with chronic mental health issues. These interventions aim to provide tailored support through carefully designed programs. Therapeutic interventions, on the other hand, focus more broadly on improving or preventing mental health issues through structured activities and experiences in nature. Lastly, incidental interventions refer to activities that, while not explicitly designed for mental health benefits, can still contribute positively to well-being. Examples include living near green spaces or engaging in spontaneous nature interactions.

The integration of NBIs into mental health care reflects a growing recognition of the value of emotional connections with natural environments. By fostering these connections, NBIs not only support mental health but also encourage a deeper appreciation for nature. This holistic approach complements traditional treatments, offering a more comprehensive strategy for enhancing mental well-being and addressing the challenges of modern life.

1.1.3. Explanatory theories and mechanisms

Researchers investigating restorative environments, and the beneficial effects of nature contact on human health frequently draw upon two key theoretical frameworks: *Stress Reduction Theory* (SRT) and *Attention Restoration Theory* (ART).

Stress Reduction Theory (SRT; Ulrich, 1983; Ulrich et al., 1991) posits that humans have an innate preference for certain natural environments, which were crucial for survival in early human history by providing resources like food, water, and safety. This genetic predisposition leads to psychophysiological stress recovery when exposed to environments with attributes such as spatial openness, patterns or structures, and water features. According to SRT, these characteristics trigger a range of beneficial responses, including increased positive emotions, reduced negative emotions, lowered physiological arousal, and decreased stress responses. SRT can also be viewed through the lens of emotion regulation, as it relates to how natural environments influence emotional processes and preferences (Johnsen, 2011).

In contrast, Attention Restoration Theory (ART; Kaplan & Kaplan, 1989; Kaplan, 1995) emphasizes the role of nature in improving mental health by enhancing, rather, a cognitive function: namely, attention. ART suggests that natural environments provide stimuli that capture attention effortlessly, aiding in the restoration from attention fatigue caused by prolonged cognitive tasks. Kaplan & Kaplan (1989) identify four key qualities of restorative environments: being away from everyday surroundings, compatibility with individual goals, sufficient coherence and extent, and fascination with the environment. These qualities provide restorativeness and collectively help restore attention and mitigate the effects of directed attention fatigue (Kaplan & Berman, 2010).

While SRT and ART offer distinct perspectives, the first focusing on affective functioning while the second on the cognitive one, they are complementary in recognizing that natural environments can facilitate recovery from stress and attention fatigue. Both theories underscore the potential of nature to restore depleted states.

In addition to these theories, recent frameworks have sought to elucidate the causal pathways and mechanisms through which nature promotes health and well-being. For example, Hartig et al. (2014) propose four pathways: stress reduction, air quality improvement, physical activity promotion, and social cohesion. Similarly, Kuo (2015) identifies 21 pathways linking nature to various health outcomes, including environmental factors, physiological and psychological states, and behaviours. Markevych et al. (2017) suggest a biopsychosocial model involving three domain areas of the health–green space association: reducing harm, restoring capacities, and building capacities, which can be transposed to blue spaces (Bonaiuto & Albers, 2022/2023; Bonaiuto & Alves, 2024).

The mechanisms underlying nature's health benefits are multifaceted and may interact in complex ways. Multiple pathways are likely engaged simultaneously, affecting one another (Hartig et al., 2014).

Additionally, given the significant impact of nature on emotional states and self-regulation (Hartig et al., 2007; Hartig & Evans, 2003; Korpela & Hartig, 2001; Korpela & Ylen, 2007; Van den Berg et al., 2003), emotion regulation processes may represent a specific and relevant example of the restoration pathway. This potential pathway will be further explored in **Chapter 2** (**Section 2.1**).

A comprehensive understanding of how nature influences emotional states necessitates an in-depth exploration of the relevant theories and definitions pertaining to emotions and emotion regulation processes. Such an exploration elucidates how these frameworks deepen insights into emotional dynamics and establish a foundation for investigating the therapeutic potential of natural environments in fostering emotional health.

The subsequent section will examine the key theories and definitions related to emotions and emotion regulation processes, highlighting their significance for emotional well-being.

1.2. Emotions and emotion regulation processes

Mental disorders are one of the top public health challenges in the WHO European Region, affecting about 25% of the population every year, and it has been recognised as a significant public health challenge in all countries. The promotion of mental health as well as the prevention and treatment of mental disorders are fundamental to safeguarding and enhancing the quality of life, well-being and productivity of individuals, families, workers, and communities, thus improving the strength and resilience of society as a whole (WHO, 2024). A growing body of literature has emphasized the fundamental role of emotions and emotional experiences in determining mental health and subjective well-being of an individual (for a review: Pandey & Choubey, 2010), showing that positive emotional experiences have a relevant functional effect on overall well-being (Quoidbach et al, 2010).

1.2.1. Theories and conceptualization of emotion

Emotion is a central aspect of the human experience, shaping our thoughts, behaviours, and interactions with the world around us. It influences our decision-making, motivates actions, and plays a significant role in mental health.

The nature of emotions, how they are experienced, and their role in guiding human action have been long debated and studied, leading to the development of multiple theories. These theories offer different perspectives, ranging from the physiological responses to environmental stimuli to cognitive appraisals that define the emotional experience. The main theories of emotion can be grouped into six main categories: (a) evolutionary theories, (b) physiological theories, (c) evaluation theories, which comprise appraisal theories and the goal-directed theory, (d) network theories, (e) social theories, and (f) constructionist theories.

This section provides an overview of these major conceptualizations of emotion and the prominent theories.

Evolutionary theories. Evolutionary theories of emotion, rooted in the work of Charles Darwin (1872), propose that emotions evolved as adaptive responses to environmental challenges and opportunities. According to this perspective, emotions have a biological basis and serve survival functions that enhance an organism's ability to respond to threats, form social bonds, and reproduce successfully. Darwin's seminal work, *The Expression of the Emotions in Man and Animals* (1872), argued that emotional expressions are universal across species, suggesting that emotions like fear, anger, and joy have evolved to meet basic survival needs. For instance, fear triggers a fight-or-flight response that helps individuals escape danger, while joy and affection promote social bonding, which is crucial for cooperative survival.

Modern evolutionary theorists, such as Paul Ekman, have built on Darwin's ideas, identifying 6 basic emotions—such as happiness, sadness, fear, anger, surprise and disgust—that are universally recognized across cultures (Ekman, 1999). These emotions are believed to have evolved due to their adaptive value, as they promote behaviours that are essential for survival. For example, anger may help an individual defend resources, while disgust protects against harmful substances.

Critics of evolutionary theories argue that they may oversimplify the complexity of emotional experiences by focusing primarily on biological and survival aspects, sometimes overlooking cultural and cognitive factors.

Physiological theories. One of the earliest attempts to explain emotions in psychology is the James-Lange theory, developed by William James (1884) and Carl Lange (1885) in the late 19th century. This theory posits that emotions arise from the perception of physiological changes in the body. According to this model, emotions are the result of bodily responses to external stimuli, not the cause. For example, in the presence of a threatening situation, one first experiences a physiological reaction, such as an accelerated heartbeat or trembling, and it is this bodily change that is interpreted by the brain as an emotion.

The James-Lange theory was groundbreaking in that it shifted attention to the role of the body in emotional experience. It argued against the traditional view that emotions directly cause physiological reactions, suggesting instead that these bodily reactions are central to the experience of emotion itself. However, this theory has faced criticism, particularly concerning its inability to explain the wide variety of emotions experienced across different situations, given that many emotions can produce similar physiological responses.

In response to the limitations of the James-Lange theory, Walter Cannon and Philip Bard (1927) proposed an alternative in the early 20th century. The Cannon-Bard theory challenges the notion that physiological arousal precedes emotional experience. Instead, it argues that emotional experiences and physiological responses occur simultaneously and independently. According to this theory, the brain processes stimuli and triggers both the emotional experience and the physiological reaction at the same time, without one causing the other.

This theory highlights the central role of the brain in emotional processing, particularly the hypothalamus and the thalamus, which Cannon and Bard (1927) believed were responsible for emotional regulation. It also addresses some of the weaknesses of the James-Lange theory by suggesting that the brain can trigger multiple responses (both emotional and physiological) to a single stimulus. However, the theory has been critiqued for not adequately addressing the role of cognitive appraisal in shaping emotional experiences.

Building on both physiological and cognitive aspects of emotion, the Schachter-Singer two-factor theory introduced the concept of cognitive appraisal as a necessary component of emotional experience. Proposed by Stanley Schachter and Jerome Singer (1962), this theory suggests that emotion results from both physiological arousal and the cognitive interpretation of that arousal. In their view, emotional experiences depend not only on physical reactions but also on how individuals cognitively assess and label those reactions in a specific context.

This cognitive arousal model represented a significant shift in emotional theory, acknowledging that emotions are not just automatic responses to stimuli but are shaped by an individual's interpretation of the situation. The same physiological response could lead to different emotions depending on how the individual evaluates the circumstances, making this theory one of the first to bridge the gap between physiological and cognitive approaches to emotion. Nevertheless, it has been critiqued for overemphasizing the role of conscious thought processes in emotion, as many emotional reactions seem to occur without deliberate cognitive appraisal.

Evaluation theories. Building on the idea of cognitive evaluation, evaluation theories of emotion focus on how individuals assess or evaluate their environment and their own responses to it, which then triggers emotional reactions. These theories can be further conceptualized into two categories: appraisal theories, which are stimulus evaluation-based, and goal-directed theories, which are response evaluation-based.

The appraisal theory, notably advanced by Richard Lazarus (Folkman & Lazarus, 1985; Lazarus, 1984), focuses almost entirely on cognitive processes, specifically how individuals interpret and evaluate situations. According to this theory, emotions arise from the interpretation, evaluation and significance individuals assign to situations and events in relation to their well-being. Consequently, the emotional response is largely shaped by judgments about how events align with personal goals, values, or desires. Emphasis is placed on individual differences in emotional experiences, suggesting that people react emotionally based on their personal evaluations of situations rather than the events themselves.

Goal-directed theories of emotion on the other hand, focus on how emotions serve as adaptive responses to the pursuit of personal goals. Emotions in this framework arise from an individual's appraisal of of how relevant a given situation is to achieving a specific goal. This appraisal includes various dimensions, such as the perceived probability of success, the level of effort required, the degree of personal control, and the expected outcomes. These cognitive evaluations result in emotional experiences. Here, emotions are seen as motivating forces that guide behavior in service of goal attainment. A distinctive feature of goal-directed theories is their emphasis on anticipatory emotions, which are forward-looking and emerge before a goal's outcome is determined. Anticipatory emotions like hope, excitement, or fear arise from the prospect of success or failure. These emotions are shaped by the perceived likelihood of reaching the goal and the personal significance of the desired outcome. For example, Frijda's model (1986) highlights that the stronger the individual's concern for the goal, the more intense the emotional experience will be, with this intensity playing a critical role in driving behaviour. Similarly, Roseman's framework (1991) emphasizes dimensions like personal power, uncertainty, and agency (whether the situation is self-caused, caused by others, or circumstantial), which contribute to the specific emotions felt in a goal context.

Both types of evaluation theories underscore the importance of cognitive processes in shaping emotional experiences, but they differ in the focus of what is being evaluated—whether it is the external stimulus or the individual's own actions in relation to their goals. While evaluation theories have been influential in understanding how emotions arise from cognitive evaluations, it has faced criticism for overemphasizing conscious processes. Critics argue that the theory overstates the role of deliberate thought in emotional responses, overlooking automatic and unconscious reactions. Researchers suggest that emotions can arise without prior cognitive appraisal, indicating that affective reactions may occur more rapidly than mental evaluations (e.g., Zajonc, 1980). Consequently, these theories have been criticized for giving insufficient attention to non-cognitive factors, such as neural, sensory-motor, and physiological processes (e.g., Izard, 1993), which can trigger emotions independently of cognitive appraisals. These critiques highlight the need for a broader approach to understanding the complexities of emotional responses.

Network theories. Network theories of emotion propose that emotions are not isolated states but arise from complex interactions among various components within a dynamic network of mental representations. These components include thoughts, memories, physiological responses, and behaviours, which are interconnected and can activate one another. When one element of the network is triggered, it spreads activation through the entire network, leading to the emergence of an emotional state.

A prominent example of network theories is Bower's associative network theory (1981), which posits that emotions are stored in memory as nodes connected to related cognitive and physiological information. When an emotional node is activated, it triggers associated memories, bodily responses, and behaviours, creating a coherent emotional experience. For instance, experiencing sadness may activate memories of past losses and physiological responses like tears, further reinforcing the emotion.

Network theories also emphasize the bidirectional nature of emotions, suggesting that changes in one component, such as altering a thought or behaviour, can influence and potentially modify the entire emotional network. This approach provides insights into how emotions can be sustained or regulated by targeting specific elements within the network, making it relevant to therapeutic interventions in mental health.

Overall, network theories offer a holistic view of emotion, emphasizing the interconnected and dynamic nature of emotional experiences as emerging from a web of cognitive, behavioral, and physiological factors.

Social theories. Social theories of emotion emphasize the profound impact that social contexts and group dynamics have on the experience and expression of emotions. These theories argue that emotions are not purely individual experiences but are shaped significantly by social interactions, cultural norms, and collective behaviours.

One key concept within social theories is emotional contagion, which describes how emotions can spread rapidly among individuals in groups or crowds. When people observe others expressing certain emotions, they may unconsciously mimic these emotional expressions, leading to a shared emotional state. This phenomenon explains why individuals at mass events, such as sports games or concerts, often experience heightened emotions, acting in unison as if part of a collective emotional wave.

Furthermore, social theories emphasize the role of social norms in regulating emotional expressions. Individuals learn which emotions are acceptable to express based on cultural and societal expectations. As Averill (1983) points out, emotions can be seen as transitory social roles, where people perform the emotions that their society expects from them in given situations. For example, in collectivist cultures like Japan, emotional restraint is often valued, while in more individualistic cultures like the United States, emotional expression may be encouraged.

Weiner's attributional theory (1985) further explores the social nature of emotions by suggesting that our emotional reactions are based on the causes we attribute to events. When we assign blame or credit for an outcome, it shapes the emotions we feel, whether those are anger, guilt, pride, or relief. These emotional responses, in turn, influence how we behave in social situations.

Overall, social theories of emotion highlight that emotions are not just internal psychological states but are deeply intertwined with the social environment. They are influenced by group dynamics, cultural norms, and the way we interpret and react to the actions of others, making emotions inherently relational and context-dependent.

Constructivist theories. Constructivist theories of emotion propose that emotions are not universal, pre-programmed reactions to stimuli, but rather are constructed by individuals based on their unique experiences, cultural context, and cognitive processes. These theories assert that emotions are the result of complex, dynamic interactions between an individual's perceptions, conceptual knowledge, and social learning. Rather than viewing emotions as hardwired biological responses, constructivist approaches emphasize the role of cognition and interpretation in shaping emotional experiences.

One of the most prominent constructivist models is the Theory of Constructed Emotion (Barrett, 2017). According to this theory, emotions are not triggered by specific events but are constructed in the brain as the mind makes sense of sensory input. Specifically, emotions arise from two components: core affect, which involves basic feelings of pleasure or displeasure, and arousal value of stimuli, where individuals use past experiences and cultural knowledge to label these feelings as specific emotions.

This process emphasizes that emotions are context-dependent and can vary across cultures and individuals. Rather than being fixed, emotions are shaped by cognitive predictions and social learning, meaning they are flexible and constructed in real-time as the brain interprets bodily sensations and external situations. Constructivist theories highlight the dynamic, learned nature of emotions, emphasizing that they are shaped by both personal history and societal norms.

This constructivist perspective has gained traction in recent years, especially in studies emphasizing the role of culture and language in emotional experiences. However, it has also faced criticism for downplaying the role of physiological and evolutionary factors in shaping emotions.

1.2.2. Emotion classification

Research on emotion has increased significantly over the past two decades with many fields' contribution and scientists struggling to reach consensus over definitions (LeDoux, 1995; 2012). Based on some key aspects, emotions can be defined as responses to relevant stimuli directed toward specific targets (e.g., people, objects, or events), differentiated, and relatively short-lasting (Ekman, 1993; Frijda &

Mesquita, 1994). Emotions are associated with distinct patterns of appraisals (i.e., evaluations of events in relation to relevant concerns), subjective experiences, physiological reactions, action tendencies (i.e., behaviours), and expressions (Frijda et al., 1989; Lazarus, 1991).

Following this definition, it is essential to differentiate between emotions, moods, feelings, and affect, as these concepts, though related, refer to different aspects of the emotional experience and have distinct characteristics and functions.

Mood is defined as a more enduring emotional states that is less intense than emotions but influences how people perceive and interact with the world over an extended period. Unlike emotions, which are often triggered by specific events or stimuli, moods tend to be more diffuse and may not have an identifiable cause. Watson and Clark (1997) describe moods as periods where individuals consistently experience certain feelings and have thoughts that reflect those feelings. For instance, someone in a good mood may experience positive emotions like contentment or optimism, accompanied by thoughts that reinforce this positive outlook, whereas someone in a bad mood might feel irritability or sadness, which colours their interpretation of events negatively.

On the other hand, *feelings* refer to the subjective, internal and conscious experience of emotions, distinct from external sensations or thoughts. They are evaluated as pleasant or unpleasant and differ from emotions in that they are purely mental and lack the outward expressions or physiological responses associated with emotions. While emotions engage with the world and often drive behaviour, feelings are purely evaluative and introspective, reflecting how individuals internally appraise experiences and reflect on their emotional states. For example, one might feel sadness as a result of experiencing an emotion like grief.

Finally, *affect* is an overarching term that refers to the broad spectrum of emotional experiences, including feelings, emotions, moods, and attachment (Hogg et al., 2010). It indicates the general experience of emotion and mood, often measured along a continuum from positive to negative. Affect is used to describe the overall tone of an individual's emotional life, whether they are in a generally positive or negative state. This concept is integral to many psychological theories and can be broken down into three main components: emotions, moods and affectivity (i.e., an individual's general disposition or temperament, indicating a tendency towards positive or negative emotional states).

Distinguishing between these concepts helps in understanding the different layers of emotional experience and is crucial in psychological research and practice, as each aspect plays a unique role in shaping behaviour, decision-making, and well-being.

In the study of emotions, researchers frequently debate two major classification approaches regarding their structure: whether emotions are best understood as discrete entities or as dimensions within a continuous space.

In discrete models, emotions are categorized into a limited number of fundamental, distinct types, each with specific characteristics and evolutionary significance. According to this perspective, basic emotions such as sadness, happiness, fear, anger, disgust, and surprise are considered innate and universal across cultures, experienced in a relatively short duration and distinct from one another (Ekman & Oster, 1979; Ekman et al., 2013). These core emotions are biologically programmed and serve essential adaptive functions, such as alerting us to potential threats (fear), facilitating social bonding (happiness), or signalling dissatisfaction (disgust). These primary emotions are considered to be foundational, from which more complex or nuanced emotions can emerge through their combinations or variations. For example, the emotion of jealousy might be understood as a blend of sadness and anger, while anticipation could involve a mixture of happiness and surprise.

Conversely, dimensional models of emotion suggest that emotions can be described along continuous dimensions rather than as separate categories. This approach utilizes a small number of fundamental dimensions to characterize and differentiate emotional experiences. One of the most widely used dimensional frameworks is the two-dimensional model, which positions emotions along two primary axes: valence and arousal (Russell & Mehrabian, 1977; Watson et al., 1988). According to the Circumplex Model of Emotion, developed by James Russell (1980), the valence dimension reflects the positive or negative nature of an emotion, ranging from unpleasant to pleasant. This dimension helps to identify whether an emotional experience is generally agreeable or disagreeable. The arousal dimension, on the other hand, captures the intensity or strength of the emotion, ranging from low arousal states like boredom or calmness to high arousal states like excitement or agitation (Nicolaou et al., 2011).

Expanding on this, the three-dimensional model introduces a third dimension: dominance or power. This dimension assesses the perceived strength or control a person feels in relation to the emotion, ranging from feelings of weakness or helplessness to feelings of strength or assertiveness. This additional dimension can differentiate between emotions such as anger and fear by considering the level of perceived control or power involved (Grimm et al., 2007). In the dimensional approach, emotions are seen as points within a continuous space rather than discrete categories. Emotions are not viewed as independent entities but rather as varying systematically along these dimensions. This model allows for a nuanced understanding of how different emotions relate to each other and how they can be experienced in varying intensities and contexts.

Despite the longstanding controversy surrounding the choice between discrete and dimensional models of emotion, there is a growing acceptance among researchers for integrating these approaches.

Hybrid models propose that while core affect is inherently dimensional, the conscious interpretation or appraisal of these affects can be understood in categorical terms (Russell, 2003; Barrett, 2006).

Thus, the appropriateness of using dimensional versus discrete representations depends on whether the focus is on core affect or emotional episodes. Additionally, individual differences influence how people label their affective states, with some individuals aligning more with dimensional frameworks and others with discrete categorizations (Barrett, 1998).

In bridging the gap between different emotion classification systems, it is essential to recognize that, while various models offer distinct perspectives on the nature of emotions, they converge on the idea that emotions, despite their functional and evolutionary origins aimed at enhancing survival (Frijda, 1986), are not always adaptive. Consequently, effective emotional regulation is crucial for maintaining psychological health and achieving personal goals (Aldao et al., 2015). In such contexts, the ability to manage one's emotions is vital for appropriately responding to environmental demands (Aldao et al., 2010; Gross, 2008; McLaughlin et al., 2011).

1.2.3. Definition of emotion regulation

Emotion regulation encompasses the processes individuals use to influence the intensity, duration, and nature of their emotional experiences and expressions.

These processes help align emotions with personal goals and adapt to varying situations (Gross & Thompson, 2007). By employing emotion-regulation strategies, individuals can either enhance, diminish, or sustain both positive and negative emotions to achieve specific objectives or adapt to changing circumstances (Aldao, 2013; Gross, 2002).

Emotion regulation involves both automatic and controlled processes. While the prototypical image of emotion regulation is one of deliberate, effortful intervention designed to override spontaneous emotional responses, this is not the sole form of regulation. Controlled processes, which require active effort and engagement, involve psychological and neurobiological systems related to action and attention control (Ochsner & Gross, 2005, 2008; Tice & Bratslavsky, 2000). Conversely, many emotion-regulation strategies operate automatically, with minimal conscious awareness. These automatic processes, which are often reflexive or unconscious, play a crucial role in managing emotions efficiently, especially in rapidly changing environments. Automatic regulation includes factors such as speed, autonomy, and external stimulus-driven processes (Mauss et al., 2007). Although automaticity involves various independent factors like intentionality, controllability, and efficiency, these constructs are diverse and may not provide a consistent organizing principle for emotion-regulation strategies.

The functions of emotion regulation extend beyond immediate emotional relief and can be categorized into three primary domains (Koole, 2009):

1. ***Hedonic functions***: Emotion regulation is traditionally seen as a mechanism to enhance pleasure and minimize discomfort (e.g., Larsen, 2000; Westen, 1994). This function operates both consciously and unconsciously, driven by the need to conserve cognitive and physical resources during emotional distress. Hedonic regulation aims to return individuals to more pleasurable or neutral emotional states.

2. ***Goal-oriented functions***: Emotion regulation is essential for achieving situational goals, especially in social contexts (Tamir et al., 2007). For example, individuals might regulate emotions to conform to social norms or to appear composed. Additionally, people may maintain negative emotions, such as fear or worry, if they believe these emotions will help them achieve certain goals, like avoiding danger.

3. ***Person-oriented functions***: On a broader level, emotion regulation contributes to maintaining the coherence and stability of the overall personality system (Baumann, Kaschel, & Kuhl, 2005; Kuhl, 2000). By balancing competing goals and facilitating emotional flexibility, it supports long-term psychological well-being and personal growth. This form of regulation integrates various personality processes, ensuring alignment with broader personal and developmental objectives.

Emotion regulation inherently involves influencing specific emotional responses. The nature of the emotional response being targeted often influences the strategies employed in the regulation process. Thus, the system within which the emotional response is generated can serve as a primary framework for classifying various emotion-regulation strategies.

Three major emotion-generating systems that have been extensively studied are attention, cognitive knowledge, and bodily expressions. Each system can be a focus for emotion regulation, with strategies designed to manage one or more of them.

These broad categories help structure the understanding of how different regulation strategies operate across various emotional contexts (Gross, 1998, 2001; Parkinson & Totterdell, 1999; Philippot et al., 2004):

1. ***Attention***: Strategies targeting attention involve managing where individuals direct their focus and selecting incoming information from sensory input (e.g., Fan et al., 2005). This includes shifting attention away from distressing stimuli or concentrating on neutral or positive activities to alter emotional responses. These strategies are crucial for controlling the flow of emotionally relevant information and can significantly impact emotional outcomes.

2. ***Knowledge***: This category includes strategies that alter cognitive appraisals—how individuals interpret and evaluate emotionally significant events (e.g., Lazarus, 1991; Scherer et al., 2001; Moors, 2007). For example, cognitive reappraisal involves changing one's perspective on a situation to reduce its emotional impact.

3. ***Bodily expressions***: Emotions frequently surface through physical manifestations like facial expressions, body posture, and physiological responses. Strategies targeting bodily expressions aim to regulate these physical aspects of emotion. Examples include techniques such as deep breathing or progressive muscle relaxation to modulate emotional arousal, and expressive suppression to control visible signs of emotion. Furthermore, bodily responses can significantly influence emotional experiences in ways that go beyond mere attention or cognitive appraisals (Niedenthal et al., 2005; Zajonc, 1998).

In summary, emotion regulation involves various processes to adjust emotional experiences, with strategies targeting attention, cognitive appraisals, and bodily expressions to achieve specific goals and maintain overall psychological well-being. The next section will explore how these strategies are classified and the implications of individual differences in emotion regulation.

1.2.4. Classification of emotion regulation strategies

The dominant theory in emotion regulation is Gross's (2015) Process Model, which defines emotion regulation as the process by which individuals influence what emotions they have, when they have them, and how they experience and express them. This theory posits that emotion regulation purposes to reduce, enhance, or maintain emotional experiences based on personal needs or goals at that specific moment (Aldao, 2013; Gross, 1998, 2002).

Strategies for emotion regulation can be categorized based on when they are applied during the emotion-generative process: situation selection, situation modification, attentional deployment, cognitive change, and response modulation.

The first four category of strategies are classified as antecedent-focused because they are applied before or during the emotional experience, whereas response modulation is considered response-focused, as it is used after the emotion has already been triggered (Gross, 2002; Ochsner & Gross, 2008, 2014). Antecedent-focused strategies are generally viewed as more effective due to their proactive nature, which allows for the modification of the emotional experience before or as it unfolds. In contrast, response-focused strategies aim to manage emotions after they have been experienced, often proving less effective in addressing the root causes of the emotional response (Gross, 2001).

Within this framework, a range of different subcategories of strategies can be conceptualized. **Table 1.1** presents the definition of each of the five categories of emotion regulation strategies, along with examples of corresponding subcategories.

Table 1.1. *Definition of the five categories of emotion regulation strategies, with examples of subcategories*

Category	Subcategory examples
1. ***Situation selection***: influencing exposure to situations that could generate desirable or undesirable emotions	Conflict avoidance: avoiding situations to minimise the likelihood of a conflict arising (e.g., Luong & Charles, 2014).
2. ***Situation modification***: altering a situation to modify its emotional impact	Problem-solving: using instrumental supports and planning to address problems (e.g., Yeung et al., 2012).
3. ***Attentional deployment***: controlling the allocation of attention to modify an emotional response	Distraction: engaging with other stimuli or activities to focus one's own attention away from stimuli or situation initially engaged with (Hofer et al., 2015) Rumination: dwelling on negative thoughts and feelings (Aldao & Nolen-Hoeksema, 2012)
4. ***Cognitive change***: changing the evaluation of a situation to influence its emotional impact	Acceptance: allowing and accepting one's feelings (Schirda et al., 2016) Cognitive reappraisal: reconsidering the meaning of a situation or one's ability to cope with a situation (Brummer et al., 2014)
5. ***Response modulation***: engaging in a behaviour to influence some aspect of a generated emotion	Expressive suppression and emotional expressivity: attempting to conceal or freely show the expression of emotion (e.g., Gerolimatos & Edelstein, 2012).

Emotion regulation can also be conceptualized as a dispositional trait or a situational state. Dispositional emotion regulation refers to stable, habitual tendencies to regulate emotions in a particular way across different situations (Gross & John, 2003). Conversely, situational emotion regulation pertains to how individuals apply specific strategies in response to particular stressors or contexts (Gross, 1998).

By definition, even if they refer to separate concepts, individuals with a high dispositional tendency to use certain regulation strategies are more likely to employ these strategies in relevant situations as well (Blalock, Kashdan & Farmer, 2016; Hofer & Allemand, 2017; McRae et al., 2011).

Emotion-regulation strategies significantly impact everyday functioning and mental health (Bonanno, 2004; Gross & Muñoz, 1995). Effective emotion regulation —whether as a trait or a state— helps individuals manage their emotional experiences, leading to reduced negative emotions, enhanced resilience to stress, and personal growth. Conversely, difficulties in emotion regulation or emotional dysregulation can impair health and contribute to the development and maintenance of psychological disorders (Pandey & Choubey, 2010).

Maladaptive strategies, such as avoidance, expressive suppression, and rumination, are associated with increased negative affect, lower positive affect, and reduced life satisfaction, and are linked to various mental health issues including anxiety, depression, and social dysfunction (Campbell-Sills et al., 2006; Gross & Munoz, 1995; Moore et al., 2008; Quoidbach et al., 2010; Rood et al., 2009). In contrast, adaptive strategies like reappraisal, acceptance, and mindfulness are more effective and contribute positively to emotional and psychological well-being (Aldao et al., 2010).

Although certain emotion-regulation strategies are considered as inherently effective, contextual and individual factors significantly influence their use and subsequent effectiveness. Recent research highlights the dynamic and contextual nature of emotional responses (e.g., Aldao, 2013; Aldao & Nolen-Hoeksema, 2012; Aldao, Sheppes, & Gross, 2015; Bonanno & Burton, 2013). Various individual and environmental factors impact the success and frequency of emotion regulation.

First, the effectiveness of emotion regulation strategies is shaped by several contextual factors, including the characteristics of the emotion itself—such as its valence, arousal, and intensity—which must be regulated (e.g., Martins et al., 2016; Schirda et al., 2016). Additionally, factors such as an individual's motivation (e.g., Gable & Harmon-Jones, 2011; Tamir, Mitchell, & Gross, 2008), the personal relevance of emotional stimuli (e.g., Sands et al., 2018), and situational demands (e.g., Aldao, 2013; Dixon-Gordon, Aldao & De Los Reyes, 2015) also play a critical role. The ability to flexibly adapt regulation strategies to meet these varying contextual demands is essential for effectively managing emotions in a way that aligns with personal goals and capacities (e.g., Aldao, 2013; Bonanno & Burton, 2013).

Secondly, individual differences such as age and gender affect the use of emotion-regulation strategies. Aging is associated with improved emotion regulation and greater emotional control (Gross et al., 1997). Older adults typically experience fewer negative emotions and may use strategies like positive reappraisal more frequently than younger adults (Blanchard-Fields, Mienaltowski, & Baldi, 2007; John & Gross, 2004). However, they may also rely more on passive strategies such as avoidance or suppression (Blanchard-Fields, Stein, & Watson, 2004). Gender differences also play a role, with men often using suppression more frequently and women more frequently using reappraisal, rumination, active coping, acceptance, and social support (Gross & John, 2003; Nolen-Hoeksema & Aldao, 2011; Spaapen et al., 2014; Tamres et al., 2002). Gender may also moderate the relationship between emotion regulation strategies and mood (Nolen-Hoeksema, Morrow, & Fredrickson, 1993).

Cultural norms and values further impact emotion regulation. Different cultures promote and sanction various emotional responses, affecting the use and frequency of specific regulation strategies (Butler, Lee, & Gross, 2007; Campos, Campos, & Barrett, 1989; Saarni, 1984). For example, cultures that emphasize self-reflection may use reappraisal more frequently, while those valuing open emotional expression might use suppression less often (Haga, Kraft, & Corby, 2009; Matsumoto, Yoo, & Nakagawa, 2008; McRae et al., 2011; Su et al., 2015). Studies have shown that Americans report using reappraisal strategy more frequently than Japanese individuals, who, conversely, tend to use the strategy of expressive suppression more than Americans (Matsumoto, 2006).

Lastly, personality is a crucial factor influencing the use of emotion regulation strategies. Personality traits, which reflect consistent patterns in thinking, behaviour, and feeling (e.g., McCrae & Costa, 2008), are often examined through the Five-Factor Model (FFM). This model identifies five broad dimensions: extraversion, conscientiousness, openness to experience, agreeableness, and neuroticism (McCrae & Costa, 1997). Research indicates that these traits are linked to emotional experiences and moods—extraversions is associated with positive moods, while neuroticism correlates with negative moods (Costa & McCrae, 1980; Steel, Schmidt, & Shultz, 2008). Additionally, personality traits influence the selection of emotion regulation strategies; for example, emotional suppression tends to be negatively related to extraversion, whereas reappraisal is negatively related to neuroticism (Gross & John, 2003; Lischetzke & Eid, 2006; Ng & Diener, 2009).

Recognizing these factors and understanding how individual differences interact with situational demands and emotional characteristics are important for creating personalized approaches and developing more targeted interventions that enhance adaptive emotion regulation and promote psychological well-being. Furthermore, considering the role of specific environmental contexts, such as natural versus urban settings, can refine these interventions.

The contextual and surrounding environment plays a pivotal role in shaping emotional responses and influencing the success of regulation strategies (Aldao, 2013; Suri et al., 2018). For instance, as discussed earlier in this chapter, natural environments promote relaxation and stress recovery (Ulrich, 1983) offering a supportive setting for self-regulation (Korpela & Hartig, 1996; Kaplan & Berman, 2010). Conversely, high-density urban environments may intensify negative emotions and stress (e.g., Abbott, 2012), potentially impeding effective emotional regulation.

1.3. Conclusion

In conclusion, this chapter has provided a foundational understanding of the key concepts relevant to the study of nature and emotion regulation. It began by defining natural environments and exploring various types of nature experiences, followed by an examination of the wide range of benefits that such experiences offer, including physiological restoration and mental well-being. The review of explanatory theories, such as Stress Reduction Theory (SRT) and Attention Restoration Theory (ART), highlighted the psychological mechanisms through which nature supports emotional and cognitive recovery. Additionally, the core theories of emotions and emotion regulation processes, including the classification and regulation of emotions, were discussed, establishing a framework for understanding how environmental contexts, such as nature, may influence these processes.

These insights lay the groundwork for the next chapter, which will delve deeper into the specific role that nature plays in emotion regulation. Drawing upon an evidence-based review, **Chapter 2** will assess the current research on how exposure to natural environments impacts various emotion regulation strategies, offering a more detailed exploration of the interplay between nature and emotional processes. This will allow for a closer examination of the empirical evidence supporting the therapeutic potential of nature in promoting emotional health and well-being.

CHAPTER 2.

The Role of Nature in Emotion Regulation Processes: An Evidence-Based Rapid Review [1]

2.1. Introduction

Building on the previous chapter's exploration of nature's benefits and the conceptualization of emotion and emotion regulation, this chapter delves into how natural environments facilitate emotion regulation. It offers a systematic review of existing research on the topic, highlighting both direct and indirect ways in which natural settings support emotional well-being.

One of the most widely suggested mechanism that explains the mental health benefits of nature, is the psychological benefits conferred by opportunities for emotional regulation offered by natural spaces (McMahan and Estes, 2015; Roe et al., 2017; Zhang et al., 2022). The notion that natural environments can be used for emotion regulation is an underlying foundation for several approaches in environmental psychology. As stated above, empirical evidence has widely demonstrated that exposure to natural environments may have direct effects on emotional processes, such as, for example, the reduction of negative

[1] This chapter is based on a previously published paper: Vitale, V., & Bonaiuto, M. (2024). The role of nature in emotion regulation processes: An evidence-based rapid review. *Journal of Environmental Psychology*, 102325. The content has been adapted for incorporation into this thesis.

emotions and the increase of positive emotions (e.g., Berman et al., 2008; Hartig et al., 2003, 2011; van den Berg et al., 2003). But natural environments seem to also have an indirect effect on emotional processes by restoring attentional resources and having beneficial influences on executive functioning and self-regulation (Berman et al., 2008; Berto, 2005; Kaplan & Berman, 2010), for example by facilitating constructive reflection on unresolved issues (Herzog et al., 1997; Kaplan & Kaplan, 1989). Because of these effects, individuals may use nature instrumentally to regulate one's own emotions.

For example, Richardson (2019) recognized that previous research has primarily focused on the restorative benefits of nature, but has overlooked the specific impact of nature on emotion regulation. Unlike restoration, which generally involves a passive recovery from stress or fatigue, emotion regulation refers to more active and deliberate processes aimed at managing and modifying emotional experiences. This active regulation of emotions in response to environmental contexts has not been as thoroughly explored in relation to nature. In his conceptual paper, he proposed an adaptation of Gilbert's (2005, 2014) model to elucidate this relationship, considering three fundamental components: positive emotions, physiological response, and connection with nature. The first component emphasizes the influence of nature on emotional states, fostering positive emotions like joy and tranquillity, which, in turn, contribute to effective emotion regulation and overall well-being. The second component highlights how exposure to nature acts as a catalyst for activating the parasympathetic nervous system, inducing a state of relaxation and well-being. The third component underscores the significance of establishing a connection with nature as a means of respite from everyday demands and stressors, enabling effective emotion regulation and restoration of psychological balance.

In a recent paper, Bratman and colleagues (2021) provided an overview of the evidence about different ways by which the five categories of emotion regulation strategies, proposed by Gross (2015), are influenced by natural environmental factors, with the consequence of providing affective benefits.

First, concerning the situation selection strategy, natural environments may be chosen by people to experience desirable emotions (Johnsen & Rydstedt, 2013; Korpela et al., 2001). Indeed, individuals may seek out and select favourite natural environment places as a form of situation selection, to be visited because they acknowledge that these are places that help them to self-regulate (Hartig et al., 2007; Korpela, 2018; Roe et al., 2017).

Secondly, with regard to situation modification, previous studies showed that people often choose to move to nearby nature or seek to bring natural elements such as indoor plants into office buildings, through biophilic design (Kellert, 2018), and this also may represent a form of emotion regulation.

Third, the role of nature exposure on the attentional deployment strategy may be explained by the fact that some aspects of natural environments offer greater affordances for positive distraction away from the self (Jiang et al., 2019; Nolen-Hoeksema et al., 2008; Roelofs et al., 2009), thus providing affective benefits due to a shift in focus to positive, external elements of the environment, and away from repetitive and negative self-referential thoughts, known as rumination (Aldao & Nolen-Hoeksema, 2012). In support of this, recent research has found that nature exposure may reduce a tendency to engage in this maladaptive form of attention allocation (Bratman, et al., 2015; Bratman et al., 2021; Lopes et al., 2020).

About the fourth family of strategies that refers to cognitive change, previous work sustained that reappraisal and reinterpretation of events is greatly impacted by the environment (McRae et al., 2017), as well as by the underlying levels of stress that are occurring at the time (Colombo et al., 2020). In natural settings it may be easier to engage in reappraisal processes, with more successful capability, given the emotional affordances of those spaces and the associated lowered stress levels because of nature exposure (Sheppes et al., 2011).

Last, there are the response modulation strategies, and, in this regard, it has been suggested that individuals may choose natural environments as spaces in which they feel more able to express previously inhibited emotional responses, thereby decreasing chronic levels of suppression (Bratman et al., 2021; Butler et al., 2003). For example, nature exposure can alter affordances for suppression through decreasing the probability of needing to suppress for social reasons.

Bratman et al. (2021) provided a valuable overview of the evidence demonstrating nature's impact on emotion regulation strategies, synthesizing a wide range of studies. The review highlights existing evidence while also calls for further research to confirm and expand upon these findings.

Drawing from these insights and building upon the notion that emotion regulation could serve as a pivotal mechanism driving the emotional outcomes of nature exposure, the present work aims to deepen understanding by exploring additional aspects of the relationship between nature exposure/connectedness and emotion regulation. While Bratman et al.'s review focused primarily on the affective benefits of nature exposure, within the framework of the five emotion regulation categories of the Process Model, the present review extends this by examining a broader spectrum of emotion regulation processes more broadly as well as the role of specific strategies. This expanded scope aims to offer a more comprehensive understanding of their role in the context of nature exposure and other related aspects. Moreover, this review provides detailed information about previous studies, including the instruments used and methodologies employed, enhancing transparency and potential replicability.

By systematically analysing prior research, this work seeks to strengthen the evidence base, improve the reliability and validity of findings, and guide future research in nature-based emotion regulation strategies.

Given the significant questions involved in functional emotion regulation and the hypothesized regulation of emotions through nature contact, relevant databases were scanned for studies that investigated emotion regulation effects stemming from exposure to nature, in order to synthesize them in this contribution.

The general aim is to have a deeper understanding of existing literature regarding the impact of nature contact and connectedness on both general emotion regulation processes and specific strategies. This entails a comprehensive review of studies that have explicitly addressed emotion regulation in the context of nature exposure and related aspects, utilizing established emotion regulation terminologies, concepts, and methodologies as foundational frameworks, in order to integrate findings from nature/health and emotion regulation literature.

2.2. Method

2.2.1. Rapid review

A rapid review of the literature was conducted in November 2022, to assess the existing knowledge on the association between emotion regulation and nature-related aspects, which include different types of nature exposure, and psychological constructs related to the feeling of affiliation or connection with nature. A subsequent search of literature was conducted in January 2024 to update the review with more recent articles, using the same procedure of the first one.

Rapid reviews, categorized as one of the review methods within the Cochrane Review Methods (Garritty et al., 2016; Tricco et al., 2015), represent a type of knowledge synthesis that simplifies or omits certain components of the systematic review process to expedite the production of timely insights about a topic. For example, a rapid review may involve using a single reviewer or reducing the number of databases searched (Khangura et al., 2012).

Despite these simplifications, rapid reviews generally adhere to the core principles of systematic reviews, by employing methodical and transparent methodologies to identify, select, and critically analyse data from the relevant databases. They have been recognized as an efficient tool for obtaining evidence on new topics (Garrity et al., 2021), and have demonstrated the potential to yield similar conclusions to more comprehensive systematic review methods (Khangura et al., 2012).

In this case, the decision to employ a rapid review approach was driven by time constraints, limited resources, and the need to base future research on available evidence.

A rapid review offered a practical alternative to gain valuable information, providing a preliminary synthesis of existing evidence, identifying key findings and knowledge gaps for future research.

Finally, the relative paucity of previous similar efforts on this topic renders this rapid review a sufficient first step to provide significant advancement in the field, while future steps certainly may adopt deeper and more systematic approaches.

Despite resource limitations, the rapid review methodology was conducted with a commitment to upholding rigor and transparency throughout the process. Based on Cochrane's guidelines for Rapid Reviews (Garritty et al., 2021), several steps have been undertaken: 1) Setting the research questions; 2) Setting eligibility criteria; 3) Literature search; 4) Study selection based on Title and abstract screening and subsequent Full-text screening; 5) Data extraction; and 6) Narrative synthesis of the evidence.

Due to the nature of a rapid review, a thorough critical appraisal and assessment of study quality was not conducted, so that the quality criteria of the included publications were not controlled. Consequently, studies were not included/excluded based on a formal quality assessment; however, during the data extraction process, care was taken to check that all selected studies clearly reported their research aims, employed appropriate methods and analyses, and provided valid and clear statements of findings. The data selection process was conducted by a single review author, who performed the literature search, study selection and screening, as well as data extraction. In order to enhance the reliability of the review process and minimize potential bias, a second review author independently verified these assessments, to ensure accuracy and increase the validity of the findings.

2.2.2. *Research questions*

By doing a rapid literature review, the present work seeks to answer the following specific questions.

- What are the identifying characteristics (e.g., research questions, sample population, type of nature contact, study design) of studies on use of nature for emotion regulation?
- What types of emotion regulation strategies did these studies examine?
- Which measures did these studies used to investigate these aspects?
- What kinds of effects of nature on emotion regulation did these studies describe?
- What do the present review's findings imply for the future development of studies on nature contact and its effects on emotion regulation?

2.2.3. *Searching and screening*

With these questions in mind, a literature search was conducted using an *a priori* review protocol. In order to ensure the inclusion of studies that have undergone peer review and met the basic criteria and quality for publication, the analysis focused only on studies published on scientific journals, aiming to prioritize studies that have undergone a rigorous evaluation process by experts in the field.

The following databases were used to generate potentially relevant articles: *PsycInfo*, *PubMed*, *Google Scholar*, *Science Direct*, and *PubPsych*. The search was limited to peer-reviewed journal articles published in English; however, no limits on the date of publication were applied. Also, characteristics of samples (e.g., clinical vs. nonclinical), age, gender and research design were not considered exclusion criteria of the study. The full list of the inclusion and exclusion criteria are reported in **Table 2.1**.

The search keywords used in the study are presented in **Table 2.2**. For all databases, all combinations of the search keywords were used. All synonyms per topic were connected with a disjunction ("emotion regulation" OR "affect regulation" OR "mood regulation" etc.) and all topics were connected with a conjunction (Emotion regulation (and all synonyms) AND Nature (and all synonyms) etc.). Keywords related to emotion regulation processes were chosen based on a meta-analytic review on the structure of emotion regulation strategies (Naragon-Gainey et al., 2017).

Table 2.1. *Inclusion and exclusion criteria for selecting research reports for Review 1*

Inclusion Criteria	Exclusion Criteria
Research studies with no clinical and clinical samples	No results or outcomes, or impacts presented
Focus on the impact of nature on emotion regulation strategies	No information about the use of nature on emotion regulation strategies
Assessments of nature-related aspects: - Direct and indirect contact with nature (e.g., being in nature, photos, videos) - Psychological constructs related to affiliation with nature (e.g., nature connectedness)	No assessment of nature-related aspects
Assessment of emotion regulation in general or at least one specific emotion regulation strategy	No assessment of emotion regulation
Papers full-text available and reporting outcomes, evaluations and impacts	Full-text paper not available
English language	Non-English language
Qualitative or quantitative, mixed and/or multi-method research	Non-research articles (e.g., review papers, dissertations, book chapter)

Table 2.2. *Search keywords for Review 1*

Emotion Regulation	Nature
Emotion regulation	Nature
Emotion restoration	Nature experience
Affect regulation	Nature exposure
Mood regulation	Nature contact
Reappraisal	Nature environment
Expressive suppression	Restorative nature
Acceptance	Green space
Behavioral avoidance	Blue space
Distraction	
Experiential avoidance	
Rumination	
Problem solving	
Mindfulness	
Worry	

Note.
Words within groups combined with OR.
Words among groups combined with AND.

These keywords were used in each online database. Databases search activity is shown in **Table 2.3**. Articles were selected on the basis of the combination of the two topics (Emotion regulation and Nature). After the articles search, a review of the selected articles was performed, in order to decide whether each abstract concerned the experience of (or interaction with) nature, and whether the focus of the study was on the impact of nature exposure or other relevant nature-related variables on emotion regulation. Studies that examined emotion outcomes of nature but did not specifically address emotion regulation processes or strategies were excluded from the analysis.

Table 2.3. *Search activity summary for Review 1*

List of sources searched	Date of search	Initial retrieval	After filters	After title screening	After title & abstract screening	After full text screening
Science Direct	08.11.2022	51,407	6,891 Research article	11	6	4
	23.01.2024	2,231	1,555 Research article + English	11	5	1
PubMed	08.11.2022	75,986	1,683 Research article + English + human sample	30	8	3
	24.01.2024	6,696	287 Research article + English + human sample	7	3	1
PsycInfo	09.11.2022	10,585	6,364 Research article + English + human sample	23	6	4
	24.01.2024	1,317	1,156 Research article + English + human sample	4	2	0
Google Scholar	09.11.2022	191,000	18,300 Research article + English	68	18	9
	25.01.2024	7,210	1,430 Research article + English	9	4	2
PubPsych	10.11.2022	3,469	3,019 Research article + English	14	7	3

	26.01.2024	511	505 Research article + English	6	2	0
TOTAL	10.11.2022	**332,447***	**36,257***	**146***	**45**	**23**
	26.01.2024	**17,965***	**4,933***	**37***	**15**	**4**
	TOTAL	**350,412***	**41,190***	**183***	**60**	**27**

Note. The total counts in certain cells (*) may include some overlap due to potential duplicated articles.

2.2.4. Data extraction and synthesis of the evidence

After the selection of the articles, the data extraction was carried out for all the included studies, using a pre-established form. The main components of the data extraction form were: the year of publication and country of study; study design; characteristics of study sample; characteristics and measure of nature-related aspects (i.e., nature exposure and affiliation with nature); assessment of emotion regulation strategies; research results and an additional column for supplementary notes for inserting other measures used in the study and further details about the research design, if applicable. Furthermore, a synthesis of the evidence is provided, following the Cochrane Rapid Review guidelines (Garritty et al., 2021). First, a preliminary descriptive summary of the included studies is presented, describing location, sample characteristics and adopted methodologies of the studies. Then, a narrative synthesis (i.e., a method used to summarize findings from multiple studies by identifying common themes and patterns in the data; Popay et al., 2006) was adopted to further synthesise the results. In particular, findings have been organized around the types of assessment of nature-related aspects and measures of emotion regulation. Finally, a summary of the outcomes about the effects of nature on emotion regulation is provided according to the type of emotion regulation's assessment (in general or specific strategies).

2.3. Results

The PRISMA flow chart (**Figures 2.1 and 2.2**) shows the studies' selection and screening process for the two searches. The initial search produced 36,257 initial hits with 146 remaining after title screening. Eighteen duplicates were removed, leaving 128 papers to be further screened (see **Appendix A.1** for a table comprising all studies, with corresponding reasons of exclusion). The second search produced 4,933 initial hits with 37 remaining after title screening. One duplicate was removed, leaving 36 papers to be further screened (see **Appendix A.2** for a table comprising all studies, with corresponding reasons of exclusion).

An abstract screening process was conducted for screening against the inclusion and exclusion criteria, yielding to the removal of 83 records for the first search and 22 for the second one. Regarding the initial search, a total of 45 articles were identified for full-text collection and screened for eligibility through a content evaluation of the papers (see **Appendix A.3** for the full list of studies included in this stage), whereas in the second search, 15 articles were found eligible and further screened (see **Appendix A.4** for the full list of studies included in this stage). Twenty-two articles were excluded at this stage for the first search because they: did not include assessment of emotion regulation strategies (n=16) or of nature-related aspects (n=4) or could not access full text (n=2). About the second search, eleven papers were excluded for the following reasons: did not include assessment of emotion regulation strategies (n=8) or of nature-related aspects (n=2) or both (n=1). **Tables 2.4** and **2.5** include the list of studies removed at this stage of the review processes, with the corresponding reason of exclusion.

As a result, a final number of 23 articles for the first search and 4 for the second search were deemed to meet the inclusion criteria and to be of sufficient relevance to be included in the review, with a comprehensive total of 27 papers.

To note, some of the included articles reported multiple studies inside, that have been considered separately, resulting in a total of 33 research studies. Specifically, the article by

Johnsen and Rydstedt (2013) included two studies; the one by Mochizuki-Kawai, Matsuda and Mochizuki (2020) encompassed four experimental studies; Richardson and McEwan (2018) reported one main study and one supplementary study; Korpela and colleagues (2019) comprised two studies in their paper.

Figure 2.1. *PRISMA flow diagram of the first search and selection process for Review 1*

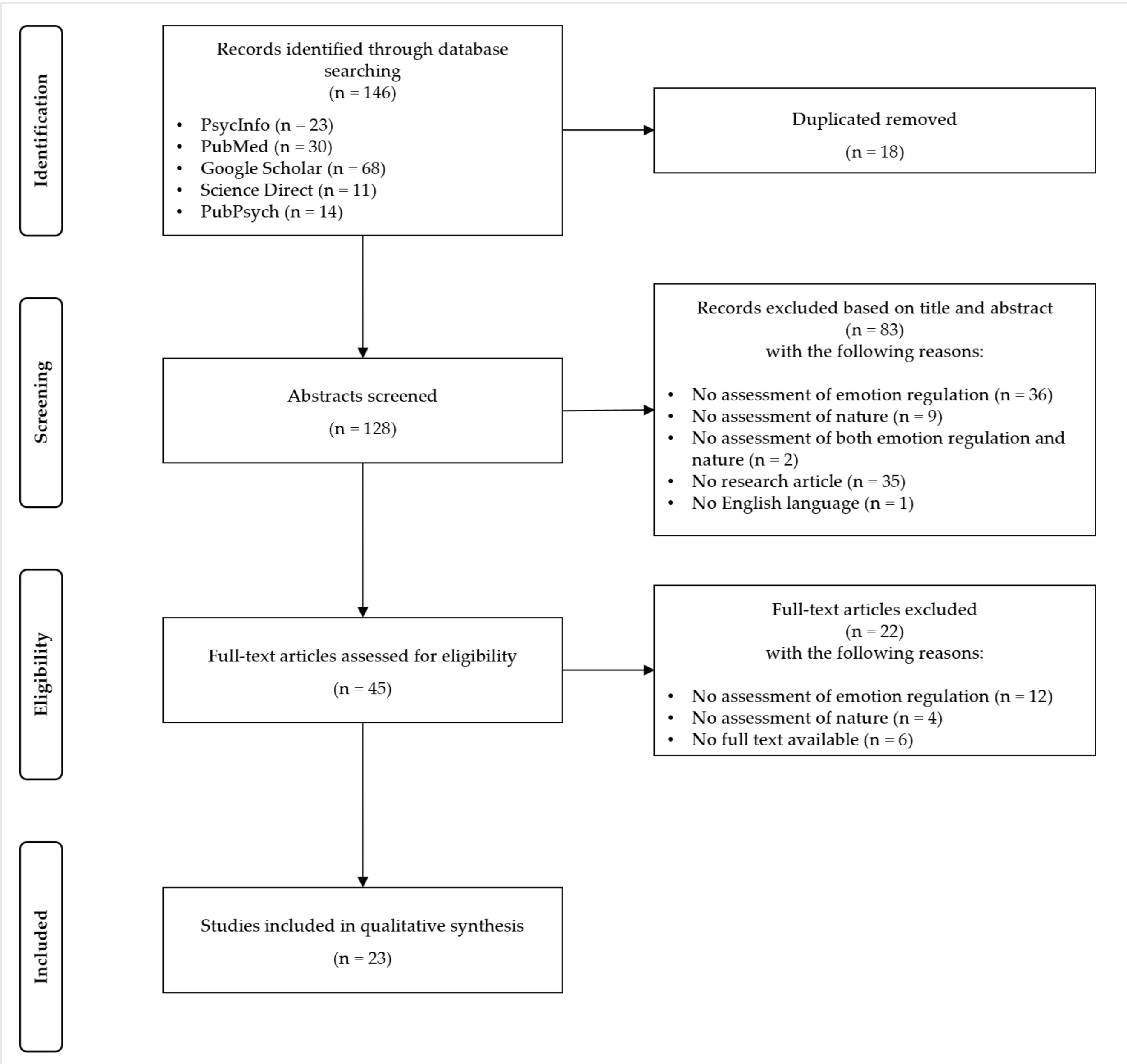


Figure 2.2. *PRISMA flow diagram of the second search and selection process for Review 1*

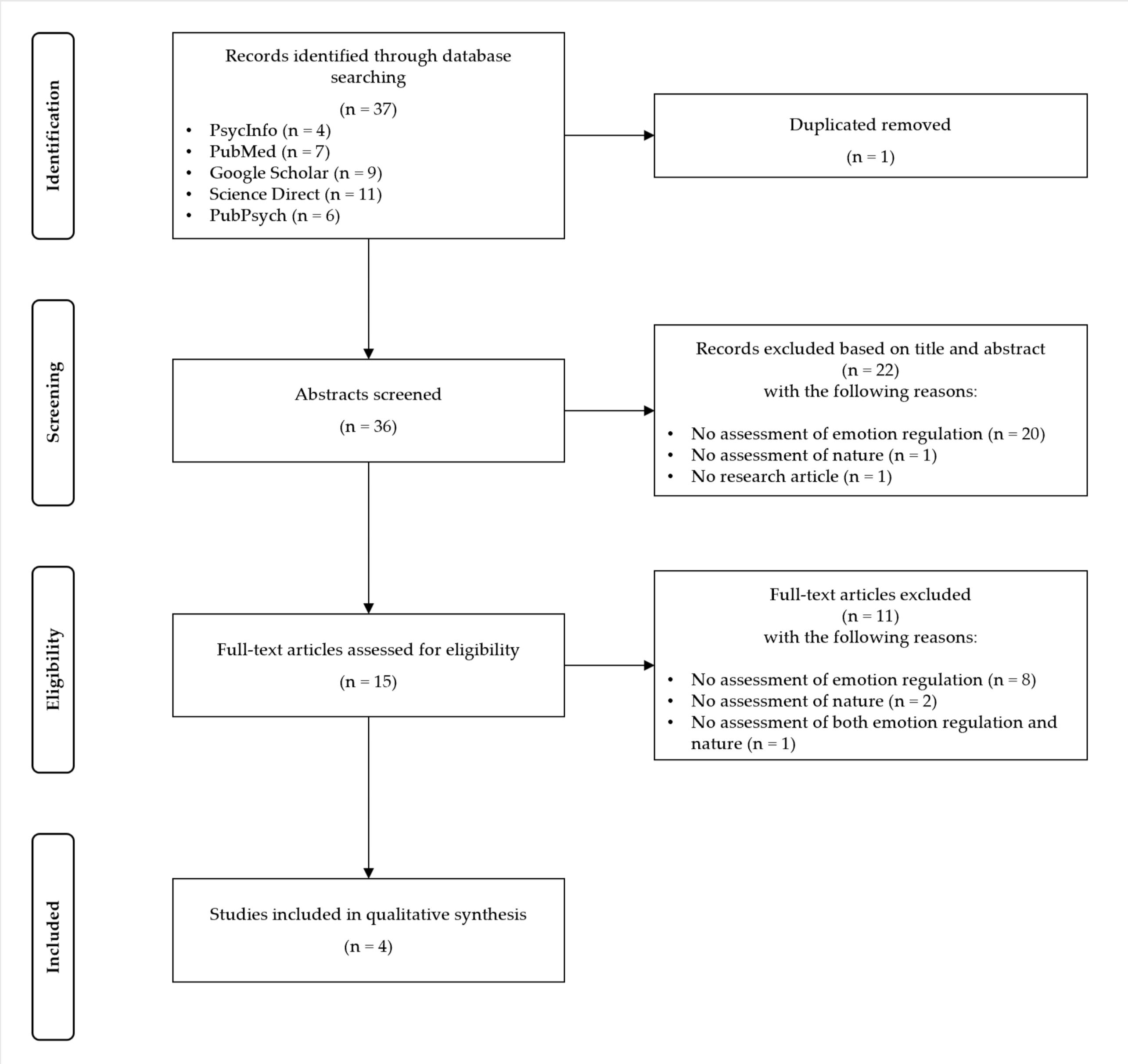


Table 2.4. *Characteristics of excluded studies based on full text for the first search of Review 1*

Study	Reason for exclusion based on full text		
	Nature [a]	***Emotion Regulation*** [b]	***Full-text*** [c]
Bergeman, Blaxton & Joiner (2021)	X		
Berman et al. (2012)		X	
Beute & De Kort (2014)		X	
Birch, Rishbeth & Payne (2020)		X	
Boemo et al. (2022)	X		
Emami et al. (2018)		X	
Han, Kang, & Meng (2022)		X	
Hanley, Derringer & Hanley (2017)		X	
Harrison & Clark (2020)			X
Hartig, Mang & Evans (1991)		X	
Hiekkaranta et al. (2021)	X		
Ibes & Forestell (2022)		X	
Korpela et al. (2014)		X	
Li et al. (2022)		X	
Malekinezhad et al. (2020)		X	
Mason & Korpela.(2009)		X	
Neill, Gerard & Arbuthnott (2019)		X	
Pirgie et al. (2016)			X
Samus et al. (2022)		X	
Schirda et al. (2012)	X		
Snell et al. (2016)		X	
Snell et al. (2020)		X	

Note. Reasons for exclusion based on full text are indicated with an X placed in the corresponding column for each of the studies. The X stands for the absence of the related criteria, namely: [a] No assessment of nature-related aspects, [b] No assessment of emotion regulation, [c] No availability of the full-text paper.

Table 2.5. *Characteristics of excluded studies based on full text for the second search of Review 1*

Study	Reason for exclusion based on full text	
	Nature [a]	*Emotion Regulation* [b]
Browning et al. (2023)		X
Chhajer & Hira (2024)		X
Dettweiler et al. (2023)		X
Ibrahim et al. (2023)	X	
Ivaldi (2023)		X
Lanza et al. (2023)		X
Liang et al. (2024)		X
Ma et al. (2023)		X
Oswald et al. (2023)		X
Sallay et al. (2023)		X
Sanyer et al. (2023)		X
Sun et al. (2023)		X
Theodorou et al. (2023)		X
Yang et al. (2023)	X	
Zeng et al. (2023)	X	X

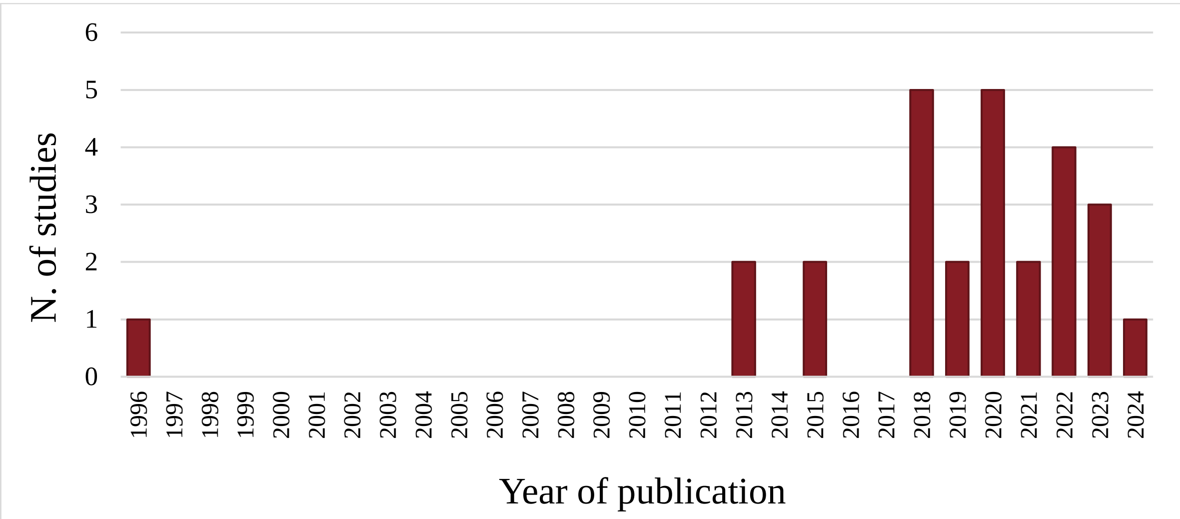
Note. Reasons for exclusion based on full text are indicated with an X placed in the corresponding column for each of the studies. The X stands for the absence of the related criteria, namely: [a] No assessment of nature-related aspects, [b] No assessment of emotion regulation

2.3.1. Study characteristics

The literature obtained from the two searches was characterized in terms of study design, participant description (including sample size and age range), country, assessment of nature and emotion regulation, and results of the study.

Table 2.6 presents a summary of the characteristics of each included study and provides details on the reported outcomes. Furthermore, an overview of publication years of the included studies is shown in **Figure 2.3**. In this regard, it is worth noting that the majority of the articles found were published in recent years, with just one of the included studies published before 2013 (Korpela & Hartig, 1996). This may confirm that there is limited existing literature on the association between nature and emotion regulation, with a noticeable increase in research interest in this topic in recent decades. The absence of older research on this issue is also in line with other prior articles' statements. For instance, Johnsen (2011) claimed that a search using the PsycInfo database by means of the keywords "emotion regulation and natural environment" returned only seven citations, with just one relevant item. Moreover, a recent article (Bratman et al., 2021), which examined the evidence for affective impacts of nature exposure and underlying mechanisms (with a focus on emotion regulation), has mostly reported citations over the last decades as indication of the nature effects on emotion regulation processes.

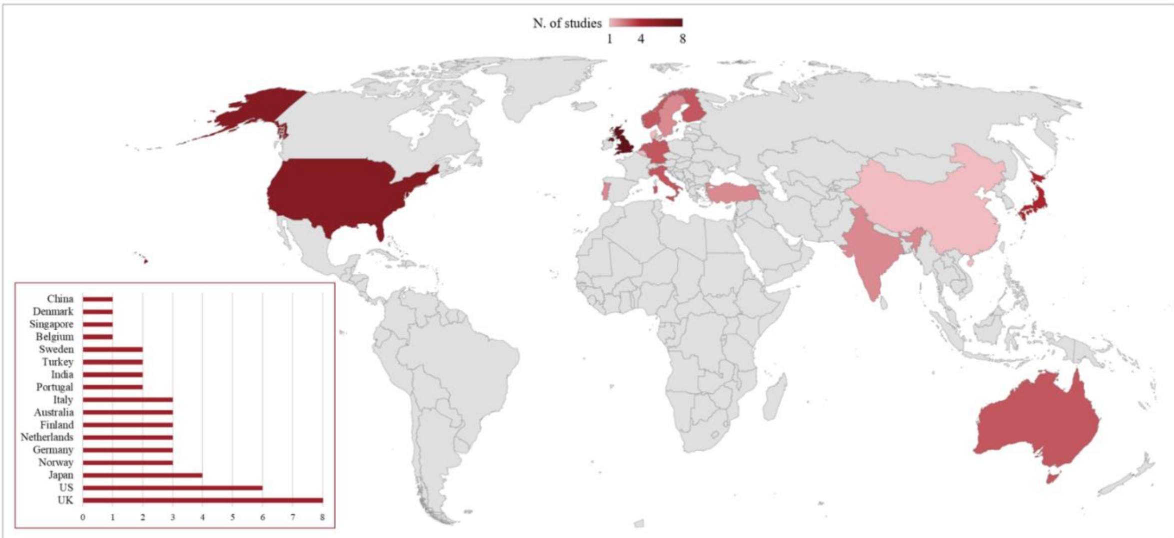
Figure 2.3. *Number of studies included in Review 1 by year of publication*



Location. The included studies were located in 14 different countries: seven of them in UK (Fido et al., 2020; Golding, Gatersleben & Cropley, 2018; Ma et al., 2023; Mueller & Flouri, 2020; Richardson & McEwan, 2018 – both studies; Swami et al., 2020), five in the USA (Bratman et al., 2015[a]; Bratman et al., 2015[b]; Browning et al., 2023; Huynh & Torquati, 2019; Stewart & Haaga, 2018), four in Japan (Mochizuki-Kawai, Matsuda & Mochizuki, 2020 – all the four studies), three in Norway (Johnsen, 2013; Johnsen & Rydstedt, 2013 – both studies), two in Turkey (Bakir-Demir, Berument & Akkaya, 2021; Bakir-Demir, Berument & Sahin-Acar, 2019), and one each in Germany (Dimitrov-Discher et al., 2022), The Netherlands (Beute & de Kort, 2018), Finland (Korpela & Hartig, 1996), Portugal (Lopes, Lima & Silva, 2020), Australia (Mygind et al., 2022), India (Sahni & Kumar, 2021), Belgium (Severin et al., 2022), Singapore (Zhang et al., 2022), Italy (Theodorou et al., 2023) and China (Liang et al., 2024). Notably, the study by Stewart & Haaga (2018) did not include data on participants' nationality.

Moreover, a multi-country research (Korpela et al., 2018) collected data from various countries (Study 1: Australia, Finland, Germany, UK, Italy, India, the Netherlands, Portugal, and Sweden; Study 2: Australia, Denmark, Finland, Germany, UK, Italy, the Netherlands, Sweden, and the USA). **Figure 2.4** illustrates the geographic distribution of the included studies by country.

Figure 2.4. *Map of the number of studies included in Review 1 by countries*



Sample Characteristics. The included studies involved a total of 172,821 participants. Sample size ranged from 8 to 172,490 participants. Across the included studies which specified participant ages, mean/median age ranged from 3.35 to 49.51 years. Age ranges were fairly consistent (total: 16-85), covering mostly young and middle-aged adults, although four studies focused on children (Bakir-Demir, Berument & Sahin-Acar, 2019; Mueller & Flouri, 2020; Mygind et al., 2022; Liang et al., 2024), with an age range of 2–11 years. All the studies were conducted with both male and female samples, mainly with a higher percentage of female participants, except one study that used only a male sample due to methodological reasons (Dimitrov-Discher et al., 2022). The most common study samples consisted of healthy participants, mostly specified as college/university students. One study specifically targeted individuals with high levels of depression or anxiety or stress as participants with specific health conditions (Beute & de Kort, 2018).

Methodologies. In terms of methodology, all the included studies employed a quantitative approach, except for two studies: one utilized qualitative method (with semi-structured interviews analysed through a phenomenological approach; Severin et al., 2022), and one employed mixed method (Korpela & Hartig, 1996).

Studies varied in terms of research design: 15 cross-sectional (Bakir-Demir, Berument & Akkaya, 2021; Bakir-Demir, Berument & Sahin-Acar, 2019; Dimitrov-Discher et al., 2022; Fido et al., 2020; Huynh & Torquati, 2019; Johnsen, 2013 – study 2; Johnsen & Rydstedt, 2013; Korpela et al., 2018 – both studies; Liang et al., 2024; Mygind et al., 2022; Richardson & McEwan, 2018 – Supplementary study; Sahni & Kumar, 2021; Swami et al., 2020; Zhang et al., 2022), one cohort (Mueller & Flouri, 2020), and 12 experimental studies, using either between- (n = 9) or within-subjects (n = 6) design. Of the experimental studies, seven were conducted in a field setting (Beute & de Kort, 2018; Bratman et al., 2015[a]; Bratman et al., 2015[b]; Johnsen & Rydstedt, 2013 – study 1; Lopes, Lima & Silva, 2020; Ma et al., 2023; Richardson & McEwan, 2018 – main study), six in a laboratory setting (Golding, Gatersleben & Cropley, 2018; Mochizuki-Kawai, Matsuda & Mochizuki, 2020 – all the four studies; Theodorou et al., 2023), one through an online platform (Stewart & Haaga, 2018), and one study provided participants with VR contents and equipment for using it at home (Browning et al., 2023).

Table 7 shows further details about studies' method and design. Due to the range of diverse research methods, outcome measurements and assessment of nature included in the studies, a narrative synthesis of the findings was undertaken.

Table 2.6. *Characteristics of studies included in Review 1*

N.	Study	Research design	Sample characteristics (size, gender, age, country)	Assessment of Nature	Assessment of Emotion Regulation	Notes Other measures	Main findings
1	Bakir-Demir, Berument & Akkaya (2021)	Quantitative method Correlational study Cross-sectional survey	140 college students F (n=123) + M (n=17) Age range 18-25 (*M* = 21.02, *SD* = 1.38) Turkey	Nature relatedness (NR; Nisbet et al., 2009)	The Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001)	Other measures: - The Perceived Stress Scale (PSS; Cohen et al., 1983) - Hair cortisol concentration (HCC) - The Adult Temperament Questionnaire (ATQ-Negative reactivity subscale; Evans & Rothbart, 2007)	• Significant indirect effect from nature connectedness to perceived stress through adaptive emotion regulation strategies • Results did not reveal the indirect effect through non-adaptive emotion regulation strategies
2	Bakir-Demir, Berument & Sahin-Acar (2019)	Quantitative method Correlational study Cross-sectional survey	299 children F(n=165) + M (n=134) Age range 8-11 (*M* = 9.28, *SD* = 0.71) Turkey	Normalized Differential Vegetation Index (NDVI) + mothers' and child's perceptions of greenery in the neighbourhood Connection to Nature Index (CNI; Cheng and Monroe, 2012) Inclusion of Nature in Self Scale (INS; Schultz, 2002) Nature Relatedness Scale (NR; Nisbet et al., 2009)	The child version of the Cognitive Emotion Regulation Questionnaire (CERQ-k; (Garnefski et al., 2007) Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA; Gullone & Taffe, 2012)	Other measures: - The Inhibition Subscale of the Childhood Executive Functioning Inventory (CHEXI; Thorell & Nyberg, 2008) - The Barratt Impulsiveness Scale-11 (BIS-11; Patton, Stanford & Barratt, 1995) - Temperament in Middle Childhood Questionnaire (TMCQ; Simonds & Rothbart, 2004)	• Greenery did not directly predict the children's emotional regulation skills • The relationship between greenery and emotional regulation was indirectly mediated by nature connectedness.
3	Beute & de Kort (2018)	Quantitative method Experimental study (field) Crossover design (Within-subjects)	15 participants with high depression or anxiety or stress levels F (n=12) + M (n=3) Age range 18-29 (*M* = 21.6, *SD* = 3.0) Netherlands	Use of slideshows with images from local urban (control) and natural scenes. Each slideshow lasted 3 minutes and consisted of 18 different scenes. Participants were instructed to view the slideshows once	Ecological Momentary Assessment to measure: - Mood: hedonic tone, energy, and tension - Worry and rumination with two items	Selection criteria of participants: a minimum score of 14 ("mild depression") for the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996), or 21 for the Symptoms CheckList-90-R (SCL-90-R; Arrindell &	• Exposure to natural content increased positive affect, and lowered rumination and worry • Participants reported more positive affect in the nature week than in the urban week • Participants indicated that they worried less when watching nature twice daily than when watching urban scenery

				in the morning and once in the afternoon and to imagine being in the displayed environments. Participants took part in both conditions (nature and urban (four weeks between conditions).		Ettema, 2003) anxiety scale, or of 14 on the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). Other measures: - Stress with one item - Psychosomatic complaints: headache, neck- and back-pain, stomach and bowel problems - Heart rate	• Tension, energy, and self-reported stress level did not improve when viewing the natural images • Mental well-being improved over time in both the urban and the nature week • Lower heart rates recorded in the nature week than in the urban week
4	Bratman et al. (2015)[a]	Quantitative method Experimental study (field) Pretest-posttest; randomised groups (between subjects)	60 participants F (n=33) + M (n=27) Total mean age = 22.9 USA	Participants took a 50-min walk in either an urban or nature environment (random assignment). The nature walk took place in a park along a paved path through grassland with scattered shrubs and oak trees. The Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004)	The Rumination-Reflection Questionnaire (RRQ; Trapnell & Campbell, 1999) Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988)	Participants were told to take ten pictures of "whatever captured their attention" during the walk. These instructions were used as a cover story to help disguise the intention behind the study. After the walk, they were re-assessed on the same set of affect measures and cognitive tests. Other measures: - State-Trait Anxiety Inventory (STAI; Marteau & Bekker, 1992) - The operation span task (OSPAN –working memory test; Turner & Engle, 1989) - The Change Detection task (Visuospatial working memory, Luck & Vogel, 1997).	• Compared to urban experience, nature experience led to greater decreases in rumination, anxiety, and negative affect.

5	Bratman et al. (2015)[b]	Quantitative method Experimental study (field) Pretest-posttest; randomised groups (between subjects)	38 participants F (n=18) + M (n=20) Total mean age = 26.6 USA	Participants took a 90-min walk in either an urban or nature (park) environment (random assignment).	The Rumination-Reflection Questionnaire (RRQ; Trapnell & Campbell, 1999) Measurement of brain activity in the subgenual prefrontal cortex (sgPFC)	Participants were given a smartphone and told to take 10 photographs during their walk. After the walk, participants reported again their levels of rumination and brain activity was measured.	• Walk in a natural setting, decreases both self-reported rumination and neural activity in the sgPFC • Walk in an urban setting has no such effects on self-reported rumination or neural activity.
6	Browning et al. (2023)	Quantitative method Longitudinal experimental study Pre-post comparison after 3/4 weeks (within subject) Intervention vs. control condition (between subject)	40 participants F (n=30) + M (n=10) (intervention n = 24; control n = 16) Age range 18-22 (*M* = 19.3) USA	Use of virtual nature (VR) Students in the intervention condition were asked to watch one of six 360-degree videos on Monday through Saturday of each week for 3/4 weeks 4 minutes video, including forests, beaches, deserts, lakes, grasslands, or alpine areas The control condition received no intervention or instructions beyond completing the online surveys.	The Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) The Rumination Reflection Questionnaire (RRQ; Trapnell & Campbell, 1999)	Other measures: - the Mood and Anxiety Symptom Questionnaire (MASQ; Watson et al., 1995) to measure panic and depressive symptoms - Engagement with Beauty Scale (Diessner, 2008) - Nature visits over the past year and camping experiences over the lifetime - Past VR experience - Questions about demographic - Sleep quantity and physical activity	• Virtual nature decreased worry, panic, and depressive symptoms while increasing rumination • In the control condition, depressive symptoms appeared to worsen while worry, panic, and rumination remained constant. • Not all trends in mean comparisons were statistically significant, however. Decreases in worry and panic were significant for the virtual nature condition. No other changes in mental health approached significance for either condition. • Female participants showed greater decreases than male participants. • Participants with VR experience before the study also showed greater decreases than new VR users. • Participants with more visits to outdoor nature in the past year and lifetime camping experience showed greater decreases than participants with less outdoor nature exposure. • Higher levels of engagement with beauty also moderated the impact of virtual nature on changes in worry.
7	Dimitrov-Discher et al. (2022)	Quantitative method Correlational study Cross-sectional study	42 participants only male	Use of databases about amount of green space, based on land-use data,	Measurements of activity in brain regions relevant for regulating emotions	The ScanSTRESS task was used to induce acute social stress by carrying out figure	• Results showed stronger activation in brain regions involved in emotion-based

		Data from functional magnetic resonance imaging + secondary dataset analysis	Age range 20-48 (*M* = 30.12, *SD* = 5.57) Germany	including urban parks, urban forests, allotment gardens, in different buffer areas around participants' addresses.		rotations and mathematical subtraction tasks while being observed by a two-person panel who provided verbal negative feedback.	regulation of stress for participants with higher availability of green spaces • Increasing amounts of green space were linked to greater activation in brain regions relevant for regulating emotions in a stressful task: - the insular cortex (which is implicated in emotional perception and salience detection of cues), - the right ventromedial (vmPFC) and ventrolateral prefrontal cortex (vlPFC), left dorsolateral prefrontal cortex (dlPFC), and ventral anterior cingulate cortex (vACC), which are relevant area for emotion regulation - amygdala and ventral striatum, which are related to the perception of emotional features of a stimulus, - the fusiform cortex, which is important for facial emotion recognition - the precuneus and posterior cingulate cortex (PCC), which are related to self-referential thought
8	Fido et al. (2020)	Quantitative method Correlational study Cross-sectional survey	309 participants F (n=152) + M (n=157) Age range 18–66 (*M* = 30.34; *SD* = 10.60) UK	Nature Relatedness Scale (NR-S6; Nisbet & Zelenski, 2013)	The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003)	Other measure: - The Short Dark Triad (SD3; Jones & Paulhus, 2014) as a measure of psychopathy	• Positive association between scores on nature connectedness and the use of cognitive reappraisal, but not expressive suppression strategies. • Nature connectedness was negatively associated with psychopathy scores. The use of expressive suppression, but not cognitive reappraisal strategies, was positively associated with psychopathy. • A significant interaction between nature connectedness and psychopathy scores was found, such that associations between nature connectedness and use of cognitive re-appraisal strategies were weaker in subject with high psychopathy.

	Golding, Gatersleben & Cropley (2018)	Quantitative method Experimental study (laboratory) Randomized Controlled Trial (between subjects)	58 participants F (n=45) + M (n=13) Age range 21-73 (*M* = 27) UK	Use of slideshows with nature For the experimental manipulation, participants either watched a slideshow of a natural or an urban environment or waited in the room with no distractions.	The adapted Thoughts Questionnaire (Edwards, Rapee & Franklin, 2003) Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988)	A presentation task was used to induce rumination and influence mood before the slideshow Other measures: - Ruminative Responses Scale (RRS; Treynor et al., 2003) - Connectedness to Nature Scale (Mayer & Frantz, 2004) - Being Away and Fascination subscales (PRS; Hartig et al., 1996)	• State rumination reduced in all three conditions in the post-test • Environmental exposure had no effect on levels of rumination or negative mood. • Reductions in task-related rumination were not influenced by environmental exposure • Positive mood declined in participants who saw the urban slideshow but remained the same in those who saw the nature slideshow.
10	Huynh & Torquati (2019)	Quantitative method Correlational study Cross-sectional survey	360 Undergraduate students F (n=237) + M(n=123) Age range 18–54 majority were between the ages of 18–24 y USA	The Connectedness to Nature Scale (Mayer & Frantz, 2004)	The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008) The Positive States of Mind Scale (PSOMS; Horowitz, Adler & Kegeles, 1988)	Other measures: - Satisfaction with Life Scale (SWLS; Diener et al., 1985) - The Hospital Anxiety and Depression Scale (HADS; Bjelland, et al., 2002) - The Perceived Stress Scale (PSS; Cohen, Kamarck & Mermelstein, 1983)	• Mindfulness (mindful attention, mindful awareness, and mindful acceptance), independently, mediate the association between connection to nature and psychological well-being (depression, anxiety, perceived stress, life satisfaction, and positive states of mind).
11	Johnsen (2013)	Quantitative method Correlational study Cross-sectional survey	142 participants F (n=74) + M (n=54) Age range 16-79 (*median age range* = 40-49) Norway	Participants were asked to complete the questionnaire after visiting a natural area. Items used to measure emotion regulation were specifically focused on the regulation of emotion in nature.	Emotion regulation in nature: 11 ad-hoc items Restoration Outcome Scale (ROS; Korpela et al., 2008) Ego Restoration Scale (Johnsen, 2012)	Other measures: - The Big Five Inventory (BFI-44; Engvik & Føllesdal, 2005; John & Srivastava, 1999) - The Perceived Stress Scale (PSS; Cohen, Kamarck & Mermelstein, 1983)	• Emotion regulation is an important motive for people seeking out nature • Emotion regulation in nature was related to restorative outcomes of the exposure to nature • Use of nature as emotion regulation strategies to increase positive emotions and decrease negative emotions predict restorative outcomes.
12	Johnsen & Rydstedt (2013)	Study 1: Quantitative method Experimental study over two weeks (field) Randomized Controlled Trial (between subjects)	Study 1: 35 college students F (n=27) + M (n=8) Study 2: 473 college students F (n=313) +M (n=160)	Study 1: Participants in the experimental condition were asked to use a picture of nature actively as stimuli for emotion regulation in their everyday life, while two control groups looked at a	Study 1: The Norwegian version of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) Ego Restoration Scale (Johnsen, 2012)	Other measures Study 1: - Attentional Function Index (AFI; Cimprich, Visovatti, & Ronis, 2011): to assess perceived cognitive	Study 1: • A significant effect of the manipulation was found on positive mood, but there was an initial increase and then a decrease. • The experimental group reported slightly higher negative mood than the other two groups at baseline, but there were not

		Study 2: Quantitative method Correlational study Cross-sectional survey	*Mean age: 22.6* Norway	picture of nature (without any instruction) or a picture of balloons. Study 2: Participants viewed 6 pictures of different environments (urban with/without people, “unsafe or scary” natural environments, living rooms, shopping malls, and classical nature) and indicated their reactions.	Study 2: The Norwegian version of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) Intention to seek out nature: 2 ad-hoc items Emotional potential of different environments: 4 ad-hoc items	functioning in everyday activities that require working memory and executive attention Study 2: - The Big Five Inventory (BFI-44; Engvik & Føllesdal, 2005; John & Srivastava, 1999)	significantly differences in mood at any time point. Study 2: • The classical natural environment was rated highest on emotional potential of all environments tested. • Perceiving a higher emotional potential in nature was related to a higher intention to seek out nature when happy or sad.
13	Korpela et al. (2018)	Both studies: Quantitative method Correlational study Cross-sectional surveys	Study 1: 507 participants F (n=372) + M (n=135) Age range 17-57 Australia, Finland, Germany, Great Britain, Italy, India, Netherlands, Portugal, and Sweden Study 2 626 participants F (n=464) + M (n=162) Age range 16-60 Australia, Denmark, Finland, Germany, Great Britain, Italy, the Netherlands, Sweden, and the USA.	No specific nature measures or condition. Items used to measure emotion regulation were specifically focused on the regulation of emotion in natural (and urban) environment.	A modified version of MARS (Measure of Affect Regulation Styles; Larsen and Prizmic, 2004)	Other measures: - The Satisfaction With Life Scale (SWLS; Diener et al., 1985) - The Emotional Well-being Scale from the RAND 36-Item Health Survey (Aalto et al., 1995) - Perceived general health with a single question “How is your health at the moment?”	• Environmental regulation formed a separate factor of affect regulation in the exploratory structural equation models (ESEM). • No relations of environmental strategies with emotional well-being were found • Both the perceived frequency of use and efficacy of environmental strategies were positively related to perceived health. • The perceived efficacy of environmental strategies was positively related to life satisfaction in regulating sadness.
14	Korpela & Hartig (1996)	Mixed methods (qualitative: listing of favorite place + quantitative: experience in the place) Correlational study	78 College students F (n=49) + M (n=29) Age range 19-46 (*M* = 25.46, *SD* = 6.19) Finland	Many of the favorite places (where self-regulate) identified by participants were natural environments	The Zuckerman Inventory of Personal Reactions and Feelings (ZIPERS; Zuckerman, 1977) + Perceived Restorativeness Scale (PRS; Hartig et al., 1996) → subjects’	Participants had to answer the items for rating their favorite and unpleasant places.	• Favorite places identified by subjects were most often places with greenery, water, and scenic quality. • Consistent with notions of self-regulation, favorite place experiences are characterized by high levels of being away, fascination, coherence, and compatibility

		Cross-sectional surveys			evaluations of the pleasant and unpleasant places		• Differences were also found in self-reported emotional states associated with each place (higher positive affect, lower anger, aggression, fear and arousal for favorite places)
15	Liang et al. (2024)	Quantitative method Correlational study Cross-sectional study From the COHERENCE (a yearly sequential cross-sectional investigation that covers around 1600 primary and middle schools)	172,490 participants F (n=95,259) + M (n=76,231) Age range 6-18 (*M* = 10.2) China	Green and blue spaces (GBS) exposure assessment based on school and residence addresses, calculating GBS as a percentage within a circular buffer (500m and 800 m) that encompassed the residential and school neighborhoods of the participant: - Residential daily exposure rate (RER) - School daily exposure rate (SER)	The Strengths and Difficulties Questionnaire (SDQ; Goodman & Goodman, 2009)	Other measures: - Socio-demographic questions: age, gender, weight status, body mass index (BMI), parental highest attained education, household monthly income, parental smoking habits, average outdoor physical activity (PA) time, average screen-based time, sleep duration.	• Living in close proximity to greenspace and water areas, and having more exposure to GS and BS coverage, resulted in improved emotional and behavioral health among youths. • Individuals exposed to higher levels of GS around their residence or school had lower rates of emotional and behavioral difficulties compared to those who had lower levels of exposure at 500m buffer • Exposure to high levels of BS around residence or school was associated with a decrease in the likelihood of students at risk of emotional and behavioral difficulties than those with low level • Higher level of greenery around school and residence areas in all buffer sizes were linked to lower scores on emotional symptoms.
16	Lopes, Lima & Silva (2020)	Quantitative method Experimental study (field) Pre-post test randomised groups (between subjects)	62 participants F (n=41) + M (n=21) Age range 18–68 (*M* = 25) Portugal	Participants were randomly allocated to one of two walking conditions (30 min, 2 km): walk in nature (garden) vs. walk in city (street)	Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011) The Brief State Rumination Inventory (BRSI; Marchetti, Mor, Chiorri, & Koster, 2018) The Positive and Negative Affect Schedule (PANAS; Crawford & Henry, 2004)	Other measures: - Short version of the Nature Relatednedss Scale (NR-6; Nisbet & Zelenski, 2013). - Awe and externally oriented thoughts during the walk - Rating of how challenging and tiring walking was	• A 30-min walk in an urban park significantly reduced ruminative thinking, whereas a 30-min walk along a city without natural elements did not. • Nature walks significantly reduced negative mood and elicited more awe and more externally oriented thoughts than the city walk. • More awe participants experienced while walking, the more negative affect was reduced, which then lead to reduced rumination.

17	Ma et al. (2023)	Quantitative method Longitudinal experimental study Pre-post comparison after each waling session + after the 1-week intervention + follow up after another week (within subject) Intervention (i.e., nature) vs. control (i.e., urban) condition (between subject)	104 participants Total mean age = 23.6 (female/male = 94:10) UK	Participants independently undertook a daily 35-minute walk for a week (7 days) to either an experimental (i.e., nature, public park) or control (i.e., urban, commercial street) walking environment. All aspects of the urban walking intervention were equivalent to those of the nature walking group except for the environment. Both routes were chosen with consideration for safety, and 30-35 minutes to walk at a moderate pace. + Nature-Relatedness Scale (Nisbet & Zelenski, 2013)	The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) and The Toronto Mindfulness Scale (TMS; Lau et al., 2006) were used to assess *trait* mindfulness and *state* mindfulness, respectively.	Other measures: - Questions regarding demographic variables: gender, age, educational level, and status regarding weekly physical activity, experience of walking in nature and exposure to nature, accessibility to green spaces, mental-health conditions, and treatment history regarding sleep difficulty - Sleep quality - The Short Form of Profile of Mood State (POMS-SF) was used to measure participants' daily mood states before and after their walking sessions	• Overall, results showed that outdoor mindful walking for both groups improved university students' sleep quality, mood, and trait mindfulness levels regardless of environment. • There was no significant interaction between group and time on trait mindfulness, or main effect of group. There was a significant main effect of time, showing that for both walking conditions trait mindfulness scores improved following the intervention. • The intervention's effects on trait mindfulness were sustained from the post-intervention to the follow-up timepoints. • No significant effects on nature relatedness and on state mindfulness (measured before and after each walking session).
18	Mochizuki-Kawai, Matsuda & Mochizuki (2020)	Same for all the 4 studies: Quantitative method Experimental study (laboratory) Pretest-posttest crossover trial order randomised (Within subjects)	Study 1a: 31 participants F (n=13) + M (n=18) Age range 18-45 (*M* = 22, *SD* = 4.7) Study 1b: 35 participants F (n=12) + M (n=23) Age range 19–55 (*M* = 24.4, *SD* = 7.6) Study 2: 32 participants Only male Age range 18–27 (*M* = 21.6, *SD* = 2.0) Study 3:	Passive viewing of a typical flower image as a stimulus (in comparison to other stimuli) after an acute visual stressor	Study 1a: Changes in blood pressure viewing a typical flower image (vs. a mosaic of fragmented flower image or a fixation point) after experiencing psychological stress Study 1b: Changes in blood pressure viewing a flower image (vs. a sky image or. a chair image) after experiencing psychological stress Study 2: Salivary cortisol levels after viewing a typical flower image (vs. a mosaic image of flower fragments) after	During the procedure a negative IAPS images (e.g., violence, injuries, car crashes) was used to generate stress in participants	Study 1a and lb: • Viewing an image of a typically-shaped flower decreased elevated blood pressure to a greater degree than viewing other stimuli. • Results suggest that viewing a flower image provides psychological and physiological recovery effects after stress. Study 2: • viewing a flower image has an impact on the endocrine system, reducing saliva cortisol levels after they were elevated by psychological stress. Study 3: • Activation of the right amygdala–hippocampus region was decreased during viewing of this image in comparison to viewing a flower-mosaic or

			17 participants F (n=7) + M (n=10) Age range 21–41 (M = 25.5, SD = 1.5) Japan		experiencing psychological stress Study 3: Functional magnetic resonance imaging (fMRI) viewing a typical flower image (vs. viewing a mosaic of fragmented flower image, or a fixation point) after experiencing psychological stress		a visual fixation point after an acute visual stressor. • Results suggest that viewing a flower may induce automatic distraction from a stressor and lead to a reduction in amygdala–hippocampus activation and negative emotion, thereby downregulating physiological responses.
19	Mueller & Flouri (2020)	Quantitative method Correlational study Longitudinal cohort data Data from the Millennium Cohort Study (MCS; longitudinal study)	13,774 Children at ages 3, 5 and 7 years F (n= 6794) + M (n=6980) UK	Neighbourhood greenspace was measured with data from the Multiple Environmental Deprivation Index (MEDIx) Measured also at sweeps two, three, and four years	The Child Social Behavior Questionnaire (CSBQ; Luteijn et al., 1998)	Other measures: - Home physical environment: access to a private garden, presence of open fires, level of damp/condensation, presence of second-hand smoke - Family background: maternal education, poverty, maternal psychological distress (the six-item Kessler Psychological Distress scale), family structure, residential mobility, home ownership - Children general cognitive ability (IQ)	• No association of neighbourhood greenspace with self-regulation, indexed by independence and emotional dysregulation
20	Mygind et al. (2022)	Quantitative method Correlational study Cross-sectional study	1,196 Children F (n=575) + M(n=621) Age range 2–5 (M = 3.35, SD = 0.77) Australia	Vegetation cover within four key behaviour settings: the home yard; the home neighbourhood; ECEC outdoor areas; the ECEC neighbourhood. → average across these four settings	The Strengths and Difficulties Questionnaire (SDQ; Goodman & Goodman, 2009)	Sociodemographic and built environment (i.e., residential density, neighbourhood crime, and neighbourhood traffic) background variables were also collected.	• Emotional difficulties were inversely associated with vegetation cover in the home and neighbourhood • Indications that the presence of home yard (but not neighbourhood) vegetation cover may act as a potential buffer against the inequality in risk of abnormal emotional difficulties related to maternal education

							levels → The higher odds of emotional difficulties associated with lower levels of maternal education was reduced with higher percentages of home yard vegetation cover.
21	Richardson & McEwan (2018)	Main study: Quantitative method Experimental study (field) Pre-post comparison (within subjects; before intervention, post-30 days and post-2 months) Supplementary study: Quantitative method Correlational study Cross-sectional survey	Main study: 308 participants F (n=260) + M (n=48) Age range 18-85 (*M* = 49.51, *SD*=14.17) Supplementary study: 153 participants F (n=97) + M (n=56) Age range 18-75 (*M* = 45.78, *SD*=11.74) UK	Main study: 30 days intervention to engage people with nature by asking them to interact with nature every day for one month. + Inclusion of nature in self scale (INS; Schultz, 2001) The natural beauty sub-scale from the Engagement with Beauty scale (EWNB; Diessner et al., 2008) Supplementary study: The natural beauty sub-scale from the Engagement with Beauty scale (EWNB; Diessner et al., 2008) Inclusion of nature in self-scale (INS; Schultz, 2001)	Supplementary study: The Difficulties in Emotion Regulation Scale (DERS; Bjureberg et al., 2016).	Main study: A wide range of potential activities were suggested across various themes and levels. The four main types are noticing (e.g., take a moment to watch a butterfly), sharing (e.g., sharing experiences and feelings via social media), doing (e.g., pro-nature behaviours such as leaving a wild area in the garden) and connecting (e.g., nature-based arts). Other measures (both studies): - Pro-nature behaviour. - Questions about general health and happiness	Main study: • Significant increases from pre-participation baseline to post-participation for nature connectedness, health, happiness, and conservation behaviours. • There were also significant and sustained increases from pre-participation baseline to follow-up for the same measures. Supplementary study: • Correlation analysis showed that those with difficulties in emotional regulation had a lower connection with nature and lower happiness. • Difficulty in emotional regulation was not associated with EWNB. • Mediation analysis indicated that emotional regulation mediated the relationship between nature connectedness and happiness.
22	Sahni & Kumar (2021)	Quantitative method Correlational study Cross-sectional survey	334 participants F (n=199) + M(n=135) Age range 18-64 (*M* = 36.8, *SD* = 13.1) India	Presence of nature in the neighbourhood areas both in childhood and current Frequency of visits to natural spaces Nature relatedness scale (NR-6; Nisbet et al., 2013).	Mindfulness Attention and Awareness Scale (MAAS; Brown & Ryan, 2003)	Mindfulness is considered as the mental state of being attentive to and aware of what is taking place in the present (Brown & Ryan, 2003)	• Frequency of visit to nature-rich spaces has a significant positive association with mindfulness. • This association was further found to be strengthened by nature relatedness. • Nature in the current neighbourhood was not found significantly associated with mindful attention and awareness. • Neighbourhood nature during childhood is significantly associated with nature relatedness and mindful attention and awareness.

23	Severin et al. (2022)	Qualitative study Semi-structured interviews Phenomenological approach	8 participants F (n=5) + M (n=3) Age range 21-25 Belgium	Participants were asked to describe their relationship with the coast and the impact of living near the coast on their daily lives.	Participants were asked about the specific emotions they feel at the coast and what effect these emotions have on them.	Extra prompts for the interview were sometimes used to facilitate further discussion, such as asking whether the emotions were accompanied with physical sensations or thoughts.	• Participants indicated the coast as a safe haven in which they can experience emotional restoration, awe and nostalgia. • These emotional states are accompanied with adaptive emotion regulating strategies, such as reflection and positive reappraisal, that may facilitate coping with difficult thoughts and feelings.
24	Stewart & Haaga (2018)	Quantitative method Experimental study (survey)	94 participants *Sample characteristics before exclusion (N = 130)* F (n=72) + M (n=57) + 1 (not disclosed) Age ranges: - 41–65 years = 48%, - 26–40 years = 40%, - 25 or under = 5%, - over 65 = 6% Nationality data were not collected	Participants were randomly assigned to one of two experimental conditions, watching a 15-min video of a nature scene or of an urban scene + The Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004)	The State Mindfulness Scale (SMS; Tanay & Bernstein, 2013) The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003)	The Positive and Negative Affect Schedule (PANAS-State; Watson, Clark, & Tellegen, 1988) The Ryff Scales of Psychological Well-Being (RSWB; Ryff & Keyes, 1995)	• Connectedness to nature was significantly positively correlated with subjective well-being, positive affect, and mindfulness, and significantly inversely related to negative affect. • Participants who were exposed to the nature video showed higher scores on connectedness to nature, positive affect, state mindfulness, and well-being than did those exposed to the urban video. • State mindfulness mediated the relation between exposure to nature with affect and well-being.
25	Swami et al. (2020)	Quantitative method Correlational study Cross-sectional survey	398 participants F (n=199) + M (n=196) + 3 identified as other Age range 18-67 (*M* = 28.05, *SD* = 9.47) UK	Nature Exposure Scale (NES; Kamitsis & Francis, 2013 The Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004).	The 20-item Philadelphia Mindfulness Scale (PMS; Cardaciotto et al., 2008)	Other measures: - The 10-item Body Appreciation Scale (BAS-2; Tylka & Wood-Barcalow, 2015) - Questions about gender identity, age, ethnicity, education, height, and weight.	• Significant indirect effects from nature exposure via connectedness to nature to body appreciation and from nature exposure via mindful awareness to connectedness to nature. • The association between nature exposure and body appreciation was mediated by mindful awareness followed by connectedness to nature.
26	Theodorou et al. (2023)	Quantitative method Experimental study Between-subject design	N = 187 F (n=150) + M (n=35), 2 missing Total mean age = 21.17 Italy	Use of virtual nature (VR) Each participant was randomly assigned to one of the four experimental conditions, one for each type of virtual environment presented: (1) an urban	The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003; italian version: Balzarotti, 2021) was measured at the pre-test	Other measures: - State Subjective vitality scale (Ryan & Frederick, 1997) measured pre- and post-exposure - Sociodemographic variables	• Results showed two significant interactions, respectively between lacustrine and arctic environments and cognitive reappraisal. More specifically, for participants with low levels of habitual use of cognitive reappraisal, the effects of virtual nature (vs. urban) exposure on subjective vitality were not significant,

				environment; (2) a national park; (3) a natural area with a lake; and (4) an arctic environment. Participants were asked to watch four 360° panoramic photos for each environment (4 minutes in total)		- Inclusion of Nature in Self (INS; Schultz, 2002) - Perceived Stress Scale (PSS; Cohen et al., 1983) - Previous VR experience and other aspect related to the VR system and experience of the study	while for participants with high levels, the effects were significant and positive. • All three types of natural environments presented were significantly more effective than the urban environment in increasing levels of subjective vitality. • Cognitive reappraisal alone did not determine changes in subjective vitality. Instead, the interaction of cognitive reappraisal with the type of environment was significantly associated with observed changes in this outcome.
27	Zhang et al. (2022)	Quantitative method Correlational study Cross-sectional survey	977 participants F (n=535) + M (n=442) Age range 21-85 Singapore	Objective urban green space (UGS) 3 questions about residents' subjective evaluation of nearby UGS, defined as green spaces located within five-minute walking distance UGS exposure as the time spent visiting green spaces, in terms of frequency and duration of direct usage of UGS	1-item: "The nearby green spaces help me to relax".	Other measures: - The General Health Questionnaire (GHQ-12; Goldberg, 1972) - The General Self-Rated Health question (GSRH; DeSalvo et al., 2006) - Questions about the time spent for mild, moderate, and strenuous physical activities, following the Godin-Shephard Leisure-Time Physical Activity Questionnaire (Amireault et al., 2015) - 2-items on the functions of nearby UGS in facilitating social interaction - Questions about demographic, socio-economic, and other individual data (e.g., education level, marital and residential status, nature relatedness, number of children, health problems)	• Emotional regulation mediated the association of perceived UGS provision and UGS exposure with mental health. • Emotional regulation was the key mechanism that explains the mental health benefits of UGS (in comparison to mechanisms related to social interaction and physical activity)

2.3.2. *Assessment of nature-related aspects*

Different measurement tools and techniques were used to collect data on nature-related factors. An overview of nature-related aspects and details about measurements is presented in **Table 2.7**. In this regard, a first relevant distinction is that some of the included studies assessed a range of nature-related aspects with specific measurements, whereas others included nature as a form of experimental condition, sometimes compared to other stimuli.

About the first typology of studies (i.e., assessment of nature-related aspects), seven of the articles reviewed adopted self-reported measure about participants' perception of affiliation with nature. In this regard, four instruments were utilized for this purpose: five studies (Bakir-Demir et al., 2021; Bakir-Demir et al., 2019; Fido et al., 2020; Ma et al., 2023; Sahni & Kumar, 2021) utilized the Nature Relatedness scale (NR; Nisbet et al., 2009); three studies (Bakir-Demir, Berument and Sahin-Acar, 2019; Richardson & McEwan, 2018 – both studies) adopted the Inclusion of Nature in Self scale (INS; Schultz, 2002); three studies (Huynh & Torquati, 2019; Stewart & Haaga, 2018; Zhang et al., 2022) the Connectedness to Nature scale (CN; Mayer & Frantz, 2004); and one study (Bakir-Demir, Berument and Sahin-Acar, 2019) used the Connection to Nature Index (CNI; Cheng and Monroe, 2012). To note, Bakir-Demir et al. (2019) employed three of the aforementioned scales to measure this variable. Other studies focused on measuring surrounding nature, mostly in terms of quantity of nature nearby participants' residential area. To do that, some of them (n = 5) relied on a range of objective measures of nature nearby participants' residential area: using the Normalized Differential Vegetation Index (NDVI; Bakir-Demir, Berument and Sahin-Acar, 2019; Liang et al., 2024); through publicly accessible governmental databases (Dimitrov-Discher et al., 2022; Mueller & Flouri, 2020), and data from a research organisation (Mygind et al., 2022). Instead, other studies (n=3) adopted self-reported methodologies, were participants provided their perception and evaluation and of the quantity of nature in their neighbourhood, obtaining a subjective scoring

(Bakir-Demir et al., 2019; Sahni & Kumar, 2021; Zhang et al., 2022). Two of these studies combined both objective and subjective methodologies to assess this aspect (Bakir-Demir et al., 2019; Zhang et al., 2022). Additionally, three studies assessed participants' frequency of exposure to natural spaces in their everyday life (Swami et al., 2020), and in terms of nature visits (Sahni & Kumar, 2021; Zhang et al., 2022).

Concerning the second type of studies (i.e., those including nature as experimental condition), many of them (*n* = 19) were based on the investigation of the effects of direct contact with nature. Specifically, four studies used immersive nature, comparing the effect derived from walking in nature (e.g., garden, park), in contrast with walking in an urban street (Bratman et al., 2015[a]: Bratman et al., 2015[b]: Lopes, Lima and Silva, 2020; Ma et al., 2023); whereas eleven studies adopted virtual nature, using images or videos of natural environments or elements (Beute & de Kort, 2018; Golding, Gatersleben and Cropley, 2018; Johnsen & Rydstedt, 2013 – both studies; Mochizuki-Kawai, Matsuda & Mochizuki, 2020 – all studies; Stewart & Haaga, 2018), as well as virtual reality (VR) tools (Browning et al., 2023; Theodorou et al., 2023). Another reviewed study involved participants completing a survey after visiting a natural space (Johnsen, 2013); and lastly, one study implemented a 30-day intervention, where participants were asked to engage with nature in their everyday life (Richardson & McEwan, 2018; Main study).

Finally, four studies had not used specific measurement methods or experimental conditions about nature (Johnsen, 2013; Korpela et al., 2018; Korpela & Hartig, 1996; Severin et al., 2022). However, they were still included as they utilized indirect forms of assessment, such as including questions about emotion regulation specifically in nature (refer to **Table 2.7**). Also, it should be noted that several studies adopted a combination of multiple strategies, across the ones described above, to assess nature-related aspects (refer to **Table 2.6**). Moreover, all studies were based on the assessment or experimental conditions that mostly involved green spaces (or nature in general), whereas one study considered green and blue spaces exposure (Liang et al., 2024) and only one study specifically focused on blue spaces (Severin et al., 2022).

Table 2.7. *Overview of nature-related aspects assessment adopted by studies included in Review 1*

Type of assessment	Study	Details
<u>Measurements</u>		
Connection with nature		
• Nature Relatedness scale (NR; Nisbet et al., 2009)	Bakir-Demir et al. (2021) Bakir-Demir et al. (2019) Sahni & Kumar (2021) Fido et al. (2020) Ma et al. (2023)	Assessment of the affective, cognitive, and experiential aspects of individuals' connection to nature
• The Connectedness to Nature scale (CN, Mayer & Frantz, 2004)	Huynh & Torquati (2019) Zhang et al. (2022) Stewart & Haaga (2018)	Measurement of a sense of inclusion or closeness with nature on both an emotional and cognitive level
• Connection to Nature Index (CNI; Cheng and Monroe, 2012)	Bakir-Demir et al. (2019)	Measure children's affective attitude toward the natural environment (16 items)
• Inclusion of Nature in Self scale (INS; Schultz, 2002)	Bakir-Demir et al. (2019) Richardson & McEwan (2018, both studies)	Self-report instrument that includes a single-item graphical measure to assess connectedness with nature and cognitive beliefs about nature
Surrounding nature		
Objective measures		
• Land-use data extracted from the Urban and Environment Information System	Dimitrov-Discher et al. (2022)	Information on the amount of urban green space calculated as a total sum and as a percentage of public GS with a minimum size of 0.5 ha, including urban parks, urban forests, allotment gardens, and cemeteries, in different buffer areas around street addresses.
• the Multiple Environmental Deprivation Index (MEDIx)	Mueller & Flouri (2020)	Combined data from the Coordination of Information on the Environment (CORINE; EEA, 2000) and the 2001 Generalised Land Use Database (GLUD; Office of the Deputy Prime Minister, 2001).
• Vegetation cover mapped across the Perth Metropolitan Region (Caccetta et al., 2012).	Mygind et al. (2022)	Vegetation cover within four key behaviour settings: (1) the home yard; (2) the home neighbourhood; (3) ECEC outdoor areas; (4) the ECEC neighbourhood Data were captured in February 2016. High resolution, stereo, four-band (red, blue, green, infra-red) aerial imagery was captured, measuring vegetation and vegetation structure throughout the study area.

• Normalized Differential Vegetation Index (NDVI)	Bakir-Demir et al. (2019)	Density of vegetation in a neighbourhood of children was obtained by using NASA's NDVI method (Weier & Herring, 2000). NDVI is based on the calculation of the Near Infra-Red band and visible wavelength band. The amount of vegetation is measured by comparing the level of infrared with visible light. The NDVI value in buffers of 100 m around the children's home addresses.
• Spatial datasets (not specified) to obtain objective urban green space measure	Zhang et al. (2022)	Measure of vegetation cover, canopy cover, park area as proportion of green spaces within a given spatial scale around respondents' residence (within a 400 m circular buffer, a 400–800 m nested buffer, and an 800–1600 m nested buffer)
	Liang et al. (2024)	Percentage of green and blue spaces within a circular buffer (500m and 800m) based on participants' school and residence addresses
Subjective perceptions of nearby nature		
• Presence of nature in the neighbourhood areas both childhood and current	Sahni & Kumar (2021)	The construct of "nature in the neighbourhood" was rated through a single item, each for the current neighbourhood and childhood neighbourhood.
• Perceptions of greenery in the neighbourhood	Bakir-Demir et al. (2019)	1 item: mothers' and children's perceptions of the levels of greenery around their homes
• Subjective evaluation of nearby urban green spaces	Zhang et al. (2022)	Three questions were used to measure residents' subjective evaluation of nearby urban green space, defined as green spaces located within five-minute walking distance (equivalent to 400 m-radius circular buffer).
Frequency of nature exposure		
• Nature Exposure scale (NE; Kamitsis & Francis, 2013)	Swami et al. (2020)	Individual's level of exposure to nature in everyday life and activities, and levels of exposure to nature outside of everyday environments
• Frequency of visit	Sahni & Kumar (2021)	Participants were also asked to report the frequency of visit to nature areas
• Urban green space exposure	Zhang et al. (2022)	Measured as the product of frequency and duration of direct usage of UGS
Experimental conditions		
• Walk in nature (park, garden) vs urban walk	Bratman et al. (2015)[a]: 50-min walk Bratman et al. (2015)[b]: 90-min walk Lopes, Lima & Silva (2020): 30-min walk Ma et al. (2023): 35-min walk for a week	
• Use of nature images	Beute & de Kort (2018)	
	Golding, Gatersleben & Cropley (2018)	

	Johnsen & Rydstedt (2013, both studies)	Study 1: Participants actively used a picture of nature as environmental stimuli for emotion regulation in their everyday life, while two control groups looked at a picture of nature (without any instruction) or a picture of balloons Study 2: Participants viewed 6 pictures of different environments (urban environments with/without people, "unsafe or scary" natural environments, living rooms, shopping malls, and classical natural environments) and indicated their immediate reactions to them
	Mochizuki-Kawai, Matsuda & Mochizuki (2020; all the four studies)	Viewing of a typical flower image
• Use of nature video	Stewart & Haaga (2018)	Participants were randomly assigned to one of the video experimental conditions: - In the nature condition, the video showed the perspective of someone taking a walk along a creek in a national forest. The video shows pine trees, a dirt path and covered ground, and a running adjacent creek, accompanied by natural sounds - In the urban condition, the view was of a walk through the downtown area of a major US city. The scenery was prototypically urban, with streets and buildings, cars and traffic, and distinct city sounds
• Virtual nature scenarios (VR)	Browning et al. (2023)	Intervention with participants viewing 4-minutes videos that include forests, beaches, desert, lakes, grasslands or alpine areas each day (except on Sundays) for 3/4 weeks
	Theodorou et al. (2023)	Random assignment to one of the 4 conditions: urban, park, lake, arctic environment (4-minutes)
• After visiting a natural space	Johnsen (2013)	Sample consisted of visitors to two wilderness and natural areas in Norway
• Intervention to engage people with nature	Richardson & McEwan (2018; Main study)	Participants were asked to interact with nature every day for one month
<u>Not direct measurement of nature</u>		
	Johnsen (2013) Korpela et al. (2018)	Items used to measure emotion regulation were specifically focused on the regulation of emotion in nature
	Korpela & Hartig (1996)	Participants listed their favorite spaces to self-regulate: Many of the favorite places identified by participants were natural environments
	Severin et al. (2022)	Participants were asked to describe their relationship with the coast and the impact of living near the coast on their daily lives.

2.3.3. Emotion regulation assessment

Different types of measurements concerning emotion regulation strategies have been adopted by the reviewed studies. As for the nature-related aspects assessment, some studies also included multiple types of measures to explore emotion regulation.

Some of the studies focused on the general assessment of emotion regulation, by using validated scales concerning emotion regulation (n=8), as well as physiological measurements (n=6) and ad-hoc items (n=6). Moreover, some studies also assessed emotional states (n=6) and restoration (n=3). An overview of these instruments is presented in **Table 2.8**.

Regarding the first modality of emotion regulation assessment (i.e., validated measures of emotion regulation), different scales were used: The Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001) by Bakir-Demir, Berument and Akkaya (2021); a modified version of the Measure of Affect Regulation Styles (MARS; Larsen and Prizmic, 2004) by Korpela and colleagues (2018); Strengths and Difficulties Questionnaire (SDQ; Goodman & Goodman, 2009) by Mygind and colleagues (2022) and Liang et al. (2024); the Difficulties in Emotion Regulation Scale (DERS; Bjureberg et al., 2016) by Richardson and McEwan (2018). Other two studies that included child samples, used specific measurements validated for this kind of population: one study (Bakir-Demir, Berument & Sahin-Acar, 2019) adopted both the child version of the Cognitive Emotion Regulation Questionnaire (CERQ-k; Garnefski et al., 2007) and the Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA; Gullone & Taffe, 2012), whereas another study (Mueller & Flouri, 2020) utilized the Child Social Behaviour Questionnaire (CSBQ; Luteijn et al., 1998).

A second type of assessment concerns the implementation of physiological measurements associated to emotion regulation's aspects. Different methods have been adopted: neuroimaging method through arterial spin labelling (Bratman et al., 2015[b]); functional magnetic resonance imaging (Dimitrov-Discher et al., 2022; Mochizuki-Kawai, Matsuda & Mochizuki, 2020 – Study 3); systolic and diastolic blood pressure (Mochizuki-Kawai, Matsuda & Mochizuki, 2020 – Study 1a and Study 1b); salivary cortisol levels (Mochizuki-Kawai, Matsuda & Mochizuki, 2020 – Study 2).

Lastly, six of the investigated studies utilized a third modality of emotion regulation assessment, proposing a range of ad-hoc items (Johnsen, 2013; Johnsen & Rydstedt, 2013 – Study 2; Korpela et al., 2018; Korpela & Hartig, 1996; Severin et al., 2022; Zhang et al., 2022). These novel items were more specifically focused on emotion regulation strategies in nature or as a consequence of nature contact, except for the items used by Korpela & Hartig (1996), that also included questions about emotion regulation in urban environments (see **Table 2.8** for the full list of items).

An additional approach consisted in the investigation of participants' emotional or restorative states as a consequence of nature exposure, together with other assessments of emotion regulation. About the emotional states assessments, the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988) has been used by three studies (Golding, Gatersleben & Cropley, 2018; Johnsen & Rydstedt, 2013 – Study 1; Stewart & Haaga, 2018). Furthermore, the Positive States of Mind Scale (PSOMS; Horowitz, Adler & Kegeles, 1988) has been adopted in the study by Huynh & Torquati (2019), whereas Korpela & Hartig (1996) used the Zuckerman Inventory of Personal Reactions and Feelings (ZIPERS; Zuckerman, 1977). Concerning the assessment of restoration, the Ego Restoration Scale (Johnsen, 2012) was adopted by two studies (Johnsen & Rydstedt, 2013; Johnsen, 2013), and the Restoration Outcome Scale (ROS; Korpela et al., 2008) was used in one study (Johnsen, 2013). It should be noted that studies that adopted just this type of measurement for the investigation of emotion regulation have not been included in the present review, since they are not specifically focused on emotion regulation strategies.

Table 2.8. *Measurements used for the general assessment of emotion regulation adopted by studies included in Review 1*

Type of measure	Study	Details
Validated scales		
• The Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001)	Bakir-Demir, Berument & Akkaya (2021)	36-item scale to evaluate individuals' cognitive emotion regulation strategies after experiencing negative situations or events, investigating both adaptive (refocus on planning, positive reappraisal, putting into perspective, and positive refocus) and non-adaptive strategies (rumination, self-blame, blaming others, and catastrophizing). The Turkish language version of the CERQ was used in this study (Tuna & Bozo, 2012).
• The child version of the Cognitive Emotion Regulation Questionnaire (CERQ-k; (Garnefski et al., 2007)	Bakir-Demir, Berument & Sahin-Acar (2019)	Measure of the emotional regulation skills of children by using their thoughts and cognition. The CERQ-k is composed of nine subscales, each of which includes four items. In this study, only 3 subscales about adaptive regulation strategies were included: -positive refocusing (e.g., *"When bad things happen, I think of nicer things"*) -positive reappraisal (e.g., *"When bad things happen, I think that I can learn from it"*) -planning (e.g., *"When bad things happen, I think of how I can cope with it"*). Children were asked to respond to the statements by considering a negative event.
• Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA; Gullone & Taffe, 2012)	Bakir-Demir, Berument & Sahin-Acar (2019)	The 10-item scale includes cognitive reappraisal and expressive suppression subdomains; only the latter subdomain was used in this study (e.g., *"I control my feelings by not showing them"*)
• A modified version of the Measure of Affect Regulation Styles (MARS; Larsen and Prizmic, 2004)	Korpela et al. (2018)	Used version consists of 32 items that can be conceptually divided into 13 strategies for general affect regulation + 4 additional items representing environmental strategies (ad-hoc items)
• Child Social Behaviour Questionnaire (CSBQ; Luteijn et al., 1998)	Mueller & Flouri (2020)	based on the Adaptive Social Behavior Inventory (Hogan, Scott, & Bauer, 1992) The number of items used in the study was restricted to five for each scale and were completed by the parents: - independence (e.g., *"likes to work things out for self'"*) - emotional dysregulation (e.g., *"shows mood swings"*)

• Strengths and Difficulties Questionnaire (SDQ; Goodman & Goodman, 2009)	Mygind et al. (2022) Liang et al. (2024)	20-item parent-response scale to measure socioemotional difficulty behaviours across four scales (i.e., emotional, conduct, hyperactivity and inattention, and peer problems) and one prosocial strengths scale.
• the Difficulties in Emotion Regulation Scale (DERS; Bjureberg et al., 2016)	Richardson & McEwan (2018)	16-item scale to assess individuals' typical levels of difficulties in emotion regulation
Physiological measures		
• Neuroimaging method (arterial spin labelling)	Bratman et al. (2015)[b]	Measurement of brain activity in the subgenual prefrontalcortex (SgPFC; area active during the type of maladaptive, self-reflective thought and behavioral withdrawal of rumination)
• Functional magnetic resonance imaging (fMRI)	Dimitrov-Discher et al. (2022)	Measurements of activity in brain regions relevant for regulating emotions during a stressful task
	Mochizuki-Kawai, Matsuda & Mochizuki (2020; Study 3)	To examine brain-activation patterns relevant to emotion regulation viewing a flower image (vs. other stimuli)
• Systolic and diastolic blood pressures monitored from the left middle finger (Finometer PRO)	Mochizuki-Kawai, Matsuda & Mochizuki (2020; Study 1a and Study 1b)	To examine changes in blood pressure associated with viewing a typical flower image (vs. other stimuli) elevated blood pressure is a sign of stress-induced elevation, in response to an acute visual stressor (negative images)
• Salivary cortisol levels (enzyme-linked immunosorbent assay)	Mochizuki-Kawai, Matsuda & Mochizuki (2020; Study 2)	To examine changes in salivary cortisol levels after viewing a typical flower image (vs. other stimuli)
Ad-hoc items		
• Emotion regulation in nature	Johnsen (2013)	11 items measuring 3 factors: - situation selection (positive emotion): *"I go out into nature to experience positive feelings/joy"* - situation modification (negative emotion): *"I often go out in nature when sad/angry"* - push-motivation (rising negative emotion when not in nature): *"When I have been away from nature for some time, I feel sad/ become irritable/feel angry"* + Appraisal of nature: *"Whenever I am outdoors in nature I feel happy"*, *"Outdoor life makes me happy"*.
• Intention to seek out nature	Johnsen & Rydstedt (2013; Study 2)	2 items: *"I would seek this environment if I was sad"* *"I would seek this environment if I was happy"*

• Emotional potential of an environment	Johnsen & Rydstedt (2013; Study 2)	4 items measuring the perception of the emotion regulatory potential of different environments: *"Being in these surroundings would make me happier"* *"Being in these surroundings would make me less happy"* *"Being in these surroundings would make me sadder"* *"Being in these surroundings would make me less sad"*
• Environmental strategies	Korpela et al. (2018)	4 items included in a validated scale representing environmental strategies 2 items related to regulation in natural environments + 2 items refer to regulation in urban environments: *"I went to my favorite place in nature"* *"I went for a walk in the forest, in a park, on the beach or some other natural setting"* *"I went to my favorite place in an urban setting"* *"I took a walk downtown"*
• Favorite places for self-regulation	Korpela & Hartig (1996)	Participants were asked to list their favorite spaces they would choose to self-regulate their emotions
• Emotions at the coast (interview)	Severin et al. (2022)	Participants were asked about the specific emotions they feel at the coast and what effect these emotions have on them. Extra prompts were sometimes used to facilitate further discussion, such as asking whether the emotions are accompanied with physical sensations or thoughts.
• Emotion regulation through nearby nature	Zhang et al. (2022)	1-item: *"The nearby green spaces help me to relax"*
Emotional states		
• Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988)	Golding et al. (2018) Johnsen & Rydstedt (2013; Study 1) Stewart & Haaga (2018)	20-item scale, with 10 items measuring positive affect (e.g., excited, inspired) and 10 items measuring negative affect (e.g., upset, afraid)
• The Positive States of Mind Scale (PSOMS; Horowitz, Adler & Kegeles, 1988)	Huynh & Torquati (2019)	6-item scale to measure positive thoughts and feelings regarding events occurring over the past week
• The Zuckerman Inventory of Personal Reactions and Feelings (ZIPERS; Zuckerman, 1977)	Korpela & Hartig (1996)	12-item scale to assess how participants would feel if they were in the setting, they indicated how their favorite space to self-regulate, imagining they were there (e.g., fear, arousal, sadness, anger, happiness)

• Ecological Momentary Assessment of mood: Energy and tension items derived from the Activation-Deactivation adjective checklist (Thayer, 1989) + Hedonic tone items derived from the Uwist Mood Adjective Checklist (Matthews, Jones, & Chamberlain, 1990)	Beute & de Kort (2018)	Energy was measured with the items: "tired", "energetic", "wide awake", and "lack of energy". Tension was measured with the items: "tense", "jittery", "calm", and "at rest". Hedonic tone was measured with the items: "happy", "cheerful", "sad", and "blue".
Restoration		
• Ego Restoration Scale (Johnsen, 2012)	Johnsen & Rydstedt (2013) Johnsen (2013)	3-item scale, to investigate possible effects of the nature exposure on cognitive functions, in terms of changes in the strength aspect of self-regulation (i.e., perceived willpower) Headline: "After visiting this natural area, how do you feel?" - *"I have gained more self-control"* - *"I have gained more willpower"* - *"I feel more able to resist temptations if I want to"* Items were rated on a 7-point scale, from "not at all" to "a very high degree".
• Restoration Outcome Scale (ROS; Korpela et al., 2008)	Johnsen (2013)	6-item scale, adapted to measure restorative outcomes participants experienced after visiting the natural areas chosen for the study, in terms of "relaxation," "attention restoration," and "clearing one's thoughts". The participants indicated their restorative experiences on a 7-point scale, from "not at all" to "a very high degree."

A different approach used by the reviewed studies is focusing on the investigation of specific strategies of emotion regulation, specifically: rumination, worry, mindful state, cognitive reappraisal and expressive suppression. Rumination, worry and mindfulness refer to the category of attentional deployment described in the process model of emotion regulation, while cognitive reappraisal refers to the cognitive change category and expressive suppression to the response modulation one. A summary of these measurements is presented in **Table 2.9**.

Rumination refers to a maladaptive emotion regulation strategy that involves thinking passively and repetitively about negative emotions (Nolen-Hoeksema, 1991). Six of the included studies have explored this form of emotion regulation through several instruments. Three studies (Bratman et al., 2015a; Bratman et al., 2015b; Browning et al., 2023) adopted the Rumination-Reflection Questionnaire (RRQ; Trapnell & Campbell, 1999); whereas another study (Golding, Gatersleben & Cropley, 2018) used two different measurements, one concerning state rumination, the adapted Thoughts Questionnaire (Edwards, Rapee & Franklin, 2003), and one related to trait rumination, the Ruminative Responses Scale (RRS; Treynor et al. 2003). Similarly, another one of the reviewed studies (Lopes, Lima & Silva, 2020) also included two different measurements of rumination: one about trait rumination, the Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011); and one about state rumination, the Brief State Rumination Inventory (BRSI; Marchetti, Mor, Chiorri, & Koster, 2018). Moreover, another study investigated rumination and worry in daily life through an Ecological Momentary Assessment, using two ad-hoc items (Beute & de Kort, 2018).

Worry is considered a form of repetitive negative thinking about future events during which individuals feel as if they are anticipating and preparing for future threats (Borkovec, Alcaine, & Behar, 2004). A further study (Browning et al., 2023) investigated the maladaptive strategy of worry, through the validated scale of The Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990).

Another specific emotion regulation strategy investigated by the reviewed studies is mindfulness. Mindfulness, defined as a top–down strategy facilitating positive cognitive reappraisal, is characterized by "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" (Kabat-Zinn, 1994, p. 4). Five studies focalized on this particular strategy, and assessed it using different scales: the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) was utilized by Huynh and Torquati (2019), Ma et al. (2023), Sahni and Kumar (2021) and Stewart and Haaga (2018); the Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008) was adopted by Huynh and Torquati (2019) and Swami and colleagues (2020); the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013) was used by Stewart and Haaga (2018); and The Toronto Mindfulness Scale (TMS; Lau et al., 2006) was adopted in the study by Ma et al. (2023).

Finally, a further study by Fido and colleagues (2020) considered both cognitive reappraisal and expressive suppression, as specific strategy of emotion regulation. Cognitive reappraisal refers to the process of reframing or reinterpreting a situation to alter one's emotional response to it. It involves consciously changing the way one thinks about a situation to regulate or modify the associated emotional experience (Brummer et al., 2014). Expressive suppression, on the other hand, involves inhibiting or suppressing the outward expression of one's emotions. It entails consciously controlling or restraining the display of emotions, often in social contexts where expressing emotions may be deemed inappropriate or undesirable (Gross, 2002). These strategies were both measured with the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). A further study used this measure but considering only the strategy of cognitive reappraisal (Theodorou et al., 2023).

It is worth mentioning that other studies (i.e., Bakir-Demir, Berument & Akkaya, 2021; Bakir-Demir, Berument & Sahin-Acar, 2019) have utilized instruments to explore specific emotion regulation strategies. However, these works did not focus on examining individual strategies separately. Instead, they treated these strategies as a general category of adaptive or maladaptive emotion regulation, without providing specific insights into the role of each strategy.

To note, another distinction concerning the emotion regulation assessment refers to the conceptualization of emotion regulation as either trait or state. Indeed, some of the included studies (*n* = 18) focused on emotion regulation intended as a dispositional tendency to use certain strategies. Conversely, the remaining reviewed studies (*n* = 14: all the experimental studies – except for Richardson & McEwan, 2018, Theodorou et al., 2023, and the studies by Dimitrov-Discher et al., 2022) investigated the strategies adopted in a particular context, exploring emotion regulation as a momentary state.

The study by Severin et al. (2022) is more difficult to conceptualize into this frame, since they did not measure emotion regulation as a trait, but a momentary assessment of emotion regulation was not adopted neither. In that case, participants were asked about the emotions they feel at the coast, and they recalled the emotion regulation strategies adopted in that particular context. In this sense, it would be possible to infer that this can be a sort of assessment of emotion regulation intended as a state.

Table 2.9. *Measurements of the specific emotion regulation strategies adopted by studies included in Review 1*

Type of measure	Study	Details
Rumination		
• EMA of rumination	Beute & de Kort (2018)	1 ad-hoc item (four observations per day for 6 days): *"At this moment, I ruminate"*
• The Rumination-Reflection Questionnaire (RRQ; Trapnell & Campbell, 1999)	Bratman et al. (2015) [a] Bratman et al. (2015) [b] Browning et al. (2023)	Assessment of ruminative tendencies before and after the walk The RRQ is divided into two scales (rumination and reflection). Only the rumination scale was used, consisting of 12 items (e.g., *"I often reflect on episodes of my life that I should no longer concern myself with"*)
• The adapted Thoughts Questionnaire (Edwards, Rapee & Franklin, 2003)	Golding, Gatersleben & Cropley (2018)	Assessment of State Rumination to capture ruminations about the presentation task that was used to induce rumination and influence mood before viewing nature images. 24-item with 3 factors: - positive rumination statements (e.g., *'how well I handled it'*) - negative rumination statements (e.g., *'I made a fool of myself'*) - neutral statements
• Ruminative Responses Scale (RRS; Treynor et al. 2003)	Golding, Gatersleben & Cropley (2018)	22-item measuring Trait Rumination in terms of depression, reflective pondering and brooding. Participants rated their tendency to think/behave in a certain way when they felt depressed.
• Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011)	Lopes, Lima & Silva (2020)	15-item self-report scale that measures repetitive negative thinking, comprising three items for each of the assumed process characteristics of repetitive negative thinking: - repetitive (e.g., *'The same thoughts keep going through my mind again and again'*) - intrusive (e.g., *'Thoughts come to my mind without me wanting them to'*) - difficult to disengage from (e.g., *'I can't stop dwelling on them'*) - unproductive (e.g., *'I keep asking myself questions without finding an answer'*) - capturing mental capacity (e.g., *'My thoughts prevent me from focusing on other things')*
• the Brief State Rumination Inventory (BRSI; Marchetti et al, 2018)	Lopes, Lima & Silva (2020)	8-items to capture maladaptive state rumination. The scale was used to measure changes in state rumination pre- and post-walking

Mindfulness state		
• The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003)	Huynh & Torquati (2019) Sahni & Kumar (2021) Stewart & Haaga (2018) Ma et al., 2023	15 items used to measure attention – informed by a sensitive awareness of what is occurring in the present to assess the extent to which an individual is aware of and attends to current experiences (e.g., *"I could be experiencing some emotion and not be conscious of it until sometime later"*)
• Philadelphia Mindfulness Scale (PHLMS; Cardaciotto et al., 2008)	Huynh & Torquati (2019) Swami et al. (2020)	20-item instrument with two 10-item subscales assessing awareness (e.g., *"I am aware of what thoughts are passing through my mind"*) and acceptance (e.g., *"I try to distract myself when I feel unpleasant emotions"*)
• State Mindfulness Scale (SMS; Tanay & Bernstein, 2013)	Stewart & Haaga (2018)	21-item used to measure state attention and awareness of the present experience, referencing a specific very recent experience (e.g., "*I actively explored my experience in the moment*", "*I noticed pleasant and unpleasant thoughts*", "*It was interesting to see the patterns of my thinking*")
• The Toronto Mindfulness Scale (TMS; Lau et al., 2006	Ma et al. (2023)	13-item self-report measure with a 5-point response scale ranging from 0 (not at all) to 4 (very much). It assesses state and scores load into the curiosity (6 items, e.g., "*I was curious about what I might learn about myself by taking notice of how I react to certain thoughts, feelings or sensations*") and decentring (7 items, e.g., "*I experienced myself as separate from my changing thoughts and feelings*") factors.
Cognitive reappraisal and expressive suppression		
• Emotion Regulation Questionnaire (ERQ; Gross & John, 2003)	Fido et al. (2020) Theodorou et al. (2023)	The ERQ is formed of two dimensions that assess the general use of reappraisal (6 items; e.g., "*I control my emotions by changing the way I think about the situation I'm in*") and suppression regulation strategies (4 items; e.g., "*I control my emotions by not expressing them*"). Higher scores indicate greater emotion regulation strategy use.
Worry		
• EMA of worry	Beute & de Kort (2018)	1 ad-hoc item (four observations per day for 6 days): - *"At this moment, I am worrying"*
• Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990)	Browning et al. (2023)	The PSWQ measure anxious apprehension (i.e., worry) through 16 items about tendencies to worry, inability to control these tendencies, and resulting negative impacts on a 6-point scale (1 = not at all typical of me, 6 = very typical of me). (e.g., my *worries overwhelm me, many situations make me worry*)

2.3.4. Summary of the evidence

A summary of the main findings is provided in **Table 2.10**. Findings of the investigated studies are presented below in different sections, according to the type of assessment of emotion regulation strategies.

General emotion regulation. Overall, results of the reviewed studies indicate that nature exposure may have some beneficial effects on emotion regulation processes in general.

First, people seem to spontaneously report natural spaces as their favourite places for self-regulation (Korpela & Hartig, 1996). When subjects identified these places, they most often referred to places with greenery, water, and scenic quality and were associated with high levels of being away, fascination, coherence, and compatibility (i.e., the well-known four psychological features of restorativeness, Kaplan, 1995), as well as the experience of higher positive affect, lower anger, aggression, fear and arousal. Also, results from a correlation study with participants after natural areas visits, indicate that self-reported positive and negative emotion regulation (considered as situation selection and situation modification, respectively) in nature is positively associated with the restorative outcomes (i.e., ROS and ego restoration) of nature exposure (Johnsen, 2013). The study also employed a structural model, revealing that emotion regulation predicts restorative outcomes (ROS), within a broader conceptual framework where personality traits and nature appraisal (e.g., "Outdoor life makes me happy") serve as the primary and secondary predictors in the model.

Similarly, the qualitative study by Severin and colleagues (2022) showed that individuals spontaneously reported several adaptive emotion regulating strategies in relation to the coastal environments. Specifically, a first emotion regulating strategy depicted from the interview referred to reflecting on life, problems, and emotions while being at the coast. A second category involved meaning-making processes such as acceptance of difficult situations or events, and positive reappraisal by putting things in perspective. A third emotion regulating strategy referred to participants being able to let go or exteriorize emotions while being at the coast. Participants described being able to get a breath of fresh air, clear their mind, and let go of certain thoughts and emotions. This coincided with a deeper awareness of the present moment, and of feeling more connected to one's surroundings. Other participants expressed using the coast for emotional exteriorization that ultimately enables them to calm down and have enough energy to move forward. This can be viewed as the opposite of suppression of emotional expression.

Additional insights into the type of spaces that seems to be more suitable for people's emotion regulation processes can be obtained from the results of Johnsen and Rydstedt's work (2013; Study 2), which investigated a novel expectancy construct of emotional potential of an environment. Emotional potential refers to the perception of the emotion regulatory potential of different environments, in terms of the extent one expects emotional effects from being exposed to a certain environment. According to this concept, an environment with the emotional potential to increase positive and reduce negative emotions could be actively used for this very purpose. The study proved that the "classical" natural environment (i.e., showing greenery with trees, a lake, and a clear sky with some light clouds) received the highest rate on emotional potential of all the environments tested (urban places and "unsafe" natural spaces showing a dark forest). Furthermore, perceiving a higher emotional potential in nature was related to a higher intention to seek out nature when happy or sad.

Emotion regulation has been identified as a key mechanism that largely accounts for the association between exposure to urban green spaces and subsequent mental health benefits, surpassing other mechanisms linked to social interaction and physical activity (Zhang et al., 2022). In line with this, Korpela and colleagues (2018) found that the frequency of use of environmental strategies and their perceived effectiveness were positively linked to the perception of health and satisfaction in regulating sadness. However, it should be noted that items related to environmental strategies encompassed both natural and urban spaces.

Experimental research has further validated the positive effects of using nature as an emotion regulation strategy. For example, a study by Johnsen and Rydstedt (Study 1) revealed an increase in positive mood among participants who actively employed a picture of nature in their daily lives to regulate negative emotions or engage in reflection. However, this effect was complex, with an initial increase after the first week of the experiment and then a decrease that was still above the baseline level. Also, no effects of the manipulation were found on negative mood.

Furthermore, another included paper that conducted experimental studies on the effects of nature images focused on physiological parameters linked to emotion regulation. Specifically, it was examined the brain-activation patterns associated with the automatic emotion regulation induced by viewing the flower image. The study by Mochizuki-Kawai, Matsuda, and Mochizuki (2020) demonstrated that viewing an image of a typically shaped flower (i.e., a single daisy-type white chrysanthemum) not only promotes psychological restoration, but also facilitates physiological recovery after stress. These effects are evidenced by decreased blood pressure, reduced salivary cortisol levels, and diminished activation of the right amygdala-hippocampus, accompanied by a reduction in negative affect (Mochizuki-Kawai, Matsuda and Mochizuki, 2020).

Interesting results have also been obtained by studies that focused on nature connectedness, instead of considering the direct exposure to nature and natural elements. For instance, results of the study by Bakir-Demir, Berument and Akkaya (2021) showed a significant indirect effect from nature connectedness to perceived stress through emotion regulation strategies, so that the higher the level of nature connectedness, the lower the level of perceived stress, through the use of adaptive cognitive emotion regulation strategies, such as positive reappraisal and putting into perspective. The mediated link was not significant for non-adaptive emotion regulation strategies, such as rumination and catastrophizing. Instead, results of another study (Richardson and McEwan, 2018) demonstrated that emotion dysregulation, such as impulse control difficulties and a lack of emotional awareness, mediated the relationship between nature connectedness and happiness, showing that those who were less connected with nature experienced greater difficulty in emotion regulation (specifically, more emotion dysregulation), and consequently less perceived happiness.

Another study investigating the relationship between greenery around children's homes and their emotional regulation skills (Bakir-Demir, Berument and Sahin-Acar, 2019), found that greenery did not directly predict the children's emotional regulation. However, the association between greenery and emotional regulation was significantly mediated by nature connectedness. A further study with a children sample (Mygind et al., 2022) found that emotional difficulties were inversely associated with vegetation cover in child's home and neighbourhood (that is, the more the residential vegetation cover, the less a child's emotional difficulty). Further, the study by Liang et al. (2023) showed that children with higher level of exposure to green and blue spaces around their homes and schools had less emotional difficulties and symptoms compared to those with a lower level of exposure. Conversely, another research that used longitudinal cohort data of children's neighbourhood greenery and self-regulation, did not found any association between these factors (Mueller and Flouri, 2019). A further study confirmed the association between people's neighbourhood greenery and emotion regulation, using functional magnetic resonance imaging data (Dimitrov-Discher et al., 2022). Specifically, it was found a greater activation of brain regions involved in emotion regulation processes in participants with higher availability of green spaces after a stressful task (i.e., by carrying out figure rotations and mathematical subtraction tasks while being observed by a two-person panel who provided verbal negative feedback and time pressure).

Specific emotion regulation strategies. Some of the reviewed papers examined the effects of nature-related aspects on two particular strategies of emotion regulation: rumination, mindfulness, cognitive reappraisal and expressive suppression.

A first strategy category that has been investigated by these studies concerns rumination. In this regard, nature has been shown to have a relevant role in decreasing levels of ruminative thoughts, considered as a maladaptive forms of emotion regulation. In particular, some studies demonstrated that walking in a natural setting led to a reduction in self-reported rumination (Bratman et al., 2015[a]; Bratman et al., 2015[b]; Lopes, Lima & Silva, 2020) as well as in neural activity in the subgenual prefrontal cortex (Bratman et al., 2015[b]).

Similarly, the study by Beute and de Kort (2018) showed that the exposure to nature images, once in the morning and once in the afternoon, offered a sort of micro-restorative experience to participants, that lowered rumination and worry throughout the day for subjects with high levels of depression, anxiety or stress. A further study by Browning et al. (2023) investigated these strategies, showing that participants that viewed virtual nature scenarios through VR for 3/4 weeks showed a significant decrease in tendency of worrying post-intervention, whereas the level remained constant for participants in the control condition (i.e., no intervention). However, no changes were observed concerning rumination level. Similarly, the research conducted by Golding, Gatersleben and Cropley (2018) did not find a reduction of rumination after nature exposure, but in their study state rumination decreased over time in all the three conditions they used (nature images *versus* urban images *versus* no images), regardless of the type of environments.

Furthermore, in their study, Lopes, Lima, and Silva (2020) proposed a mediation model suggesting that contact with nature influences rumination through a causal path involving two mediators, awe and mood. Contrary to the idea of emotion regulation as a potential underlying mechanism linking nature and emotional effects, this model revealed a significant serial effect where the more awe participants experienced while walking in nature, the higher the reduction in negative affect, subsequently leading to a decrease in ruminative thinking. In this case, exposure to nature did not show direct effects on rumination; instead, it impacted emotion regulation through its influence on emotions, resulting in a decreased inclination to ruminate. This suggests that changes in emotion regulation can be secondary to spontaneous bottom-up effects of nature on emotional states.

Further research is required to explore these associations, investigate their directionality and potential bidirectional influences, as well as discern possible differences when considering other specific emotion regulation strategies.

Some of the investigated articles indicated that nature-related aspects appear to be associated with mindfulness. In this regard, nature-led mindfulness as a psychological construct is argued to help enhance present-centred attention, acceptance of experience, clarity about one's internal experience, and the ability to regulate negative emotion (Lymeus et al., 2020). In particular, the evidence from the study by Sahni and Kumar (2021) showed that the frequency of visits to natural environments was found to have a direct and positive association with mindful attention and awareness, suggesting that people who frequently visited nature-rich places reported being more mindful. This association was further found to be strengthened by nature relatedness. Also, results revealed that neighbourhood nature during childhood was significantly associated with nature relatedness and mindful attention and awareness, whereas nature in the current neighbourhood was not.

Similarly, a study by Huynh and Torquati (2019) indicated that the association between connection to nature and psychological well-being is mediated by mindfulness, in terms of mindful attention, awareness and acceptance. Also, the study by Stewart and Haaga (2018) found that state mindfulness played a mediating role in the relationship between exposure to nature (i.e., watching a nature video) and both affect and psychological well-being. Moreover, a further study (Swami et al., 2020) showed the mediating role of mindful awareness in the association between nature exposure and body appreciation (i.e., assessed as acceptance of, respect and care for one's body, and protection of one's body from unrealistic beauty standards). Based on that, connectedness to nature may support individuals to shift away from immediate self-interest and consequently help individuals to respect and appreciate one's body as part of a wider ecosystem, both of which are deserving of protection and compassion. A further study about mindfulness (Ma et al., 2023) did not find a significant effect of nature on mindfulness state nor trait. Specifically, participants in both the experimental conditions (i.e., nature vs. urban) showed a significant improvement in trait mindfulness level after the outdoor walking intervention for a week. Also, results did not show any significant effects of the intervention on nature relatedness and on state mindfulness after each session.

Among the reviewed studies, one specifically examined the emotion regulation strategies of cognitive reappraisal and expressive suppression (Fido et al., 2020). In this work, nature connectedness was found to have a positive association with the use of cognitive reappraisal as an emotion regulation strategy. Interestingly, individuals with higher levels of psychopathy showed a weaker association between nature connectedness and cognitive reappraisal, suggesting that psychopathy may influence the way in which nature connectedness relates to the use of cognitive reappraisal as an emotion regulation mechanism. However, no significant relationship was found between nature connectedness and expressive suppression.

Another study focused only on cognitive reappraisal (Theodorou et al., 2023) and found a moderating role of habitual use of this strategy for the impacts of virtual nature on subjective vitality. Specifically, only participants with high level of cognitive reappraisal showed a significant and positive effects of virtual nature (vs. urban) on their subjective vitality, whereas for those with low levels the effects were not significant. This moderating effect was found to be significant for two of the investigated virtual scenarios (lacustrine and arctic environment) but not for the park scenario, suggesting that the use of cognitive reappraisal may play a more significant role when experiencing unfamiliar environments, for instance by increasing the sensitivity to the surroundings.

Table 2.10. *Summary of the reviewed studies' main results for Review 1*

Results paths	Study
Nature connectedness → (+) cognitive reappraisal (trait) (moderated by psychopathy)	Fido et al. (2020)
Nature connectedness → (-) ER difficulties (trait) → (+) happiness	Richardson & McEwan (2018)
Nature connectedness → (+) adaptive ER (trait) → (-) perceived stress	Bakir-Demir et al. (2021)
Nature connectedness →(+) mindfulness (trait) → (+) well-being	Huynh & Torquati (2019)
Nature contact (coast) → (+) adaptive ER	Severin et al. (2022)
Nature exposure → (+) mindful awareness (trait) → (+) nature connectedness → (+) body appreciation	Swami et al. (2020)
Nature video → (+) mindfulness (state) → (+) psychological well-being	Stewart & Haaga (2018)
Nature VR → (+) vitality (moderated by cognitive reappraisal trait)	Theodorou et al. (2023)
Nature VR → (-) worry (state)	Browning et al. (2023)
Nature images → (-) rumination and worry (state)	Beute & de Kort (2018) Golding et al. (2018)
Nature images (classical) → (+) emotional potential → (+) intention to seek nature when happy and sad	Johnsen & Rydstedt (2013)
Flower images → (-) blood pressure, saliva cortisol levels and activation of right amygdala-hippocampus	Mochizuki-Kawai, et al. (2020)
Nature visits →(+) nature connectedness → (+) mindfulness (trait)	Sahni & Kumar (2021)
Nature walk → (-) rumination (state)	Bratman et al. (2015) [a] Bratman et al. (2015) [b]
Nature walk → (+) mindfulness (trait)	Ma et al., 2023
Nature walk → (+) awe → (-) negative affect → (-) rumination (state)	Lopes, Lima & Silva (2020)
Nearby nature and nature exposure → ER in nature → (+) mental health	Zhang et al. (2022)
Nearby nature (green and blue) to school and residence → (-) ER difficulties (trait)	Liang et al. (2024)
Neighbourhood greenery → (-) ER difficulties (trait)	Mygind et al. (2022)
Neighbourhood greenery → (+) activation in brain areas relevant for ER	Dimitrov-Discher et al. (2022)
Neighbourhood greenery → (+) nature connectedness → (+) ER skills	Bakir-Demir et al. (2019)
Use of environmental strategies → (+) perceived health and satisfaction in regulating sadness	Korpela et al. (2018)
ER in nature → restorative outcomes	Johnsen (2013)
Natural spaces as favorite place for self-regulation → (+) high restorativeness and positive emotions	Korpela & Hartig (1996)

Note. → = significant association; (+) = positive association; (-) = negative association.

2.4. Discussion

This rapid review aimed to explore the literature on the relationship between nature exposure and other relevant nature-related aspects with emotion regulatory processes. Twenty-seven articles were reviewed, with a total of 33 unique studies. Combining the results of the investigated studies, a diverse range of evidence was found regarding the significant role of nature factors in effectively influencing emotion regulation. The following paragraphs presents the discussion of the review findings, addressing the initial research questions posed at the outset of the present work.

2.4.1. Characteristics of the studies

The following section provides an overview of the key characteristics observed in studies investigating the use of nature for emotion regulation.

Regarding the sample population, the studies primarily targeted healthy young and middle-aged adults. However, it is worth noting that there were a limited number of studies that included children and individuals with specific health conditions. There was a lack of comprehensive coverage of cultural and geographical differences within the samples, which could potentially influence the generalizability of the findings.

The included studies aimed to investigate the effects of nature exposure and nature-related aspects on emotion regulation processes, with some focusing on the direct effects of nature exposure, while others explored the role of theoretical constructs such as the feeling of connection and relatedness with nature.

In terms of the type of nature contact investigated, various approaches were employed. Nature exposure was explored through activities such as nature walks and the viewing of nature images. Furthermore, specific natural environments were investigated, including green spaces, coastal settings, and various sub-categories of green and blue spaces. This allowed for a diverse exploration of the impact of different natural contexts on emotion regulation. Other studies explored different dimensions, measuring the quantity of nature in participants' residential areas or frequency of exposure to natural spaces in everyday lives. This broader perspective on nature contact sought to uncover the potential benefits of frequent encounters with natural elements in urban or residential settings, capturing the influence of both immediate and long-term exposure to natural settings on emotion regulation processes and allowing for a more nuanced understanding of this influence.

Some studies also delved into the role of theoretical constructs in relation to nature and emotion regulation. Constructs such as the feeling of connection and relatedness with nature were investigated to assess their influence on emotional regulation processes. These theoretical frameworks provided a deeper understanding of the underlying mechanisms through which nature can affect emotions.

Within the reviewed studies, a notable distinction can be made regarding the focus on emotion regulation, specifically in terms of the types of strategies examined. Some studies took a broader approach by investigating emotion regulation in general, while others specifically delved into particular strategies, such as rumination, mindfulness, cognitive reappraisal and expressive suppression.

Moreover, the studies encompassed a range of research designs, reflecting the multidimensionality of the topic. Experimental studies, qualitative investigations, and survey-based approaches were among the commonly employed methodologies. Similarly, the measurement tools used to assess nature-related aspects and emotion regulation processes varied across studies. This variation highlights the complexity and diversity of research in this field, enabling the exploration of various facets of nature contact and emotion regulation and contributing to a more comprehensive understanding of the topic. However, it is important to acknowledge that the heterogeneity in research designs and the variations of measurement tools used across the studies introduce potential sources of variability and limit the extent to which the findings can be generalize.

In summary, the studies examining the use of nature for emotion regulation have provided insights into various aspects, such as the effects of nature exposure, the role of theoretical constructs related to nature, and the influence of different natural environments. While predominantly focusing on healthy young and middle-aged adults, there is a need for greater diversity in terms of sample representation. Additionally, future research could benefit from a more comprehensive examination of cultural and geographical differences. Future studies should also strive for more standardized approaches to enhance comparability across studies, thereby facilitating a better understanding of the underlying mechanisms and enabling more reliable generalizations.

2.4.2. Overall findings

The reviewed studies provide valuable insights into the relationship between nature exposure, emotion regulation, and psychological well-being. This section presents an overview of the overall findings, highlighting two distinct lines of investigation: emotion regulation in general and specific strategies for emotion regulation.

Included studies that explored emotion regulation in general revealed that these processes may underlie the benefits of nature exposure and nature-related aspects. For instance, research indicated that emotion regulation acts as a mediator, explaining the negative association between nature connectedness and stress (Bakir-Demir et al., 2021), as well as the positive association with happiness (Richardson and McEwan, 2018). Moreover, it has been identified as the key mechanism in explaining the beneficial effects of green spaces exposure on mental health (Zhang et al., 2022).

On the other hand, another set of studies focused on examining specific strategies for emotion regulation. These investigations shed light on the potential of different types of nature exposure, such as walking in natural environments or viewing nature images, videos and through VR, in reducing rumination (Beute and de Kort, 2018; Bratman et al.., 2015[a]: Bratman et al., 2015[b]; Lopes, Lima and Silva, 2020) and worry (Beute and de Kort, 2018; Browining et al., 2023), and increasing mindfulness state (Stewart & Haaga, 2018), as well as the role of nature connectedness in predicting the use of adaptive strategies, such as cognitive reappraisal (Fido et al., 2020) and mindfulness (Huynh & Torquati, 2019). Also, cognitive reappraisal was found to be potential moderator in the effect of nature exposure (Theodorou et al., 2023).

Based on these findings, some recurrent paths of associations can be traced:

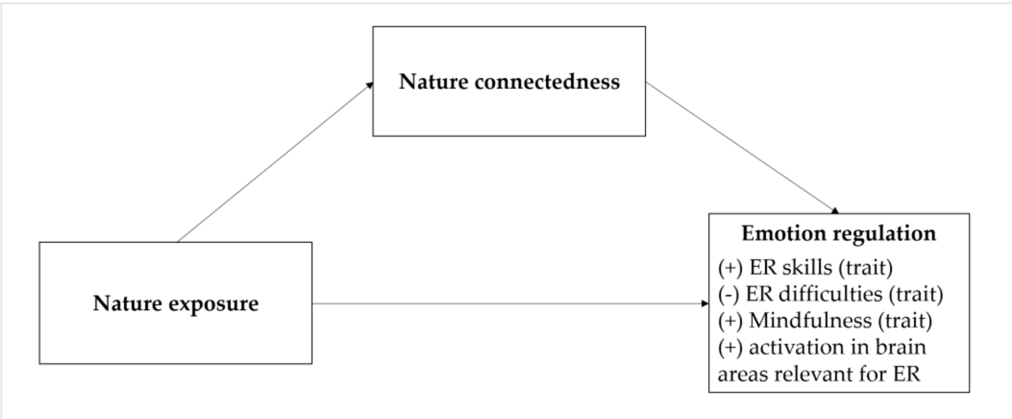
1. Different forms of nature exposure (i.e., walk, images and videos) are correlated with emotion regulation, increasing adaptive strategies, and decreasing maladaptive ones (**Figure 2.5**);

Figure 2.5. *Conceptual model linking different types of nature exposure to emotion regulation outcomes*

Note. ER = emotion regulation; (+) = positive association; (-) = negative association.

2. Visiting natural spaces and living in a neighbourhood with a greater presence of green are linked with emotion regulation. In some studies, this association has also been demonstrated to be mediated by nature connectedness (**Figure 2.6**);

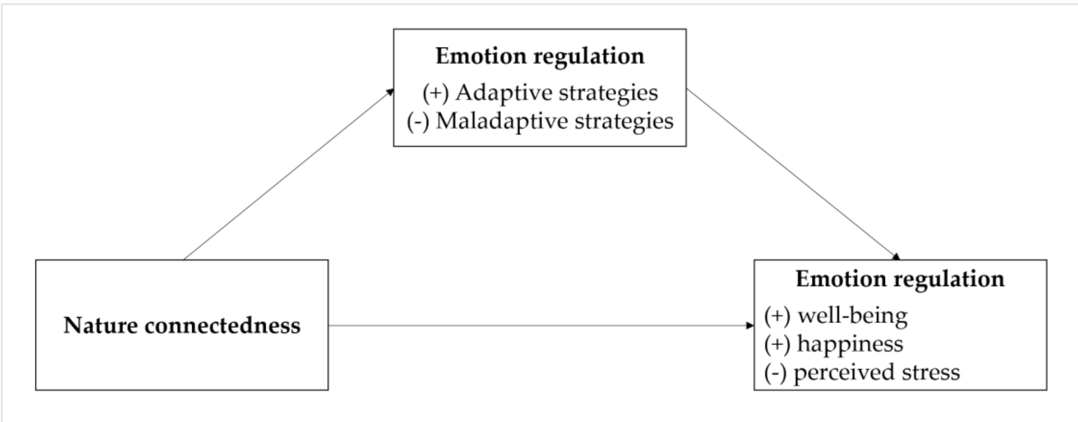
Figure 2.6. *Conceptual model linking neighbourhood greenery and nature visits to emotion regulation outcomes with mediation through nature connectedness*



Note. ER = emotion regulation; (+) = positive association.

3. Emotion regulation processes mediate the association between nature connectedness and a range of mental health outcomes (**Figure 2.7**).

Figure 2.7. *Conceptual model linking nature connectedness to mental health outcomes with mediation through emotion regulation processes*



Note. (+) = positive association; (-) = negative association

By exploring both emotion regulation in general and specific emotion regulation strategies, these studies contribute to the understanding of the diverse mechanisms through which nature contact can influence emotional well-being. The findings underscore the importance of considering different strategies and their respective impacts on emotion regulation when examining the relationship between nature exposure and psychological outcomes.

The findings of the reviewed studies can be interpreted within the framework of the Markevych model (2017). Firstly, in terms of harm reduction, the evidence suggests that emotion regulation plays a mediating role in the association between nature connectedness and exposure to natural spaces with stress and happiness. Specifically, nature exposure and connectedness seem to increase adaptive emotion regulation (general skills as well as mindfulness trait and state), contributing to improving feelings of happiness and psychological well-being, as well as decreasing emotion regulation difficulties, consequently reducing stress perception. Secondly, in the domain of restoring capacities, studies have demonstrated the positive association between nature exposure, emotion regulation, and psychological well-being, indicating that contact with natural environments can serve as a means of restoring emotional balance and enhancing emotional well-being. Lastly, in the domain of building capacities, different forms of nature exposure, such as engaging in nature walks or viewing nature images, have been found to reduce rumination and enhance mindfulness states, indicating the potential of nature exposure to strengthen individuals' capacity to regulate their emotions effectively and facilitate the use of more adaptive emotion regulation strategies.

Overall, the reviewed findings support the integration of emotion regulation into the Markevych's framework, highlighting the role of nature in promoting emotion regulation across the three paths. This integration enhances our understanding of how nature can contribute to emotional well-being and provides a foundation for future research and interventions aimed at leveraging the therapeutic benefits of nature in enhancing emotion regulation capacities.

2.4.3. Future research

Findings of this review align with the evidence about the effectiveness of nature exposure in enhancing positive emotion and reducing the negative ones. These nature beneficial effects are likely to be mediated, in some part, by the elicitation of adaptive forms of emotion regulation strategies. However, many aspects about this topic are still unclear and overlooked by previous studies.

First, it is noteworthy that the existing body of research has not extensively examined the impact of nature-related aspects on several specific emotion regulation strategies, leading to a scarcity of evidence in this topic. Reviewed studies explored just a few emotion regulation strategies (i.e., rumination, worry, mindfulness, cognitive reappraisal and expressive suppression); however, nature-related aspects may also have beneficial effects on the other emotion regulation categories of the process model (i.e., situation selection and modification), as well as on other specific types of emotion regulation strategies (Bratman et al., 2021) that have not been specifically explored yet (such as emotional expressivity).

However, many studies on restorative environments have examined aspects related to emotion regulation, albeit using different terminology, such as the two main theories of Stress Reduction Theory (SRT) and Attention Restoration Theory (ART). Indeed, the SRT focuses on how emotional processes motivate and are impacted by nature contacts (Ulrich, 1983, 1991), suggesting that exposure to nature reduces stress and negative emotions and increases positive emotions, whereas the ART highlights the impact of nature contact on restoring directed attention (Kaplan, 1989; 1995), that also contributes to increased capacity for reflection on problems (e.g., Hartig et al., 1996). Additionally, research on environmental preference and self-regulation further explore this topic. In particular, Korpela et al. (2001) applied self-regulation theories to understand how individuals utilize, form connections with, and develop skills tailored to specific environments during periods of distress, illustrating how these environments aid in emotion regulation.

While not all this research explicitly uses emotion regulation theories and language, thus was not included in the present review, it's important to recognize the rich tradition in nature-health research indirectly addressing emotion regulation processes. This body of literature should be considered in future efforts to integrate emotion regulation into mainstream nature-health research.

Moreover, there is still little literature about potential differences in the effects derived by interacting with different types of natural environments. Included studies mostly concentrated on nature in general or specifically on green spaces, except for just one study that focused on the particular case of emotion regulation near to coastal settings (Severin et al., 2022) and a further study that considered both green and blue spaces' exposure (Liang et al., 2024). Some of the experimental studies also used stimuli with blue elements (e.g., lakes, beaches, arctic; Browning et al., 2023; Theodorou et al., 2023), but they did not focus on their specific effects in comparison to only green stimuli. Further, several sub-categories of green (e.g., forest, parks) and blue (see, lake) exist and may have different impacts on emotion regulation processes. Thus, future studies on the link between emotion regulation and nature should explore a greater variety of natural space, taking into account their own peculiarities.

Additionally, many forms of nature contact exist, varying by spatial scale, proximity, sensory pathways, as well as the individual's activities and level of awareness while spending time in a natural setting. From this review, it appears that previous studies have not carried out comparisons between different types of nature contact and their similarities and differences in the consequent effects on emotion regulation processes are still undetermined.

Further, little is known about possible variations in the effects of nature on emotion regulation according to people's individual factors, for instance with different age, gender, mental and physical health conditions, socio-economic conditions, cultural background. Indeed, almost all the investigated papers used healthy young and middle-aged adults as samples, apart from three studies that focused on children and other two studies that included individuals with specific health conditions. A limited coverage of cultural and geographical differences is also a limit under this respect.

On the basis of these considerations, there is a clear need for more studies that replicate existing findings in different nature contexts and type of exposure, and with different populations. To achieve this, greater emphasis should be placed on the methodological rigor and the selection of measurement tools employed in research. Future investigations into the effects of nature exposure on emotion regulation processes would benefit from a more robust grounding in emotion regulation theory and the careful selection of assessment tools, in order to enhance the generalizability of the findings across different geographical and cultural areas, populations and languages, as well as ecosystems and natural contexts.

Moreover, in everyday life, individuals have a wide range of emotion regulation strategies at their disposal, and it is likely that people may combine various strategies to cope with their emotions (Thuillard & Dan-Glauser, 2020). As nature seems to have an impact on several regulation strategies, future research should also investigate potential interaction effects of multiple emotion regulation strategies implemented simultaneously when being in natural environments.

2.4.4. Limitations

This rapid review encapsulates the available literature on the connections between nature-related aspects and emotion regulation processes. As part of the review, a systematic search was undertaken, and the review process was clearly documented. This methodological approach ensures reproducibility and transparency. However, some limitations should be noted.

First, the use of a rapid review approach could limit the comprehensiveness of the studies captured in this report. In addition, the lack of a formal standardized quality assessment tool for rapid reviews could limit the generalizability of these findings.

Second, it is important to recognize that the rapid review process, limited to five databases, may have led to the oversight of potentially relevant empirical evidence, thus missing pertinent studies. For instance, Schutte & Malouff's (2018) meta-analysis identified 12 relevant studies on the correlation between mindfulness and nature connectedness, whereas only five studies were included on this aspect in the present review. This difference may be attributed to their comprehensive search methodology, which involved nine diverse databases and manual examination of reference lists.

Additionally, the review was limited to peer-reviewed publications, and potentially relevant so-called "grey" literature was not explored. This review is further limited by excluding evidence that was not published in English. Moreover, the literature reviewed did not undergo formal quality appraisal. The quality of individual studies was not evaluated, and the inclusion/exclusion of articles was not based on their quality. However, it is important to note that all included studies were published in peer-reviewed journals, which should have mitigated the inclusion of low-quality articles. Nonetheless, there may still be variability in scientific quality both within and between journals; therefore, the present findings should be considered with caution.

Another limitation of this study is that it relied on a single review author for the data selection process, due to resource and time constraints. Although efforts were made to enhance reliability by having a second review author verify these assessments, the absence of dual, independent data extraction and analysis may have introduced some degree of error. The findings should be seen as preliminary in nature and it is important to interpret them with caution, considering the potential bias or oversight associated with relying on a single review author for data selection. Future research with greater resources should consider using a more rigorous approach, such as a systematic review with multiple reviewers, to enable a more robust evaluation of the evidence. This would help to minimize bias, increase the reliability of the results, and provide a more thorough understanding of the research topic.

It is important to acknowledge a limitation in the review's inclusion criteria, which directly measured and/or had specific reference to emotion regulation strategies. As a result, studies indirectly addressing aspects related to emotion regulation but using different terminology may have been excluded. For instance, cognitive change in the restoration literature is frequently discussed using terms such as attention, executive functioning, cognitive flexibility, and reflection. While the present review specifically targeted emotion regulation strategies with their corresponding terminology, it is recommended for future research to consider these alternative perspectives in order to obtain a more comprehensive understanding of the relationship between nature and emotion regulation, using a more comprehensive search strategy including a variety of terms to capture these aspects. Another limitation regarding the review's inclusion criteria pertains to the mindfulness literature. It is important to clarify that only studies focusing on mindfulness as a self-regulatory and coping strategy, emphasizing attentive and nonjudgmental awareness of one's present experience, and exploring the impact of nature and nature-related aspects on mindfulness were included in this review. Consequently, studies examining mindfulness interventions, or those centred on the effects of mindful attention on nature connectedness were not incorporated into the review.

2.5. Conclusion

Findings of the present review suggest a potential association between nature-related aspects and emotion regulation, as well as potential benefits of nature exposure on certain emotion regulation strategies. Specifically, the reviewed studies indicate a tendency for nature exposure to be associated with increased utilization of positive emotion regulation strategies, such as mindfulness, while potentially decreasing the use of maladaptive strategies, such as rumination.

However, due to the limited number and heterogeneity of the studies, further research is needed to establish more robust and generalizable evidence in this area.

Although previous studies showed some interesting insights about the potential role of using nature for emotion regulation, this topic should be deeper investigated to better understand the underlying mechanisms involved and potential individual variations in these processes.

This rapid review also points at a lack of studies exploring the full array of available strategies that people may use for regulating their emotions. Through the focused analysis of studies utilizing relevant emotion regulation terminology and concepts, the present review can serve as a bridge between the fields of nature/health literature and emotion regulation studies, fostering theoretical development and enhancing the understanding of the mechanisms underlying the health benefits of nature exposure in relation to emotion regulation processes.

By identifying common terminology and measurement approaches used in both fields, researchers can more effectively align their methodologies and study designs. This alignment not only promotes consistency in findings across studies and disciplines but also facilitates the accumulation of evidence and the replication of results in diverse contexts.

Given the diverse benefits of contact with nature on different forms of emotion regulation, it is recommended that future nature-health studies incorporate more common and explicit application of emotion regulation theories and assessment methods. This approach would enhance the understanding of the underlying mechanisms through which nature influences emotion regulation processes and contribute to a more comprehensive examination of the nature-health relationship.

CHAPTER 3.

The Impact of Natural Virtual Environments on Emotion Elicitation: A State-of-the-Art Narrative Review [2]

3.1. Introduction

Exposure to natural environments has been widely recognized for its potential to positively affect emotions and emotion regulation processes, as highlighted in Chapter 2. Although spending time in real natural environments may offer greater well-being benefits compared to indirect experiences (Browning et al., 2020), much of the evidence supporting nature's therapeutic potential on emotions comes from studies using digital surrogates (McMahan & Estes, 2015). For instance, nature-based videos have demonstrated potential in aiding recovery from stress markers over the past 30 years (e.g., Meuwese et al., 2021; Ulrich et al., 1991). Even viewing static images of natural scenes can significantly increase positive emotions (Hartig et al., 1996), improve mood (van den Berg et al., 2003), and enhance cognitive functions like attention and impulsivity control (Berto, 2005; Berry et al., 2015).

[2] This chapter is based on a manuscript submitted for publication: Marocco, S., & Vitale, V. (2024). The impact of natural virtual environments on emotion elicitation: a state-of-the-art review. The content has been adapted for inclusion in this thesis.

Despite the therapeutic promise of digital representations of nature, these simulated environments often fall short of replicating the immersive qualities of real natural settings, potentially limiting their effectiveness (White et al., 2018). Virtual Reality (VR) technology offers a promising solution by enabling more immersive experiences. VR allows users to engage with a computer-generated, three-dimensional simulation that can mimic natural environments more effectively than traditional media, providing a deeper sense of presence and immersion (Briggs, 1996).

This immersion can be achieved through head-mounted displays (HMDs) that block out external stimuli and provide a panoramic, interactive view of an alternative environment (Furman et al., 2009). Initial studies indicate that the benefits of nature contact can extend to these immersive digital environments, with VR nature experiences linked to improvements in negative emotions, restorativeness, stress reduction, and creativity (e.g., Palanica et al., 2019; Schutte et al., 2019; Schebella et al., 2020). However, the available evidence remains limited, highlighting the need for further research to better understand the impact of VR nature scenarios on emotional states and other psychological variables (Li et al., 2021).

Concerning this, the review presented in **Chapter 2**, exploring the role of nature in emotion regulation, was able to identify only two studies that adopted Virtual Reality stimuli for examining nature's impact on emotion regulation processes, revealing a significant gap in the literature. Recognizing VR's potential to enhance the understanding of how nature influences emotions and potentially emotion regulation, a second review was initiated with a broader focus.

This subsequent review specifically targeted studies that utilized VR to elicit emotions through nature-based experiences. The shift in focus was based on the premise that understanding how VR nature experiences evoke emotions is a critical first step toward exploring their potential effects on emotion regulation processes. In this regard, the aim of this review is to provide a more comprehensive foundation for future research on the broader implications of VR tools in studying and enhancing emotion regulation. Also, such a review is relevant in order to consolidate the current knowledge, identify gaps, and provide direction for future research.

The present work will address the types of interventions used in past studies, the variety of natural environments utilised, and their differential impacts on emotional responses, specifically focusing on studies that adopted virtual reality scenarios.

3.2. Method

A state-of-the-art narrative review was conducted to investigate the role of natural virtual environments in emotion elicitation through VR, adhering to established guidelines and criteria (e.g., Green et al., 2006; Sukhera, 2022).

Narrative reviews are a form of qualitative research synthesis that describe the results of quantitative studies using diverse methodologies or theoretical frameworks, without focusing on the statistical significance of the findings (Baumeister & Leary, 1997; Siddaway, Wood, & Hedges, 2019). This type of review is particularly suitable when a comprehensive understanding of the literature is desired in relation to a collection of quantitative studies that have employed various methodologies, or that have examined different theoretical conceptualizations, constructs, and relationships (Baumeister, 2013).

A narrative review method was chosen for this study due to the heterogeneous nature of the existing research on natural virtual environments and emotion elicitation. The studies in this field used a wide range of methodologies, theoretical perspectives, and constructs, making a narrative review the most appropriate approach to synthesise the findings. This type of review allows for a detailed and holistic examination of the literature, providing an integrated overview of the current state of knowledge. Additionally, narrative reviews are effective in identifying and discussing problems, weaknesses, contradictions, or controversies within a particular area of investigation (Baumeister & Leary, 1997).

In this review, the aim is to survey the state of knowledge on the impact of natural virtual environments in emotion elicitation. This includes providing useful overviews and integrations of the existing literature, highlighting areas of consensus as well as points of contention. In doing so, the goal is to provide valuable insights that can inform and guide future research and practice in this emerging field.

3.2.1. Research questions

This review aims to address several key research questions to better understand the impact of natural virtual environments on emotion elicitation, focusing specifically on two crucial components of emotions: valence and arousal. Indeed, emotions can be mapped within a two-dimensional framework encompassing emotional valence and arousal. Valence refers to the positivity or negativity of an emotion, while arousal indicates its intensity (Barrett & Russell, 1999; Lang et al., 1998; Russell, 2003).

The following questions were formulated to guide the analysis:

- What types of interventions involving VR nature scenarios have been adopted by previous studies and which have been the most effective? This question seeks to identify the various methods used in past research to expose participants to natural virtual environments, including the length of exposure and the specific techniques employed, and evaluate their relative effectiveness in eliciting emotional responses.
- What types of natural environments have been used? This inquiry aims to categorise and describe the different natural environments that have been featured in previous studies, providing a comprehensive overview of the settings used. Also, it refers to the differential effects of various types of natural environments, such as green (e.g., forests, parks), blue (e.g., oceans,

rivers), white (e.g., snowy landscapes), and brown (e.g., deserts), on emotion elicitation within virtual reality contexts.

- Which type of natural environment is most effective in reducing arousal? This query focuses on determining which specific natural environment has the greatest impact on lowering physiological arousal levels, contributing to a sense of calm and relaxation.
- Which type of natural environment is most effective in eliciting emotions with positive valence? This question examines which natural environment is most successful in evoking positive emotional responses, such as happiness, contentment, or awe.

By addressing these research questions, the review aims to synthesize current knowledge and identify gaps in the literature, ultimately providing a foundation for future studies and practical applications in the field of virtual reality and emotion elicitation.

3.2.2. Searching and screening

With these questions in mind, a literature search was conducted in June 2024 to find empirical studies on the topic of interest. To ensure the inclusion of good-quality studies that have undergone peer review, the analysis focused exclusively on articles published in scientific journals, prioritising those that have been evaluated by experts in the field. The following databases were used to identify potentially relevant articles: *Scopus*, *Google Scholar*, and *ScienceDirect*.

For all databases, the same set of search keywords was used. About the VR-related literature, the keywords "virtual reality" and "VR" were used as search terms. For natural spaces, the keywords included "nature", "natural environments", and "natural scenarios". Regarding the emotion-related literature, the adopted keywords were "emotion", "mood", "emotional states", "affect", and "affective states". These search terms were used in combination to conduct the research across all databases, focusing on titles and abstracts, as follows: ("virtual reality" OR "VR") AND ("nature" OR "natural environments" OR "natural scenarios") AND ("emotion" OR "emotional states" OR "affect" OR "affective states").

The search was limited to peer-reviewed journal articles published in English. Given the rapid evolution of VR technology over the past decade, the focus was limited only on research published in the last 10 years to exclude studies using outdated technology (LaValle, 2023). Characteristics such as sample type (e.g., clinical vs. nonclinical), age, gender, and research design were not considered exclusion criteria for this review. The full list of inclusion and exclusion criteria is reported in **Table 3.1**.

Table 3.1. *Inclusion and exclusion criteria for selecting research reports for Review 2*

Inclusion Criteria	Exclusion Criteria
Research studies with no clinical and clinical samples	No results or outcomes, or impacts presented
Papers published in the last 10 years (2014-2024)	Papers published before 2014
Focus on the impact of virtual nature on emotion elicitation, considering at least one of the valence or arousal dimensions	No information about the impact of virtual nature on emotion elicitation
Use of natural environment scenarios with Virtual Reality technologies	No use of natural environment scenarios with Virtual Reality technologies
Assessment of emotion elicitation (at least one of the valence or arousal dimensions)	No assessment of emotion elicitation
Papers full-text available and reporting outcomes, evaluations and impacts	Full-text paper not available
English language	Non-English language
Qualitative or quantitative, mixed and/or multi-method research	Non-research articles (e.g., review papers, dissertations, book chapter)

3.2.3. Data extraction and synthesis of the evidence

After the selection of the articles, the data extraction was carried out for all the included studies, using a pre-established form. The main components of the data extraction form were the year of publication and country of study; study design and methods; study sample; characteristics of the virtual nature environments and the intervention (duration and modality); assessment of emotions; and results.

Furthermore, a synthesis of the evidence is provided. First, a preliminary descriptive summary of the included studies is presented, detailing their characteristics in terms of year of publication, location, sample demographics, study design and methods, features of the virtual natural environments, interventions used, and methods for assessing emotions. Then, a narrative synthesis was adopted to further synthesise the results. Based on the guidelines for discussing narrative reviews (Baumeister & Leary, 1997), which recommend section critiques rather than critiquing each individual study, the findings have been organised around the two key components of emotion elicitation: valence and arousal. Each section includes a summary of the methods and results of relevant studies, along with a brief outline of the major flaws and limitations in the evidence. This approach allows for a more cohesive and comprehensive discussion of the overall trends and insights within the literature on the potential of virtual nature in emotion elicitation.

3.3. Results

3.3.1. Study characteristics

The studies obtained from the search were characterised in terms of participant description (including sample size and age range), country, and research design (refer to **Table 3.2** for an overview). Furthermore, an overview of publication years of the reviewed studies is shown in **Figure 3.1**.

Figure 3.1. *Number of studies included in Review 2 by year of publication*

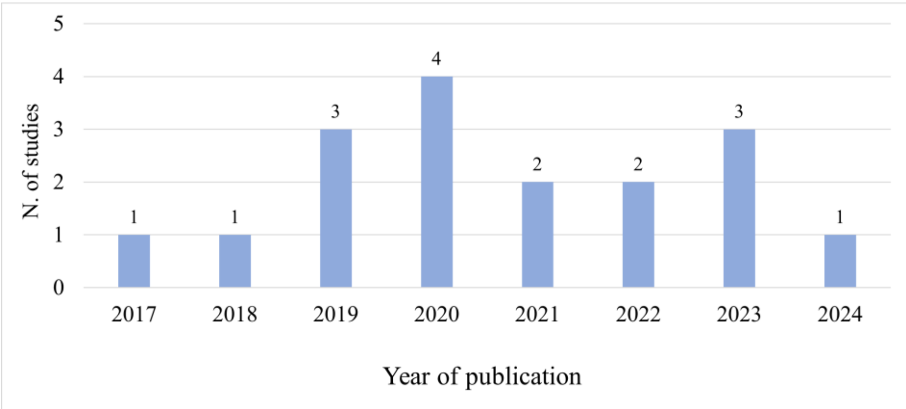


Table 3.2. *Characteristics of studies included in Review 2*

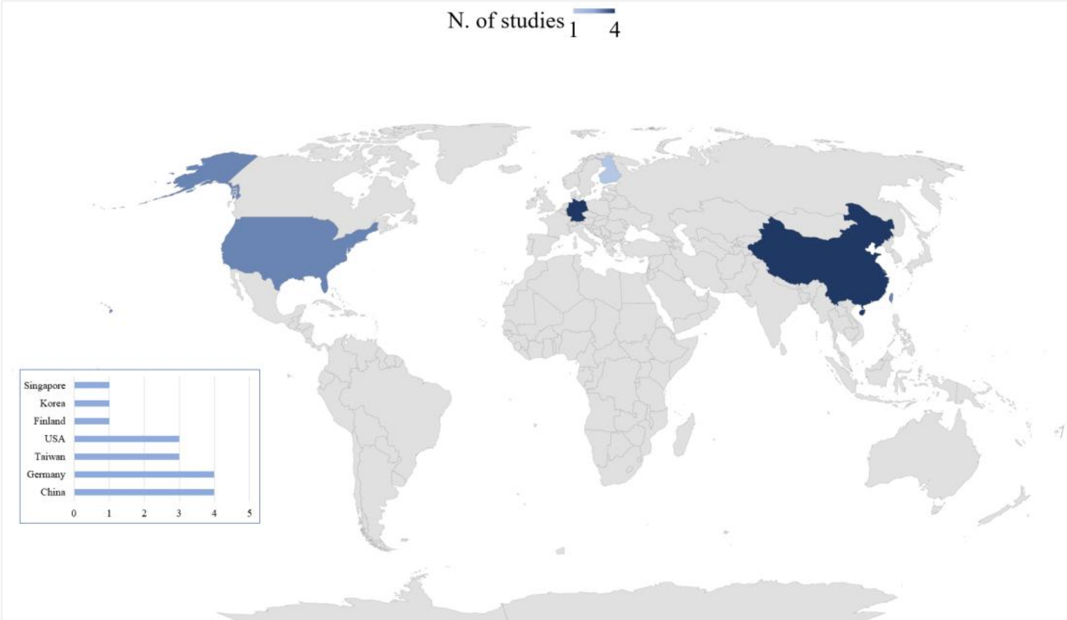
Authors	Sample	Methodology
Anderson et al. (2017)	N = 18 F (n=9) + M (n=9) Average age of 32 ± 12 years USA	Within-subject design Pre-post Quantitative method Laboratory setting
Browning et al. (2020)	N = 82 F (n=39) + M (n=43) Average age of 20 ± 1.2 years USA	Between-subjects design Pre-post Quantitative method Laboratory setting
Chan et al. (2023)	*Study 1* N = 71 F (n=33) + M (n=38) Average age of 23.2 years Students	*Study 1* Between-subjects design Only post-test *Study 2*

	Study 2 N = 79 F (n=54) + M (n=25) Average age of 24.9 years Students Singapore	Between-subjects design Pre-post Quantitative method Laboratory setting
Gao et al. (2019)	N = 120 F (n=62) + M (n=58) Average age of 20.7 ± 2.13 years Students China	Between-subjects design Pre-post Quantitative method Laboratory setting
Graf et al. (2020)	N = 14 F (n=8) + M (n=6) Average age of 76.8 years (age range: 66-84 y) Germany	Within-subjects design Pre-post Mixed-method design combining quantitative (standardised questionnaires) and qualitative (observation protocol, interview) measures Participants' homes
Ho et al. (2023)	N = 35 F (n=20) + M (n=19) Age range 20-60 years old Occupation: Factory workers on the production line China	Between-subjects design Pre-post Quantitative method Conference room in the workplace
Hong et al. (2019)	N = 40 F (n=17) + M (n=23) Average age of 24.4 ± 2.8 years (age range: 20-34 y) Korea	Within-subjects design Pre-post Quantitative method Laboratory setting
Masters et al. (2022)	N = 26 F (n=12) + M (n=14) Average age of 22 ± 3.7 years (age range: 18-30 y) Students USA	Between-subjects design Pre-post Quantitative method Laboratory setting
Mattila et al. (2020)	N = 100 F (n=44) + M (n=54) + Other (n=2) Age: Younger than 35 (67%), 35 and older (33%) Occupation: Students (61%), Working (37%), Other (2%) Finland	Within-subjects design Pre-post Quantitative method Calm office space
Meng et al. (2024)	N = 90 F (n=61) + M (n=39) Average age of 22 years Students China	Between-subjects design Pre-post Quantitative method Laboratory setting

Reese et al. (2021)	N = 64 F (n=47) + M (n=17) Average age of 23± 3.87 years Germany	Between-subjects design Pre-post Quantitative method Laboratory setting
Reese et al. (2022)	N = 50 F (n=32) + M (n=19) + Other (1) Average age of 24.2 ± 3.7 years Germany	Between-subjects design Pre-post Quantitative method Laboratory setting / Urban forest (physical condition)
Voigt-Antons et al. (2021)	N = 26 F (n=13) + M (n=13) Average age of 29.38 years (age range: 18-55 y) Germany	Within-subjects design Pre-post Quantitative method Laboratory setting
Wang et al. (2019)	N = 96 F (n=63) + M (n=33) Average age of 24.03 ± 5.29 years (age range: 18-35 y) China	Between-subjects design Pre-post Quantitative method Laboratory setting
Yi-Lei et al. (2023)	N = 30 F (n=12) + M (n=18) Age range: 22-26 years old Taiwan	Between-subjects design Pre-post Quantitative method Laboratory setting
Yu et al. (2018)	N = 30 F (n=17) + M (n=13) Age range: 20-35 years old Students Taiwan	Within-subjects design Pre-post Quantitative method Laboratory setting
Yu et al. (2020)	N = 34 F (n=28) + M (n=6) Average age of 58.76 ± 8.36 years Taiwan	Within-subjects design Pre-post Quantitative method Laboratory setting

The included studies in the review were conducted in a diverse range of countries. **Figure 3.2** displays a map illustrating the distribution of the reviewed studies across the different countries. Specifically, there were 4 studies from China (Gao et al., 2019; Ho et al., 2023; Meng et al., 2024; Wang et al., 2019), 3 from Taiwan (Yi-Lei et al., 2023; Yu et al., 2018; Yu et al., 2020), 1 from Singapore (Chan et al., 2023), and 1 from Korea (Hong et al., 2019). Additionally, 4 studies were conducted in Germany (Graf et al., 2020; Reese et al., 2021; Reese et al., 2022; Voigt-Antons et al., 2021), 1 in Finland (Mattila et al., 2020), 3 in the USA (Anderson et al., 2017; Browning et al., 2020; Masters et al., 2022).

Figure 3.2. *Map of the number of studies included in Review 2 by countries*



The reviewed studies included a diverse range of participant demographics. Sample sizes across the studies ranged from 14 to 120 participants. Age ranges were fairly consistent, covering mostly young and middle-aged adults, although Graf et al. (2020) specifically included older adults aged 66 to 84 years, with a mean age of 76.8 years. All studies included both male and female participants, with some variations in gender distribution. Most studies utilised non-clinical samples, primarily composed of healthy participants, often university students, and excluded participants with psychiatric or chronic medical conditions that could interfere with the use of VR.

This diversity underscores the need for careful consideration of sample characteristics when interpreting the findings and implications of research on virtual natural environments and emotion elicitation.

Methodologically, the majority of the studies employed quantitative methods. Only one study, Graf et al. (2020), used a mixed-method design that combined quantitative (standardised questionnaires) and qualitative (observation protocol, interview) measures.

Regarding research design, the studies included both between-subjects (Browning et al., 2020; Chan et al., 2023; Gao et al., 2019, Ho et al., 2023; Masters et al., 2022; Meng et al., 2024; Reese et al., 2021; Reese et al., 2022; Wang et al., 2019; Yi-Lei et al., 2023) and within-subjects designs (Anderson et al., 2017; Graf et al., 2020; Hong et al., 2019; Mattila et al., 2020; Voigt-Antons et al., 2021; Yu et al., 2018; Yu et al., 2020). Most studies used a pre/post-test design to measure the impact of virtual natural environments on emotion elicitation. Only Chan et al. (2023) included a study (Study 1) with an only post-test design.

In terms of the setting, the majority of the studies were conducted in laboratory settings, with exceptions such as Ho et al. (2023), who used a conference room at participants' workplaces, and Graf et al. (2020), who conducted their study in participants' homes.

3.3.2. Virtual Natural Environments

From the analysis of the literature, it emerged that most studies exploring the effect of virtual natural scenarios on emotions used green spaces (i.e., forests, meadows, parks), compared to other types of environments such as blue spaces (i.e., beaches, sea, waterfalls) or brown (i.e., deserts) and red environments (i.e., savannahs and canyons).

More specifically, nine studies in total focused on natural forest landscapes. Browning et al. (2020) used an outdoor forest setting, while Hong et al. (2019) recorded video at Minjuji Mountain using a 360-degree camera. Mattila et al. (2020) and Reese et al. (2022) focused on a general forest environment. Wang et al. (2019) examined seven different types of forest resting environments. Yu et al. (2018) used the natural forest of The Aowanda National Forest Recreation Area, and Yu et al. (2020) showed the Neidong National Forest Recreation Area in Taiwan.

Some other studies focused on different kinds of environments or mixed environments. Specifically, Gao et al. (2019) examined both blue spaces, such as an open pond with some greenery, and green spaces with various levels of canopy cover, and Yu et al. (2018) used a waterfall environment in The Aowanda National Forest Recreation Area. Meadow environments were used in three studies (Chan et al., 2023; Voigt-Antons et al., 2021; Yi-Lei et al., 2023), providing open, grassy landscapes with natural elements. Parks, particularly urban and peri-urban parks, were featured in two studies. Ho et al. (2023) used nature-based VR videos showing different areas such as parks, hiking trails, forest paths, and bikeways. Menga et al. (2024) focused on urban parks, peri-urban parks, and nature conservation areas.

Among the blue spaces, coastal environments were featured in two studies. Anderson et al. (2017) used locations over Ireland with large expansive natural vistas with views of water and beach locations on the Australian coast, while Reese et al. (2021) investigated a general coastal nature environment.

Table 3.3 provides a description of all the included studies, categorized by the different types of virtual natural environments used in the research.

Table 3.3. *Virtual natural environments used in the included studies for Review 2*

Study	Type of virtual natural environments	Description of natural environments
Anderson et al. (2017)	Blue spaces	Location with a large expansive natural vista with views of water (Ireland) and a beach location (Dream Beach)
Browning et al. (2020)	Green spaces	Forest
Chan et al. (2023)	Green and red spaces	Green Meadow and a Red Savannah.
Gao et al. (2019)	Green and blue spaces	Open pond with some greenery (blue) and partly closed green space, partly open green space, and open green space (green).
Graf et al. (2020)	Green and blue spaces	Forest with the view of the ocean or a mountain
Ho et al. (2023)	Green spaces	Parks, hiking trails, forest paths, and bikeways
Hong et al. (2019)	Green spaces	Forest
Masters et al. (2022)	Green and brown	Canyon and Forest settings/maps
Mattila et al. (2020)	Green spaces	Forest
Menga et al. (2024)	Green spaces	Urban park, peri-urban park, or conservation area
Reese et al. (2021)	Blue spaces	Coastal nature environment
Reese et al. (2022)	Green spaces	Forest
Voigt-Antons et al. (2021)	Green spaces	Green Meadow

3.3.3. Interventions

The virtual environment interventions explored were designed with varying exposure durations and modalities. The durations can be broadly categorised into short (5-10 minutes), moderate (15-20 minutes), and long exposures (30 minutes). The modalities of exposure in virtual natural environments included seated viewing, walking activities, or free exploration, with various levels of interaction.

For short exposure sessions, typically lasting between 5 to 10 minutes, participants were usually seated. In the studies by Gao et al. (2019), Hong et al. (2019), Wang et al. (2019), and Reese et al. (2021) participants were seated while they watched images/videos or navigated through the virtual scenery for 5 minutes. Chan et al. (2023) and Mattila et al. (2020) used a swivel chair, allowing participants to turn 360 degrees while remaining seated for 5 minutes. In the study by Yi-Lei et al. (2023), participants interacted within the natural virtual scene for 5 minutes under varying conditions (no interaction, interaction with a handle, interaction with gestures). Reese et al. (2022) conducted a study where participants were asked to remain seated on an office chair for a duration ranging from 5.5 to 9.5 minutes. During this time, they had the freedom to move their body, arms, and head at their discretion. Menga et al. (2024) provided a 10-minute VR immersion while seated. In the studies by Yu et al. (2018, 2020), participants watched videos in any comfortable seated position for 10 minutes. Masters et al. (2022) allowed participants to roam within the VR scenes or explore the virtual environment for 10 minutes each, respectively.

Moderate exposure studies, ranging from 15 to 20 minutes, often involved seated participants. Anderson et al. (2017) had participants seated for 15 minutes, with some in a supine position on a lounge chair for specific scenes. Voigt-Antons et al. (2021) involved participants in playing games while seated for 20 minutes. Browning et al. (2020) combined seated and walking experiences, alternating between 6 minutes of sitting and 6 minutes of walking, totalling 18 minutes, instructing participants to relax and enjoy the setting during the sitting component.

Long exposure sessions lasted around 30 minutes. Graf et al. (2020) enabled participants to explore the “VR Forest Walk” for 30 minutes, guiding them on how to navigate and interact in the virtual world. Ho et al. (2023) allowed participants to watch VR videos in a 360-degree format for 30 minutes (once a week for 12 weeks), encouraging them to move their heads freely to view from various angles.

An overview of the interventions’ characteristics, focusing on the duration and the modality of exposure to VR, is shown in **Table 3.4**.

Table 3.4. *Description of the interventions adopted by studies included in Review 2*

Study	Time of exposure	Modality of exposure
Anderson et al. (2017)	15 minutes	Subjects were seated but allowed to elevate their legs on the lounge chair.
Browning et al. (2020)	18 minutes	Subjects experienced each condition for 6 minutes of sitting and 6 minutes of walking.
Chan et al. (2023)	5 minutes	Subjects were seated on a swivel chair which enabled them to turn 360°.
Gao et al. (2019)	5 minutes	Subjects watched the images seated.
Graf et al. (2020)	30 minutes	Participants navigated and interacted in the VR.
Ho et al. (2023)	30 minutes (12 sessions)	Subjects could freely move the direction of their head to watch the video from various angles. The position of the participants was not specified.
Hong et al. (2019)	5 minutes	Subjects watched the video. The position of the participants was not specified.
Masters et al. (2022)	10 minutes	Subjects were allowed to freely explore the virtual environments. The position of participants was not specified.
Mattila et al. (2020)	5 minutes	Subjects were seated on a swivel chair which enabled them to turn 360°.
Menga et al. (2024)	10 minutes	The position of the participants was not specified.
Reese et al. (2021)	5 minutes	Subjects were allowed to freely explore the virtual environments. The position of participants was not specified.
Reese et al. (2022)	5.5 – 9.5 minutes	Subjects were seated on an office chair.
Voigt-Antons et al. (2021)	20 minutes	Subjects were seated.
Wang et al. (2019)	5 minutes	Subjects were seated.

3.3.4. Type of Assessment

For the evaluation of the emotional experience, explicit or implicit measures are used. Explicit measures rely on the conscious and intentional assessment of participants. In this type of measurement, subjects are presented with direct questions or asked for subjective evaluations regarding a specific topic. On the other hand, implicit measures aim to assess individuals' automatic and unconscious reactions. This type of measurement relies on indirect indicators of responses, such as reaction times or physiological measurements. In the included studies, it emerges that both implicit and explicit measurements were used, sometimes in combination. Specifically, implicit measures were used to assess arousal, while self-reports questionnaires were mostly used to obtain information about the valence of the emotional states.

Explicit measurements. An overview of all the explicit measurements is presented in **Table 3.5**. Among this type of measure, the Positive and Negative Affect Schedule (PANAS; Watson, et al., 1988) is the most commonly used in the explored literature. The PANAS, in its original version, consists of 20 items, divided equally into two dimensions: positive affect (e.g., enthusiastic, interested, inspired, active) and negative affect (e.g., upset, scared, nervous, irritable). Seven studies, including those by Menga et al. (2024), Masters et al. (2022), Reese et al. (2022), Graf et al. (2020), Mattila et al. (2020), Hong et al. (2019), and Anderson et al. (2017), employed the PANAS in its original version to effectively assess positive and negative emotional states.

Four studies including Yu et al. (2020), Gao et al. (2019), Wang et al. (2019), and Yu et al. (2018) used another self-report tool to assess multiple mood dimensions, which is the Profile of Mood States (POMS; McNair et al., 1971). Yi-Lei et al. (2023) and Yu et al. (2020) employed the poms scale to assess six distinct mood dimensions, namely tension or anxiety, anger or hostility, vigour or activity, fatigue or inertia, depression or dejection, and confusion or bewilderment. this tool not only captured the emotional experiences categorising them in two dimensions (positive and negative mood) but also allowed for the calculation of Total Mood Disturbance (TMD). In their analysis, TMD was derived by subtracting the vigour scores from the cumulative scores of the negative mood dimensions, providing a measure of overall mood disturbance. Gao et al. (2019) and Yu et al. (2018) assessed seven mood states, including esteem, as well as the traditional POMS dimensions. Gao et al. (2019) used the 40-item POMS Short Form (POMS-SF), while Yu et al. (2018) a Mandarin-translated questionnaire. Lastly, Wang et al. (2019) used the Brief POMS (BPOMS), a shorter version of the original POMS with 30 items. This version simplifies the assessment by focusing on five core dimensions: tension, anxiety, fatigue, vigour, and confusion–depression.

The study of Voigt-Antons et al. (2021) used the Self-Assessment Manikin (SAM; Bradley and Lang, 1994), a non-verbal, pictorial measurement scale, to assess the emotional states, specifically focusing on two dimensions: valence and arousal. They used SAM with a nine-point scale to measure valence and arousal, providing a quantitative assessment of the emotional responses.

Chan et al. (2023), used the Scale of Positive and Negative Experience (SPANE, Diener et al., 2010), which includes twelve items divided into two dimensions: positive affect and negative affect. Participants rated the extent to which they experienced each emotion on a scale from 1 (not much or not at all) to 5 (very much), providing a measure of their overall emotional state.

Mattila et al. (2020) and Reese et al. (2022) used the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997), which refers to the state of feeling alive and alert–to having energy available to the self. Ultimately, Masters et al. (2022) used the Zuckerman Inventory of Personal Emotional Reactions (ZIPERS; Zuckerman, 1977) to investigate feelings evoked in specific environments.

Table 3.5. *Explicit measurements adopted by studies included in Review 2*

Type of explicit measures	Study
Positive and Negative Affect Schedule (PANAS) (two dimensions: positive affect and negative affect)	Menga et al. (2024)
	Masters et al. (2022)
	Reese et al. (2022)
	Graf et al. (2020)
	Mattila et al. (2020)
	Hong et al. (2019)
	Anderson et al. (2017)
	Reese et al. (2021)
	Ho et al. (2023)
	Browning et al. (2020)
Profile of Mood States (POMS) (six dimensions; tension, depression, anger, fatigue, vigor, and confusion)	Yi-Lei et al. (2023)
	Yu et al. (2020)
	Gao et al. (2019)
	Wang et al. (2019)
	Hong et al. (2019)
	Yu et al. (2018)
Self Assessment Manikin (SAM) (three dimensions: valence, arousal, and dominance)	Voigt-Antons et al. (2021)
Scale of Positive and Negative Experience (SPANE) (two dimensions: positive and negative emotions)	Chan et al. (2023)
Subjective Vitality Scale (SVS) (one dimension about sense of energy, aliveness, and vitality)	Reese et al. (2022)
	Mattila et al. (2020)
Zuckerman Inventory of Personal Emotional Reactions (ZIPERS) (situation-specific trait-state test for affective responses)	Masters et al. (2022)

Implicit measurements. On the other hand, some of the included studies used a range of physiological measures, as implicit measures, to assess participants' emotional and physiological responses to virtual natural environments. An overview of all the explicit measurements is presented in **Table 3.6**.

One common measure is the Skin Conductivity Levels (SCL), which was used by Menga et al. (2024) and Browning et al. (2020). This measure evaluates the skin's electrical conductance, which varies with moisture levels and provides an indication of emotional arousal. Additionally, Non-Specific Skin Conductance Responses (nSCR), which measure distinct changes in skin conductance associated with emotional reactions, were used by Menga et al. (2024).

Electrodermal activity (EDA), another related measure, was employed by Anderson et al. (2017) to assess overall changes in the skin's electrical conductance, reflecting sweating and emotional arousal.

Heart rate (HR) monitoring was a widely used measure across several reviewed studies, including those by Voigt-Antons et al. (2021), Yu et al. (2020), Yi-Lei et al. (2023), Wang et al. (2019), Hong et al. (2019), Yu et al. (2018), and Ho et al. (2023). This measure provides data on the number of heart beats per minute, which can indicate levels of stress and relaxation.

Closely related is Heart Rate Variability (HRV), which measures the variation in time intervals between heartbeats. HRV provides a unique and non-invasive assessment of autonomic nervous system control over cardiovascular dynamics, which change during different affective states, thereby offering valuable insights into physiological arousal. This measure was used by Voigt-Antons et al. (2021), Anderson et al. (2017), Yi-Lei et al. (2023), Hong et al. (2019), and both studies by Yu et al. (2018, 2020). Yu et al. (2020) also investigated the activity levels of the sympathetic and parasympathetic nervous systems (SNS and PNS) to further understand stress and relaxation responses. Activation of the SNS redirects the body's resources from processes like digestion and resting to organs involved in physical activity, such as the heart and pupils. In contrast, the PNS is activated during restful states, such as after eating or while relaxing.

Salivary amylase concentration, an indicator of stress response, was measured by Wang et al. (2019) and Yu et al. (2018). This measure evaluates the level of the amylase enzyme in saliva, which indicates stress-reactive bodily changes.

The electroencephalogram (EEG) was used by Gao et al. (2019) to record electrical activity in the brain. Indeed, EEG can be used to detect many activities in the brain, such as stress.

Lastly, blood pressure was another measure used to detect stress. Studies by Yu et al. (2020), Ho et al. (2023), Wang et al. (2019), and Yu et al. (2018) incorporated this measure, which evaluates stress levels by monitoring hypertension. In fact, stress can elevate blood pressure and stimulate the nervous system to produce large amounts of vasoconstricting hormones, leading to increased blood pressure.

Table 3.6. *Implicit measurements adopted by studies included in Review 2*

Type of implicit measures	Study
Skin conductivity levels (SCL) (continuous electrical skin conductance, indicating arousal)	Menga et al. (2024)
	Browning et al. (2020)
Significant skin conductance responses (nSCR) (tracks specific, momentary changes in skin conductance, indicating physiological responses to stimuli)	Menga et al. (2024)
Electrodermal activity (EDA) (changes in skin conductance that reflect arousal and stress)	Anderson et al. (2017)
Heart rate (HR) (number of heart beats per minute, commonly used to assess physical and emotional arousal)	Voigt-Antons et al. (2021)
	Yu et al. (2020)
	Yi-Lei et al. (2023)
	Wang et al. (2019)
	Hong et al. (2019)
	Yu et al. (2018)
	Ho et al. (2023)

Heart rate variability (HRV) (the variation in time intervals between heart beats, reflecting the balance between the sympathetic and parasympathetic nervous systems)	Voigt-Antons et al. (2021)
	Anderson et al. (2017)
	Yi-Lei et al. (2023)
	Hong et al. (2019)
	Ho et al. (2023)
	Yu et al. (2018)
	Yu et al. (2020)
Activity level of sympathetic and parasympathetic systems (the activation of the body's stress and relaxation responses)	Yu et al. (2020)
Salivary amylase concentration (enzyme in saliva as a biomarker for stress and SNS activity)	Wang et al. (2019)
	Yu et al. (2018)
Electroencephalogram (EEG) (measures electrical activity in the brain)	Gao et al. (2019)
Blood Pressure (measures the force of blood against the walls of arteries, used to assess stress and cardiovascular responses)	Yu et al. (2020)
	Ho et al. (2023)
	Wang et al. (2019)
	Yu et al. (2018)

3.3.5. Summary of the evidence

This section summarizes the key findings from the reviewed studies regarding the impact of virtual nature interventions on emotional experiences, highlighting the major trends and insights. First, the evidence related to the valence component of emotion elicitation are examined, followed by an analysis of the arousal component.

Valence. Almost all the studies reviewed in this paper examined the effects of virtual natural environments on emotional valence.

Specifically, Anderson et al. (2017) found that exposure to natural blue environments, including locations with large expansive vistas with water and beach locations, effectively reduced negative affect but did not significantly alter positive affect. This suggests that the soothing visual elements of water and beach scenes, combined with the comfortable setting, were able to reduce negative mood. Similarly, Browning et al. (2020) observed that while outdoor natural environments significantly increased positive affect, the VR nature condition (forest) did not show a statistically significant improvement in positive affect. However, all conditions, including the indoor control and VR nature, effectively reduced negative affect. The study involved participants sitting and walking in a VR forest setting, with instructions to relax and enjoy the environment.

Gao et al. (2019) found that various blue and green natural environments significantly reduced negative mood without affecting positive mood, with partly open green space being the most effective. Also, Menga et al. (2024) noted no significant changes in positive affect after VR immersions in urban and peri-urban park scenarios, though unexpectedly the nature conservation area scenario resulted in a significant decrease in positive affect. However, all scenarios effectively reduced negative emotions.

Chan et al. (2023) reported that virtual green meadows significantly increased positive affect, whereas red savannah and museum conditions did not significantly change either positive or negative affect. This indicates that the green natural environment had a greater impact on positive emotions compared to the red one. Additionally, Graf et al. (2020) noted an increase in positive mood and a slight decrease in negative mood, though neither change was statistically significant. The study had participants interact in a virtual forest with an ocean or mountain view for 30 minutes.

Ho et al. (2023) showed that exposure to virtual natural environments, such as green areas of parks, hiking trails, forest paths, and bikeways, significantly increased positive affect and decreased negative emotions. In the study of Hong et al. (2019), the exposure to a virtual forest reported significant improvements in various dimensions of mood, including increased vigour and decreased tension-anxiety, depression-dejection, and anger-hostility. Similarly, Mattila et al. (2020) demonstrated significant improvements in positive emotional states after exposure to a forest in VR, where participants could rotate freely while seated. Additionally, Yu et al. (2018) and Yu et al. (2020) reported that virtual forest environments significantly reduced negative emotional states such as confusion, fatigue, anger-hostility, tension, and depression while increasing positive feelings and vigour. The first study involved younger adults, while the second focused on middle-aged and older adults, thus generalizing the effect across both age groups.

Reese et al. (2021) and Reese et al. (2022) both found significant increases in positive affect and decreases in negative affect following VR immersions in coastal nature and forest environments, respectively. Voigt-Antons et al. (2021) reported that a VR nature experience significantly improved the valence of the emotions after a VR horror game. Wang et al. (2019) found that virtual forest environments effectively reduced mood disturbances, including anxiety and confusion, while increasing vigour. Finally, Masters et al. (2022) found no significant changes in either positive or negative affect, though there were trends in the data indicating a decrease in negative emotions and an increase in positive affect.

Table 3.7 provides an overview of the evidence regarding emotional responses in terms of valence.

Table 3.7. *Summary of the evidence from Review 2 regarding emotional valence*

Study	Type of virtual natural environments	Valence	
		Positive emotions	Negative emotions
Anderson et al. (2017)	Ireland (green + blue)	No significant change	Decreased
	Dream Beach	No significant change	Decreased
Browning et al. (2020)	Forest	No significant change	Decreased
Chan et al. (2023)	Green Meadow	Increased	No change
	Red Savannah	No change	No change
Gao et al. (2019)	Open pond with some greenery	No significant change	Decreased
	Partly closed green space	No significant change	Decreased
	Partly open green space	No significant change	Decreased
	Open green space	No significant change	Decreased
Graf et al. (2020)	Forest with the view of the ocean or a mountain.	Increased (Not significant)	Decreased (Not significant)
Ho et al. (2023)	Areas with parks, hiking trails, forest paths, and bikeways	Increased	Decreased
Hong et al. (2019)	Forest	Increased	Decreased
Masters et al. (2022)	Forest	Increased	Decreased (Not significant)
	Canyon	Increased	Decreased (Not significant)
Mattila et al. (2020)	Forest	Increased	Decreased
Menga et al. (2024)	Urban park	No significant change	Decreased
	Peri-urban park	No significant change	Decreased
	Nature reserve area	Decreased	Decreased
Reese et al. (2021)	Coastal nature	Increased	Decreased
Reese et al. (2022)	Forest	Increased	Decreased
Voigt-Antons et al. (2021)	Green Meadow	Increased	
Wang et al. (2019)	Forest	Increased	Decreased
Yi-Lei et al. (2023)	Green Meadow	Increased	Decreased
Yu et al. (2018)	Forest	Increased	Decreased
Yu et al. (2020)	Forest	Increased	Decreased

Arousal. The impact of virtual natural environments on arousal was also examined across a significant number of studies, where high arousal is also referred to as physiological stress and low arousal is also defined as relaxation or restoration.

Anderson et al. (2017) found that exposure to blue natural scenarios resulted in a marked decrease in EDA compared to an indoor control scene, indicating a deeper and more sustained relaxation effect. Gao et al. (2019) found that various natural environments, including an open pond with greenery, partly closed green space, partly open green space, and open green space, all significantly decreased arousal as measured by EEG readings, indicating a calming effect across different natural blue and green settings.

Ho et al. (2023) reported improvements in indicators of HRV compared to the control group (with no intervention), including standard deviations of all normal-to-normal intervals, low-frequency power, and high-frequency power, suggesting the power of VR nature in reducing physiological stress. Hong et al. (2019) found that a VR forest video significantly lowered the stress index and increased HRV, suggesting enhanced physiological resilience and reduced stress.

Wang et al. (2019) found that virtual forest environments were more effective in reducing physiological stress indicators, such as blood pressure and salivary amylase levels, compared to highly artificial urban environments. Yi-Lei et al. (2023) found that interaction with hand gestures in VR significantly reduced tension and anxiety compared to no interaction or interaction with handles, suggesting that a higher immersion produces the best effect on stress relief.

The study by Menga et al. (2024) revealed that immersion in the peri-urban park and nature conservation area was associated with a significantly faster and more consistent decrease in SCL compared to the urban park. Moreover, nSCR in the nature conservation area remained significantly lower than in the urban park. This result demonstrates how higher biodiversity levels are linked to faster and more substantial stress recovery.

Yu et al. (2018) found that participants' systolic blood pressure and HR decreased over time, regardless of the type of environment (forest and urban). This suggests that the decrease in blood pressure and heart rate was not specifically influenced by the type of environment. At the same way, Yu et al. (2020), reproposing a similar study with older adults, observed no significant physiological differences between virtual natural and urban environments. The short duration of VR immersion (10 minutes) was considered a potential factor for the lack of significant physiological responses.

On the other hand, Browning et al. (2020) observed that both the nature conditions, whether outdoors or via VR, were associated with increased SCL, indicating higher physiological arousal. However, it should be noted that this increase in physiological arousal was accompanied by enhanced positive affect. This suggests that the heightened arousal was more associated with a state of excitement rather than relaxation, yet still having a positive impact on the emotional states.

Lastly, Voigt-Antons et al. (2021) reported no significant change in HRV after exposure to a virtual green meadow, arguing that the five- minute time span, participants spent in each condition, was too short for showing clearer results concerning arousal values and HR measures.

Table 3.8 provides an overview of the evidence regarding emotional responses in terms of arousal.

Table 3.8. *Summary of the evidence from Review 2 regarding emotional arousal*

Study	Type of virtual natural environments	Arousal
Anderson et al. (2017)	Ireland areas (green + blue)	Decreased
	Dream Beach	Decreased
Browning et al. (2020)	Forest	Increased
Gao et al. (2019)	Open pond with some greenery	Decreased
	Partly closed green space	Decreased
	Partly open green space	Decreased
	Open green space	Decreased
Ho et al. (2023)	Areas with parks, hiking trails, forest paths, and bikeways	Decreased
Hong et al. (2019)	Forest	Decreased
Menga et al. (2024)	Urban park	Increased
	Peri-urban park	Increased
	Nature conservation area	Decreased
Voigt-Antons et al. (2021)	Green Meadow	No significant change
Wang et al. (2019)	Forest	Decreased
Yi-Lei et al. (2023)	Green Meadow	Decreased
Yu et al. (2018)	Forest	Partially decreased
Yu et al. (2020)	Forest	No significant change

3.4. Discussion

This narrative review examined 17 international studies conducted over the past 10 years to explore the impact of natural virtual environments on emotion elicitation. The main findings are outlined below, addressing the specific research questions.

What types of interventions have been adopted by previous studies and which have been the most effective?

The studies reviewed employed various methods to expose participants to virtual natural environments, with differences in the length of exposure and specific techniques used. The duration of exposure ranged from short sessions of five minutes (Chan et al., 2023; Gao et al., 2019; Hong et al., 2019; Mattila et al., 2020) to longer sessions of 30 minutes (Graf et al., 2020; Ho et al., 2023). The modalities included seated viewing with or without the possibility to move freely (Ho et al., 2023; Yu et al., 2018; Yu et al., 2020), walking in place (Browning et al., 2020), and interacting with the environment in different ways (Yi-Lei et al., 2023). The most effective interventions were those that combined longer durations with higher levels of interaction, allowing participants, through hand gestures, to immerse themselves deeply in the virtual natural environments. This comprehensive engagement appears crucial for maximizing the emotional and physiological benefits of VR nature experiences.

What types of natural environments have been utilized? How do different natural environments differ in their ability to elicit emotions in Virtual Reality?

The studies included in the present review employed a broad spectrum of virtual natural environments, categorized into green, blue, red, and brown environments.

Green spaces were the most frequently utilized, with a strong focus on virtual forests. Only two studies adopted blue spaces virtual environments. Some studies included different kinds of environments or mixed environments. Gao et al. (2019)

included environments with open ponds and greenery, combining elements of blue and green spaces. Graf et al. (2020) also utilized mixed environments, featuring forests with views of oceans or mountains. Red and brown environments were less common, with two studies focusing on these settings. Chan et al. (2023) examined a red savannah, and Masters et al. (2022) studied canyons along with forest environments.

Which type of natural environment is most effective in eliciting emotions with positive valence?

This review reveals that virtual green meadows and forest environments are the most effective in eliciting positive emotions. Specifically, green meadows consistently demonstrated an ability to enhance positive affect across multiple studies (Chan et al., 2023; Voigt-Antons et al., 2021; Yi-Lei et al., 2023). This trend indicates that green meadows are particularly effective in generating positive emotional responses in virtual environments.

Similarly, virtual forests also showed a strong capacity to elicit positive emotions. Indeed, studies by Browning et al. (2020), Hong et al. (2019), Mattila et al. (2020), Masters et al. (2022), Reese et al. (2022), Wang et al. (2019), Yu et al. (2018), and Yu et al. (2020) found that forest environments increased positive emotions, although in some cases, these increases were not statistically significant. Despite the variability in significance, the consistent trend across multiple studies underscores the effectiveness of virtual forests in enhancing positive emotional experiences. In contrast, other types of environments such as blue spaces (e.g., beaches, coastal environments) and red or brown environments (e.g., red savannahs, canyons) showed less consistent effects on positive emotions. For example, Anderson et al. (2017) and Reese et al. (2021) reported no significant change in positive affect from blue spaces, while Chan et al. (2023) and Masters et al. (2022) found mixed results for red and brown environments. Further exploration is needed to identify potential factors contributing to the variability in their effects.

Which type of natural environment is most effective in reducing arousal?

The analysis of the included studies reveals that virtual forests as green spaces are most effective in reducing arousal. Specifically, studies by Hong et al. (2019), Wang et al. (2019), and Yu et al. (2018) reported decreases in arousal associated with forest environments, indicating their effectiveness in promoting relaxation. Additionally, various types of green spaces, including open green space and partly closed green space, were discovered to be effective in decreasing arousal levels (Ho et al., 2023; Gao et al., 2019). In contrast, green meadows demonstrated mixed results. While Yi-Lei et al. (2023) found a decrease in arousal associated with green meadows, Voigt-Antons et al. (2021) reported no significant change in arousal after exposure to a green meadow. This variability requires further exploration, given the limited number of studies conducted and analysed on these specific environments.

Blue spaces also showed a notable reduction in arousal, as evidenced by Anderson et al. (2017) and Gao et al. (2019), where expansive blue vistas and open ponds with greenery contributed to decreased arousal, validating the calming effect of water elements. However, it is important to note that the effect of blue spaces was less frequently studied compared to green environments.

Limitations and future directions. This state-of-the-art narrative review provides a comprehensive overview of current research about emotion elicitation through VR; however, it is important to acknowledge its limitations and suggest directions for future works.

Firstly, the selection of databases used for this review was limited to only three major sources. Although these databases are extensive and widely recognized, the exclusion of additional databases may have resulted in the omission of relevant studies. This limitation could have introduced a selection bias, potentially impacting the scope and comprehensiveness of the review. Therefore, future reviews should incorporate a broader range of databases to ensure a more exhaustive collection of relevant literature.

Secondly, this review did not include grey literature, that often contains valuable insights and can provide a more comprehensive perspective on the topic under investigation. The exclusion of these sources may have limited the understanding of the full spectrum of research findings and practical applications. Incorporating grey literature in future reviews of VR's potential in emotion elicitation would enhance the comprehensiveness and depth of the analysis.

Another limitation is the lack of a formal quality assessment of the included studies. Quality assessment is crucial to ensure that conclusions are drawn from robust and reliable evidence. The absence of such an assessment means that this review may include studies of varying methodological quality, potentially affecting the reliability and validity of the conclusions. Future reviews about the topic should implement systematic quality assessments to evaluate the methodological rigour, risk of bias, and relevance of each study, thereby ensuring that findings are based on high-quality evidence.

Additionally, future reviews should consider analysing the impact of various dimensions of User Experience on the sense of presence and the emotions elicited. Understanding how factors such as usability, engagement, and satisfaction influence emotional responses, and the sense of presence can provide deeper insights and inform the design of more effective and emotionally resonant user experiences. By addressing these areas, future reviews can enhance the comprehensiveness and reliability of the findings, ultimately contributing to a more nuanced understanding of the factors that influence emotional experiences and the sense of presence.

3.5. Conclusion

The review of studies on virtual natural environments reveals several key insights into their effectiveness and variations in terms of emotion elicitation. Different interventions, including the duration of exposure and interaction methods, played a significant role in the effectiveness of virtual nature experiences. Longer sessions, especially those involving interactive elements such as hand gestures, proved to be the most effective in enhancing emotional and physiological benefits.

Among the various types of natural environments used, green spaces, particularly virtual forests, were the most frequently studied and showed consistent effectiveness in both reducing arousal and eliciting positive emotions. Green meadows also emerged as highly effective in evoking positive emotions, although their impact on reducing arousal showed some variability. Blue spaces, while less frequently studied, also contributed to reduced arousal, particularly in environments featuring expansive water vistas. In contrast, red and brown environments, such as red savannahs and canyons, were less common and showed less consistent effects on emotional outcomes.

Overall, the findings underscore the strong impact of green environments, particularly forests and meadows, in promoting relaxation and positive emotional states, with variations observed in less commonly studied environments like blue spaces.

CHAPTER 4.

Context Matters:

Development of the Concept of Location Selection and Validation of a Scale for Natural Environments

4.1. Introduction

Building on the evidence from previous chapters, which highlight the role of natural environments, and more generally environmental context, in supporting emotion regulation processes, this chapter introduces the concept of "location selection" as a new category within emotion regulation strategies, with particular emphasis on how the choice of natural settings can facilitate effective emotional management.

As reviewed earlier, an increasing body of research suggests that being in natural environments, as opposed to urban ones, can alleviate various negative emotional states, such as anger, frustration, and sadness, while fostering positive emotions, like joy, vitality, and awe (e.g., McMahan & Estes, 2015). Furthermore, natural spaces have been shown to support a range of emotion regulation strategies, from modifying situations and directing attention to cognitive reappraisal and response modulation (Bratman et al., 2021). Despite these insights, many studies utilizing this framework in natural settings have relied on emotion regulation measures that primarily assess stable, context-independent traits. These tools focus on capturing how individuals typically perceive themselves across a variety of contexts, but fail to consider how specific environments shape the use of emotion regulation strategies.

To better understand the role of environmental context in emotion regulation, more context-sensitive measures are needed, ones that account for the dynamic relationship between place and emotions, as emotional responses and regulation strategies can vary depending on the environment individuals inhabit.

Although there is widespread recognition of nature's mental health benefits, existing tools are limited in their ability to fully capture the diverse ways in which natural spaces contribute to emotion regulation. For instance, Johnsen's (2011, 2013) measures provide useful insights into the motivations for seeking nature and its perceived effects, but they do not address the full scope of emotional processes influenced by natural environments. Moreover, Korpela and colleagues (2018) added environment-related items to an existing affect regulation inventory, demonstrating that environmental strategies represent a distinct factor in emotion regulation. Nonetheless, their research primarily focuses on how environments are used for situation selection and modification, leaving other regulatory mechanisms unexplored.

To address this gap, more refined measures are needed to explore how natural environments, and different types of settings in general, support various forms of emotion regulation. In this context, the concept of ideal affect, which refers to the emotional states individuals strive for, becomes particularly relevant (Tsai, 2007). Research shows that individuals differ in their desired affective states, influencing their emotion-regulatory goals and behaviours. Natural environments, with their wide range of recreational activities and affordances, may offer opportunities for individuals to regulate their emotions in alignment with their ideal affect, whether it be high-arousal or low-arousal positive states.

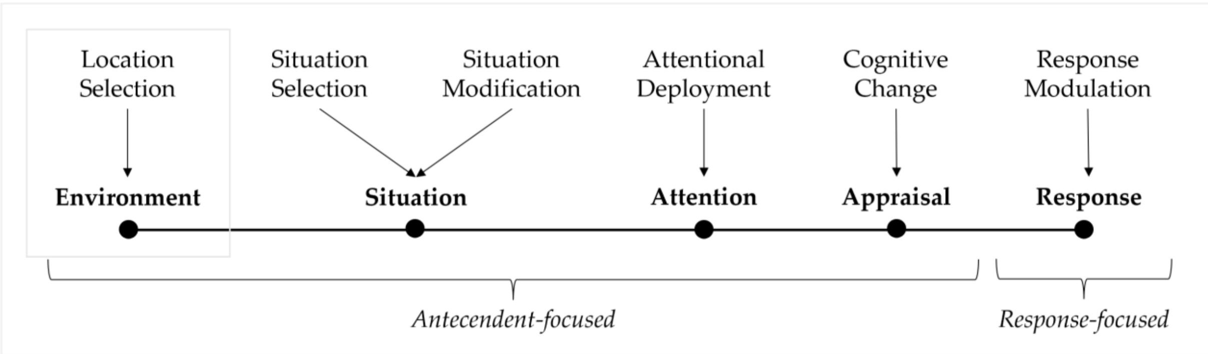
The development of the "location selection" category of emotion regulation thus proposes to include environmental context as a preliminary step in emotion regulation processes. For this purpose, this chapter introduces and validates a self-report measurement scale designed to target such a construct: i.e., to assess how different environments, with a specific focus on natural ones, are chosen by an individual person in order to facilitate her/his individual emotion regulation process.

The scale will first be validated in English (Study 1 and Study 2, including a follow-up Study 2 - T_2 to assess test-retest reliability) and subsequently translated and validated into Italian (Study 3), ensuring its broader applicability in both international and national contexts. Moreover, the scale will be applied to specific spaces (Study 4) to explore how particular types of natural environments contribute to emotion regulation, offering a more nuanced understanding of how environmental features influence emotional processes across diverse contexts.

4.1.1. Definition of Location Selection

The starting point of this section involves the theoretical conceptualization of a new category of emotion regulation strategies, termed "location selection", which precedes the strategies already defined in Gross's Process Model (1998), as discussed in **Chapter 1** (**Section 1.4**). In Gross's original model, environmental settings are not explicitly addressed as part of the emotion regulation process, although they could arguably be included within the broader category of situation selection. However, situation selection is not exclusively concerned with socio-physical environments (i.e., places), having been defined as "*approaching or avoiding certain people, places, or objects in order to regulate emotions*" (Gross, 1998, p. 283). This broader definition extends beyond the environmental context and setting in which the emotion regulation process occurs. Therefore, it is crucial to emphasize the significance of identifying the geographical location, in terms of environmental place, where emotion regulation strategies are subsequently applied, as different places possess distinct affordances that can influence the effectiveness and type of regulation strategies used. **Figure 4.1** illustrates how this new category integrates with and extends the existing model.

Figure 4.1. *The adapted Process Model of Emotion Regulation with the integration of the location selection category*



Location selection, as a preliminary and distinct strategy, emphasizes the role of the environment, specifically certain places, in emotion regulation. Different environments possess unique affordances—characteristics that provide behavioral, cognitive, and emotional opportunities (Gibson, 1979)—which can influence how effectively an individual regulates their emotions. For instance, natural environments may afford specific types of emotional experiences and regulation strategies that differ from urban settings, making the choice of location critical in emotional management.

Location selection as an emotion regulation strategy can be employed in response to negative emotions, stressful events, or even in the pursuit of an ideal emotional state. In these cases, individuals may intentionally choose a specific location based on their expectations of how that environment will impact their emotional state. Following the selection of the location, individuals can then determine the specific situation (e.g., social context, activities) within that environment.

In the scale to be validated, location selection is conceptualized as a contextual choice, where individuals deliberately select environments—especially natural ones (Korpela, 2003)—that align with their preferences for effective emotion regulation. This involves considering the congruence between emotional goals, individual preferences, and the characteristics of the chosen location.

One broad theoretical framework that supports this emphasis on environmental context is Lewin's (1951) equation, $B = f(P,E)$, which posits that behaviour (B) is a function of both the person (P) and the environment (E). Lewin's field theory explains behaviour as a result of the current interaction between an individual and their present environment, rather than past experiences. This theory highlights the dynamic relationship between person and environment, focusing on how an individual perceives and interacts with their surroundings. Historically, emotion regulation theories have predominantly focused on the individual (P), with limited attention given to the physical environment (E). The present research aims to expand this perspective by incorporating the physical environment into emotion regulation models.

The concept of location selection builds also upon and extends the framework of affective appraisals by emphasizing the behavioral and goal-directed aspects of human-environment interactions, particularly in the context of emotion regulation. Affective appraisals, as established in previous research, involve evaluations of the emotional or sensory qualities of environments, such as "relaxing," "exciting," or "stressful" (Franz, 2005; Nasar, 2008; Russell & Snodgrass, 1987). These appraisals capture cognitive or emotional judgments about a place's affective qualities and its potential to elicit particular emotional states. Grounded in the circumplex model of affect (Russell, 2003), they describe how environments are perceived along dimensions of valence and arousal, offering insights into their emotional characteristics. While such appraisals provide valuable descriptive insights, they remain largely evaluative and passive, focusing on the qualities attributed to places without considering the active use of these environments for specific emotional purposes. In contrast, Location Selection introduces a dynamic, action-oriented perspective by examining how individuals intentionally and strategically choose environments based on their perceived ability to regulate emotional states. While affective appraisals capture individuals' evaluations of an environment's emotional qualities or its potential to influence mood, location selection emphasizes the intentional decision-making process of engaging with a particular setting to achieve a specific emotional outcome.

Although these two concepts may be coherent and interconnected, they can also diverge. For instance, an individual might appraise a natural space as "calm" but may not actively choose to visit it for emotion regulation purposes, perhaps due to situational constraints, differing emotional needs, or alternative regulatory strategies. This distinction underscores the added behavioral dimension of location selection, highlighting its focus on purposeful action rather than mere evaluation. This deliberate, goal-driven engagement with environments marks a key difference between the two concepts, emphasizing the functional role of places in supporting emotional recovery or regulation.

Indeed, Location Selection differs from affective appraisals by highlighting its behavioral component, where individuals exercise agency in choosing settings based on their regulatory goals. Affective appraisals are evaluative and static, providing judgments that may or may not translate into action. Location selection, however, inherently involves action, linking appraisals to intentional decisions aimed at managing emotions. This process aligns with emotion regulation theories, which focus on how individuals engage with external contexts to influence their internal states (Gross, 2015; Koole, 2009). It also emphasizes the functional utility of environments, where the choice of a location is directly tied to its perceived ability to achieve emotional goals.

The temporal and situational context further distinguishes location selection from affective appraisals. While appraisals often reflect stable perceptions of an environment's qualities, location selection is dynamic and shaped by the individual's emotional needs and regulatory goals. For instance, a person might select a quiet park to alleviate anxiety after a challenging day but opt for a more vibrant garden to increase energy during a social gathering. This context-dependence underscores the adaptability of location selection as a regulatory strategy, illustrating how individuals actively engage with environments to address fluctuating emotional states and their ideal affect.

Additionally, location selection incorporates an outcome-oriented perspective, focusing on the anticipated emotional effects of engaging with a chosen environment. Affective appraisals describe how individuals perceive an environment but do not necessarily link these perceptions to specific emotional outcomes. In contrast, location selection centers on the practical use of environments as tools for emotion regulation, where the chosen setting is expected to lead to tangible benefits, such as reduced stress or enhanced energy. This distinction aligns location selection with the dual-process framework of emotion regulation (Koole & Rothermund, 2011; Gyurak et al., 2011), which highlights both implicit and explicit processes in achieving emotional balance.

By bridging the descriptive nature of affective appraisals with the behavioral focus of emotion regulation, the concept of Location Selection offers a novel perspective on human-environment interactions. It shifts the focus from how environments are perceived to how they are used, providing a deeper understanding of the functional relationship between place and emotion to advance theoretical and practical applications.

While affective appraisals provide foundational insights into how places are experienced emotionally, location selection emphasizes their active use as strategies for emotional well-being. This behavioral dimension enriches the discourse on the restorative and regulatory functions of natural environments, offering practical implications for nature-based interventions and therapeutic practices aimed at fostering emotional recovery and resilience. By connecting perception and action, the concept of location selection contributes to a more comprehensive understanding of how environments are not only passively experienced but also actively utilized in managing emotional states.

The primary goal of this work is to address a significant theoretical and empirical gap by developing and validating a context-dependent scale capable to assess the role of the environment in the individual's emotion regulation processes.

While this tool could be applied to various environments in terms of settings or place categories (e.g., home, office, shopping centres), the initial validation phase will focus specifically on natural environments as the working example.

This focus is driven by the growing general interest in understanding how nature contributes to emotion regulation and well-being, as highlighted by emerging research on the benefits of natural settings for emotional and cognitive processes (e.g., Astell-Burt et al., 2024; Barragan-Jason et al., 2023; Browning et al., 2024; Gawrych, 2024; Spano et al., 2023).

4.2. Study 1 – Initial scale derivation

Building on prior discussions of location selection as a novel emotion regulation category within the Process Model, this study focuses on developing a scale specifically for natural environments. While existing measures capture broad aspects of emotion regulation, only few items were employed to address how specific settings, like nature, uniquely support these processes. Research has shown that natural environments can reduce negative emotions and enhance positive states (e.g., McMahan & Estes, 2015), indicating that people might intentionally choose these settings to meet their emotional goals. However, the lack of environment-specific tools limits understanding of how place-based choices influence emotional management.

This first study seeks to address this gap by creating and validating the Location Selection in Nature Scale, designed to measure the distinct role of natural environments in emotion regulation. This scale will provide a structured way to assess how individuals intentionally use nature to support their emotional well-being, furthering knowledge about the interplay between context and emotional processes.

Aim and hypotheses. The primary aim of Study 1 is to develop the initial version of the Location Selection in Nature Scale, a measure designed to assess how individuals deliberately choose natural settings to support their emotion regulation processes. The specific objectives include determining the structure and number of items, identifying factor components, and selecting the most representative items to create a shorter, user-friendly version of the scale.

Following the reduction of items, a further objective is to conduct a preliminary assessment of the scale's factorial structure, reliability, and convergent validity. Specifically, this study hypothesizes the following:

H_1) The Location Selection in Nature Scale and its identified factors demonstrate strong internal consistency, as evidence for scales' reliability.

H_2) The Location Selection in Nature Scale and its identified factors show convergent validity with related constructs (e.g., emotion regulation measures, connectedness to nature, time spent in nature), supporting its construct validity.

Scale development. The development of the scale adhered to a structured and methodical process comprising three phases: item development, scale development, and scale evaluation. This approach, based on Hinkin's (1995) framework, was further detailed by Boateng et al. (2018) into nine steps to ensure a thorough and rigorous validation process, which are presented below.

Phase 1: Item development. This phase is focused on generating a pool of items that will serve as the foundation of the scale. It is broken down into two key steps:

1. ***Identification of domain and item generation:*** The first step in scale development is identifying the domain or construct of interest. In this case, the domain of study was the location selection as a new preliminary category of emotion regulation, with a specific focus on the emotional impact of nature spaces, as outlined in **Section 4.1** of this chapter. An extensive review of the literature was also conducted on the topic (refer to **Chapter 2**) and emotion regulation measurement tools to inform the design of the scale. The item structure from the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) was identified as a suitable foundation. The ERQ's format, which focuses on emotional goals like "*When I want to feel happier/less sad, I…*", was adapted for the new context. Following this, items were generated to represent different facets of the construct. Drawing from Russell's Circumplex Model of Affect (1980), four primary emotional dimensions were selected: low-arousal positive emotions (P-L), low-arousal negative emotions (N-L), high-arousal positive emotions (P-H), and high-arousal negative

emotions (N-H). This approach is useful for capturing the potential impact of natural environments across these emotional states. For each dimension, five items were created, resulting in an initial set of 20 items. Responses were rated on a 7-point Likert scale, ranging from 1 = Strongly Disagree to 7 = Strongly Agree. This item pool was based on deductive reasoning, i.e., "classification from above", using insights from existing literature and scales and ensuring that the items generated align closely with the theoretical constructs.

2. ***Content validity evaluation:*** To ensure content validity—defined as the degree to which the items accurately represent the construct (Morgado et al., 2017)—the items were reviewed by five experts in emotion regulation and environmental psychology (i.e., Mathew White, Marino Bonaiuto, James Gross, Gregory Bratman, David Preece). Content validity is critical to confirm that the items assess only the intended domain without overlapping into irrelevant areas (DeVellis, 2012). Specifically, experts evaluated whether the items covered the domain comprehensively and provided feedback about the structure. Revisions were made until consensus was reached, ensuring that the items were clear, representative, and theoretically sound.

Phase 2: Scale development. In this phase, the focus was on refining and structuring the generated items into a cohesive and reliable measurement tool. Key steps included pre-testing the items and the scale's instructions, administering the survey to a larger sample, and conducting statistical analyses to streamline and optimize the scale through item reduction.

3. ***Pre-testing:*** A pre-test was conducted with a small sample (N = 8) of English-speaking adults from the target population to ensure the clarity and comprehensibility of the items. Pre-testing is essential to minimize misunderstandings and cognitive burden on participants, which in turn reduces measurement error (Fowler, 1995). Feedback was gathered and used to refine both the wording of the items and the instructions.

4. ***Survey administration and sampling:*** Following the pre-test, the revised scale was administered to a larger sample of English-speaking adults, aged 18 and over, recruited via the *Prolific* platform. A sample size of about 300 participants was targeted, following recommendations from the literature for conducting robust factor analyses (e.g., Guadagnoli & Velicer, 1988; Clark & Watson, 1995; Comrey & Lee, 2013). Specifically, empirical rule suggests a 10:1 ratio of participants per item, ensuring sufficient power for factor analysis (Schumacker & Lomax, 2015; Kline, 2016; Jackson, 2003). Further, literature recommends that a minimum of 300 respondents allows for adequate representation of the target population and supports the identification of latent constructs (Comrey & Lee, 1992; Comrey et al., 1973; Tabachnick & Fidell, 2013).
5. ***Factor extraction:*** Factor analysis was conducted on the collected data to explore the underlying structure of the scale and reduce the number of items. Factor extraction identifies the optimal number of underlying factors (or domains) that fit a set of items. Through factor analysis, the latent structure and internal consistency of the items are assessed by examining shared variance among them. This process focuses on determining the number of factors, the strength of factor loadings, and the magnitude of residual variances (McCoach et al., 2013) and is also used to reduce the item set. Exploratory Factor Analysis (EFA) was used to identify latent factors and refine the scale, using the 'minimum residual' extraction method in combination with an *oblimin* rotation. This oblique rotation allows factors to take any position in the factor space and to be correlated with each other.
6. ***Item reduction:*** In scale development, item reduction is a critical process to ensure that only the most parsimonious, functional, and internally consistent items are retained (Thurstone, 1947). The goal is to identify items that are minimally related to the domain for potential deletion or modification. Based on the results of the factor analysis, items with low inter-item correlations (< 0.30) or low factor loadings (< 0.40) were eliminated. Items showing cross-loadings or lacking

unique alignment with specific factors were also deleted. This process reduced the scale to 12 items, with three items representing each of the four initially hypothesized dimension of emotional goals.

Phase 3: Scale evaluation. The final phase of the development process involved testing the psychometric properties of the scale, including dimensionality, reliability, and validity.

7. ***Tests of dimensionality:*** Dimensionality of the reduced scale was assessed through both exploratory and confirmatory factor analysis. EFA was performed to identify underlying structures, revealing a two-factor structure, and the Confirmatory Factor Analysis (CFA) was conducted to confirm this structure. To further validate the identified structure, alternative models based on theoretical grounding were analysed in order to confirm its robustness and assess whether other structural configurations could provide a better fit to the data.
8. ***Tests of reliability:*** Reliability was assessed using Cronbach's alpha. Cronbach's alpha was used to assess the internal consistency of the scale items, i.e., the degree to which the set of items in the scale co-vary, relative to their sum score (Cronbach, 1951). Reliability analyses were conducted for each of the two identified factors, as well as for the overall scale. Cronbach's alpha of 0.70 or higher is typically considered acceptable, although values above 0.80 are preferred for scales with high psychometric quality.
9. ***Tests of validity:*** Finally, the scale's validity was assessed focusing on convergent validity. Scale validity refers to how well an instrument measures the intended latent dimension or construct (Raykov, 2011). Specifically, convergent validity was evaluated by comparing the scale with established emotion regulation measures and nature-related aspects to ensure it correlated with similar constructs.

4.2.1. Method – Study 1

Sample. Data were collected through *Prolific*. Participants were compensated \$1.25 for approximately 10 minutes of survey completion.

The initial sample consisted of 316 participants. However, 24 participants were excluded from the analysis: 22 participants failed one or two attentional checks, and 2 additional participants did not finish the entire survey. Consequently, the final sample included 292 participants. The average age of participants was 41.4 years (*SD* = 13.9), spanning a range from 18 to 84 years. The gender distribution was fairly balanced, with 142 females (48.6%), 144 males (49.3%), with five participants identifying as other (1.7%), and one participant preferring not to answer (0.3%).

All participants were living in the United States at the time of the study, and 92.8% reported English as their primary language. 75.3% of the participants identified as White, 6.2% as Asian, 11.6% as Black, 4.1% as Mixed, and 2.7% as other. In terms of education, 48.3% had a bachelor's degree, and 37.3% had a high school diploma, with 49.0% were employed full-time, and 16.1% were employed part-time.

Procedure. Participants completed the full Location Selection in Nature Scale, consisting of 20 items (see **Table 4.1** and **Appendix B.1**), with response options ranging from 1 (strongly disagree) to 7 (strongly agree). In addition to this scale, participants completed the following measures:

- *Situation Selection items* (Webb et al., 2018; with 3 additional items from Duijndam et al., 2021): Participants responded to 10 items assessing their tendency to engage in situation selection, which involves choosing or avoiding situations based on anticipated emotional outcomes (see **Appendix B.2**). This scale distinguishes between engagement (actively selecting situations that may influence emotions; α = .878) and disengagement (avoiding emotionally charged situations; α = .862). Responses were rated on a 5-points scale, from 1 (not at all like me) to 5 (very much like me).

- *Process Model of Emotion Regulation Questionnaire* (PMERQ; Olderbak et al., 2022): A shortened version of the PMERQ was used (see **Appendix B.3**), selecting the three highest-loading items from each subscale (total of 30 items), using a scale from 1 (strongly disagree) to 6 (strongly agree). This questionnaire covers the key stages of the Process Model of Emotion Regulation, including situation selection, situation modification, attentional deployment, cognitive change, and response modulation. Both engagement (active regulation) and disengagement (avoidance) strategies were measured across these stages (α = .648 – .856).

- *Connectedness to Nature Scale* (CNS-14; Mayer & Frantz, 2004; short version CNS-7: Rosa et al., 2022): A 7-item version of the 14 item (α = .907) assessing participants' trait-level emotional connection to the natural world (see **Appendix B.4**). This scale is widely used across countries (Swami et al., 2024). Participants were instructed to respond based on how they generally feel, using a scale from 1 (strongly disagree) to 5 (strongly agree).

- *Nature Exposure* (from the Monitor of Engagement with the Natural Environment – MENE; Natural England, 2018): Two items that measure the frequency of participants' interactions with nature, asking how often, on average, they spent time outdoors in green and natural spaces over the past 12 months, and how many times they visited these spaces in the last 14 days (see **Appendix B.5**).

- *Childhood Nature Exposure* (Blue Health Survey, Grellier et al., 2017): A set of three items (α = .856) designed to evaluate participants' access to and engagement with natural spaces during childhood (ages 0 to 16), with a response scale from 1 (strongly disagree) to 7 (strongly agree). These items address the proximity of natural spaces to their homes, parental attitudes towards playing in nature, and the frequency of visits to natural environments during their formative years (see **Appendix B.6**).

- *Socio-demographic questions*: Participants provided information on their age, gender, number of children, education level, employment status, primary language, and English proficiency (if not their first language) to assess the characteristics of the sample.

Table 4.1. *Full Location Selection in Nature Scale*

CODE	ITEM
N-H_1	I visit nature when I want to unwind from stress.
N-H_2	I go to nature when I want to feel less tense.
N-H_3	I go to nature when I want to feel less anxious.
N-H_4	I visit nature when I want to feel less angry.
N-H_5	I go to nature when I want to feel less annoyed.
N-L_1	I go to nature when I want to feel less sad.
N-L_2	I go to nature when I want to feel less depressed.
N-L_3	I visit nature when I want to feel less bored.
N-L_4	I visit nature when I want to feel less fatigued.
N-L_5	I visit nature when I want to feel less gloomy.
P-H_1	I visit nature when I want to feel more uplifted.
P-H_2	I visit nature when I want to feel more cheerful.
P-H_3	I go to nature when I want to feel more enthusiastic.
P-H_4	I go to nature when I want to feel more inspired.
P-H_5	I go to nature when I want to feel more energized.
P-L_1	I go to nature when I want to feel more relaxed.
P-L_2	I visit nature when I want to feel a sense of tranquility.
P-L_3	I visit nature when I want to feel more at ease.
P-L_4	I go to nature when I want to feel calmer.
P-L_5	I visit nature when I want to feel more content.

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

4.2.2. Results – Study 1

Full scale.

An Exploratory Factor Analysis (EFA) was conducted using the 'minimum residual' extraction method combined with an *oblimin* rotation. Initial assumption checks were conducted. Specifically, Bartlett's test of sphericity ($\chi^2 = 5535$, $df = 190$, $p < .001$) confirmed that the correlation matrix significantly differed from the identity matrix, indicating suitability for factor analysis (Bartlett, 1950). Additionally, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy ranged from 0.920 to 0.977, exceeding the recommended threshold of 0.80, which further supported the suitability of the data for factor analysis (Cerny & Kaiser, 1977).

The EFA identified three distinct factors based on parallel analysis and the significance of factor loadings (> 0.4). The factor loadings are presented in **Table 4.2**.

- *Factor 1*: This factor primarily includes items related to negative high arousal emotions as well as all the items concerning positive low arousal emotions, explaining 34.7% of the variance.
- *Factor 2*: This factor comprises most items with negative low arousal and positive high arousal emotions, except for two items, and explains 18.9% of the variance.
- *Factor 3*: This factor encompasses only two items associated with negative high arousal emotions and one item related to negative low arousal emotions, explaining 15.8% of the variance.

The three-factor solution explains a cumulative 69.4 % of the variance.

Table 4.2. *Factor loadings for EFA on the full LS Scale based on parallel analysis (Study 1)*

	Factor			
	1	**2**	**3**	**Uniqueness**
N-H_1	0.930			0.205
N-H_2	0.794			0.279
N-H_3	0.602			0.309
N-H_4			0.743	0.289
N-H_5			0.894	0.173
N-L_1	0.500			0.366
N-L_2				0.315
N-L_3		0.750		0.382
N-L_4		0.443		0.416
N-L_5			0.494	0.327
P-H_1	0.600	0.415		0.252
P-H_2	0.413	0.522		0.292
P-H_3		0.904		0.187
P-H_4				0.433
P-H_5		0.595		0.378
P-L_1	0.952			0.197
P-L_2	0.815			0.355
P-L_3	0.601			0.307
P-L_4	0.709			0.283
P-L_5	0.477			0.367

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

The third factor's mixed and limited items suggest it may not represent a coherent component of the scale, leading to the decision to reduce the scale's items. This reduction aims to help clarify the factor structure, enhance the scale's clarity and focus, and lead to more interpretable and reliable results. Specifically, it was decided to eliminate items that do not load significantly on a single factor or that cross-load significantly on multiple factors.

Based on this, for the reduced version of the scale, the most suitable three items were selected for each of the four emotional dimensions, resulting in a total of 12 items (refer to **Table 4.3** for the selected items).

Table 4.3. *LS Scale with items reduction*

CODE	ITEM
N-H_1	I visit nature when I want to unwind from stress.
N-H_2	I go to nature when I want to feel less tense.
N-H_3	I go to nature when I want to feel less anxious.
N-L_1	I visit nature when I want to feel less bored.
N-L_2	I visit nature when I want to feel less fatigued.
N-L_3	I visit nature when I want to feel less gloomy.
P-H_1	I visit nature when I want to feel more cheerful.
P-H_2	I go to nature when I want to feel more enthusiastic.
P-H_3	I go to nature when I want to feel more energized.
P-L_1	I go to nature when I want to feel more relaxed.
P-L_2	I visit nature when I want to feel a sense of tranquility.
P-L_3	I go to nature when I want to feel calmer.

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Reduced scale.

Exploratory Factor Analysis. Using the same data set, an exploratory factor analysis (EFA) based on parallel analysis was conducted on the reduced version of the scale and identified two primary factors based on the significance of factor loadings (above 0.4).

The factor loadings and uniqueness values for each item are presented in **Table 4.4**, showing the following results:

- *Factor 1*: This factor includes items related to negative high arousal emotions and positive low arousal emotions and explains 40.9 % of the variance.
- *Factor 2*: This factor encompasses items associated with negative low arousal emotions and positive high arousal emotions and explains 27.4 % of the variance.

The two-factor solution explains a cumulative 68.3% of the variance, indicating a robust structure for the reduced scale.

Table 4.4. *Factor loadings for EFA on the short version of the LS Scale based on parallel analysis (Study 1)*

	Factor		
	1	**2**	**Uniqueness**
N-H_1	0.932		0.193
N-H_2	0.814		0.279
N-H_3	0.679		0.340
N-L_1		0.855	0.358
N-L_2		0.630	0.449
N-L_3		0.443	0.422
P-H_1		0.528	0.317
P-H_2		0.928	0.203
P-H_3		0.619	0.385
P-L_1	0.921		0.203
P-L_2	0.831		0.352
P-L_3	0.779		0.304

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

This structure aligns well with established theories of affective states. Russell and Carroll (1999) proposed a comprehensive framework delineating affective states into six bipolar clusters, characterized by combinations of valence and arousal levels that are semantically opposite pairs (see **Figure 4.2**).

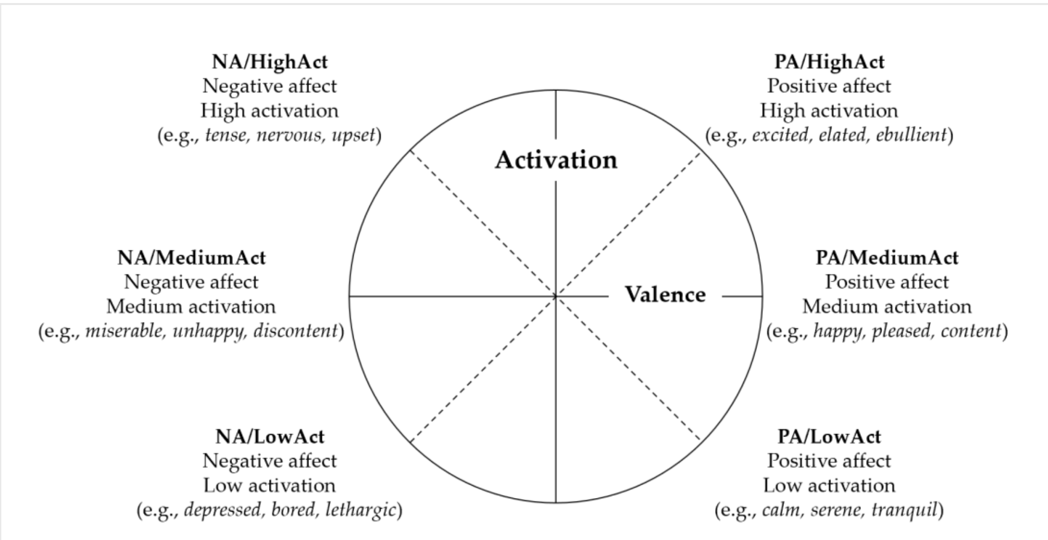
Specifically, the following clusters were identified:

1. Positive affect/high activation vs. negative affect/low activation
2. Positive affect/medium activation vs. negative affect/medium activation
3. Positive affect/low activation vs. negative affect/high activation

The two identified scale's factors can be considered within this framework, specifically focusing on the extremes of valence and activation, while omitting considerations of medium activation levels.

Based on this framework, Factor 1, which includes positive low arousal and negative high arousal emotions, can be termed *down-regulation*: it indicates the process of generating positive emotions with low activation levels and regulating high arousal negative emotions to achieve a more tranquil and balanced emotional state. Conversely, Factor 2, which encompasses positive high arousal and negative low arousal emotions, can be termed *up-regulation*: it reflects the process of amplifying high arousal positive emotions and mitigating negative low arousal emotions to achieve an energized and heightened affective state.

Figure 4.2. *Six clusters of affects by valence and activation (adapted from Russell & Carroll, 1999)*



Confirmatory Factor Analysis. The CFA was conducted to evaluate the fit of the hypothesized two-factor model: Negative high arousal - Positive low arousal emotions (Factor 1: down-regulation) and Negative low arousal - Positive high arousal emotions (Factor 2: up-regulation). Factor loadings are summarized in **Table 4.5**. All factor loadings for the indicators were statistically significant ($p < .001$), indicating robust associations between each indicator and its latent factor:

- *Down-regulation* exhibited standardized loadings ranging from 0.798 to 0.902.
- *Up-regulation* displayed standardized loadings ranging from 0.740 to 0.836.

The covariance between down-regulation and up-regulation was found to be 0.774 (*SE* = 0.0293, 95% *CI* [0.716, 0.831], $p < .001$). This significant covariance suggests a moderate positive relationship between these two factors. The model demonstrated moderately good fit according to fit indices: *RMSEA* = 0.115 (90% *CI* [0.101, 0.129]), *CFI* = 0.928, *TLI* = 0.911, and *SRMR* = 0.0542. These results collectively support the validity of the hypothesized two-factor structure for the scale.

Table 4.5. *Factor loadings for the 2-factors structure of the short version of the LS Scale (Study 1)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
Down-regulation	N-H_1	1.29	0.065	1.163	1.42	19.7	< .001	0.902
	N-H_2	1.23	0.068	1.095	1.36	18.0	< .001	0.855
	N-H_3	1.26	0.078	1.109	1.41	16.2	< .001	0.799
	P-L_1	1.22	0.062	1.096	1.34	19.6	< .001	0.899
	P-L_2	1.09	0.067	0.957	1.22	16.2	< .001	0.798
	P-L_3	1.17	0.069	1.034	1.30	17.0	< .001	0.822
Up-regulation	N-L_1	1.29	0.088	1.118	1.46	14.7	< .001	0.755
	N-L_2	1.26	0.088	1.091	1.44	14.4	< .001	0.740
	N-L_3	1.25	0.085	1.084	1.42	14.7	< .001	0.754
	P-H_1	1.19	0.070	1.052	1.33	16.9	< .001	0.828
	P-H_2	1.32	0.077	1.165	1.47	17.1	< .001	0.836
	P-H_3	1.29	0.081	1.134	1.45	15.9	< .001	0.795

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Alternative Models Testing. Given the significant covariance observed between the two factors, which may suggest the potential for a more parsimonious structure, and to further evaluate the factorial structure of the scale, additional confirmatory factor analyses were conducted to compare the identified two-factor model with alternative configurations of the Location Selection Scale.

Specifically, the following alternative models were tested: (1) a one-factor model, with a general factor including all items; (2) a two-correlated-factor model based on arousal, where one factor includes positive and negative high arousal emotion items, and the other includes positive and negative low arousal emotion items; (3) a two-correlated-factor model based on valence, where one factor includes positive low and high arousal emotion items, and the other includes negative low and high arousal emotion items; (4) four-correlated-factor model based on valence and arousal (i.e., positive high arousal emotions, positive low arousal emotions, negative high arousal emotions, negative low arousal emotions); and (5) a hierarchical bifactor model, with one general second-order factor and two first-order factors of down-regulation and up-regulation.

Goodness-of-fit was assessed using the following indices: (a) chi-square (χ^2); (b) the Root Mean Square Error of Approximation (RMSEA) and its 90% confidence interval; (c) the Standardized Root Mean Square Residual (SRMR); (d) the Comparative Fit Index (CFI); (e) the Tucker-Lewis Index (TLI); (f) the Akaike Information Criterion (AIC); (g) the Bayesian Information Criterion (BIC); and (h) the Expected Cross-Validation Index (ECVI).

Based on established guidelines (Hu & Bentler, 1999; Kline, 1998; Kelloway, 1998), the following cut-off criteria were applied to assess model fit: RMSEA values of 0.10 reflect a reasonable fit, values of 0.06 or lower indicate a good fit, and values below 0.05 represent excellent fit; SRMR values below 0.08 signify a reasonable fit, and values below 0.05 indicate a good fit. For CFI and TLI values of 0.90 or higher indicate a good fit, with values above 0.95 representing excellent fit. Additionally, smaller values for AIC, BCC, and ECVI suggest better model performance, with the ECVI specifically used to compare the relative goodness of fit among different models.

Tables with factor loadings for the one-factor model, for the two-factor models (valence vs. arousal), and for the four-factor model are reported in **Appendix B.7**. Overall, all items significantly loaded on their proposed latent factors in the tested models (standardized coefficients ranged between 0.594 and 0.905, all p's > 0.001).

Table 4.6 presents the goodness-of-fit indices for the five alternative models as well as the two-factor model representing down-regulation and up-regulation.

Based on the comparative fit indices, the results suggest that the two-correlated-factor model based on clusters (down-regulation and up-regulation) and the four-correlated-factor model based on valence and arousal demonstrate the best overall fit among the tested configurations. Both models yielded similar fit indices, with the four-factor model achieving slightly better AIC (10303) and ECVI (1.130), whereas the two-factor cluster model produced a comparable fit with slightly higher ECVI (1.131) and the same SRMR (0.054).

The hierarchical bifactorial model, which includes one general factor and two first-order factors (down-regulation and up-regulation), also performed well, with fit indices comparable to those of the two-factor cluster model (down-regulation and up-regulation). However, the two-correlated-factor cluster model demonstrated slightly better overall fit, including a lower RMSEA (0.115 compared to 0.116), and marginally better parsimony-based indices such as AIC (10304 vs. 10306), BIC (10440 vs. 10445), and ECVI (1.131 vs. 1.138). These results suggest that the cluster model provides a more efficient and interpretable representation of the data while maintaining simplicity. Although the added complexity of the bifactorial model may not offer substantial interpretive advantages, it does provide justification for the use of a general score for the scale.

In contrast, the one-factor model and the two-factor models based on valence or arousal performed poorly, with CFI values below the acceptable threshold (0.828–0.827) and RMSEA values far exceeding the cutoff for good fit (>0.175). These results indicate that these models do not adequately represent the structure of the Location Selection Scale.

Overall, while both the two-factor cluster model and the four-factor model fit the data well, the two-factor model based on clusters (down-regulation and up-regulation) offers a more parsimonious solution with strong theoretical grounding. Additionally, it aligns more closely with the findings from the Exploratory Factor Analysis, which indicated the presence of two distinct factors. These considerations support its selection as the most appropriate representation of the factorial structure of the Location Selection Scale.

Table 4.6. *Goodness-of-fit indexes for the six tested models (study 1)*

Model	χ^2 (df)	RMSEA (90% CI)	SRMR	CFI	TLI	AIC	BIC	ECVI
Two factors – clusters	256 * (53)	.115 * (.101, .129)	.054	.928	.911	10304	10440	1.131
1. One factor	543 * (54)	.176 * (.163, .190)	.078	.828	.789	10588	10720	2.106
2. Two factors – arousal	543 * (53)	.178 * (.164, .192)	.077	.827	.785	10590	10730	2.112
3. Two factors – valence	543 * (53)	.178 * (.164, .192)	.078	.827	.785	10590	10726	2.112
4. Four factors – arousal and valence	246 * (48)	.119 * (.104, .134)	.054	.930	.904	10303	10458	1.130
5. Hierarchical bi-factorial model (clusters + general)	256 * (52)	.116 * (.102, .130)	.054	.928	.909	10306	10445	1.138

Note. * p < .001; χ^2 = chi-square; df = degree of freedom; RMSEA = Root Mean Square Error of Approximation; CI = confidence interval; SRMR = Standardized Root Mean Square Residual; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ECVI = Expected Cross-Validation Index.

H_1) *Reliability analysis.* Reliability analysis was conducted to assess the internal consistency of the sub-scales derived from the exploratory factor analysis. Internal consistency reliability for the full scale and the sub-scales was assessed using Cronbach's alpha coefficients. The full scale showed a high reliability coefficient of $\alpha = 0.943$. Also, the sub-scale of down-regulation demonstrated a high reliability coefficient of $\alpha = 0.936$. Similarly, the up-regulation sub-scale also exhibited strong internal consistency with a Cronbach's alpha of $\alpha = 0.904$. These findings suggest that the full scale and both subscales demonstrate high internal reliability, as hypothesized, indicating that the items within each factor are strongly correlated and consistently capture the intended underlying constructs.

H_2) *Convergent validity.* The convergent validity of the Location Selection sub-scales and overall score was evaluated by examining their correlations with established emotion regulation measures, specifically the Situation Selection (SS) scale and the Process Model of Emotion Regulation Questionnaire (PMERQ). Additionally, correlations were assessed with nature-related variables, including connectedness to nature (CNS) and time spent in nature over the past two weeks. Descriptive statistics and correlation results are summarized in **Table 4.7**.

The correlational analysis provided strong support for the convergent validity of the Location Selection scale. Specifically, both the up-regulation and down-regulation sub-scales, as well as the total score, demonstrated significant positive correlations with engagement components of the SS and the PMERQ scales. These results suggest that participants who scored higher on the LS scale were also more likely to actively engage in situation selection and emotion regulation strategies. The LS sub-scales also correlated positively, albeit to a lesser extent particularly for the up-regulation subscale, with disengagement strategies measured by the SS and PMERQ scales, indicating that even avoidance-based approaches to regulating emotions were somewhat related to the LS processes. Moreover, there were strong positive correlations between the LS scores and measures of connectedness to nature and recent nature visits. These correlations suggest that individuals who feel more emotionally connected to nature and who frequently engage with natural environments tend to score higher on the LS scale, further supporting its relevance to nature-related constructs.

Overall, the results show the scale's capacity to correlate with various dimensions of emotion regulation, particularly with active engagement, and demonstrates a strong alignment with nature connectedness and exposure, as hypothesized.

Table 4.7. *Descriptive statistics (means and standard deviations in parentheses) and correlations analyses for convergent validity of the short version of the LS Scale (Study 1)*

	Mean (*SD*)		LS_up-regulation		LS_down-regulation		LS_total score	
SS_Eng	4.40 (0.61)	*Pearson's r*	0.312	***	0.205	***	0.277	***
		p-value	< .001		< .001		< .001	
SS_Dis	4.04 (0.78)	*Pearson's r*	0.207	***	0.171	**	0.203	***
		p-value	< .001		0.003		< .001	
PMERQ_SS_Eng	3.83 (1.15)	*Pearson's r*	0.198	***	0.249	***	0.241	***
		p-value	< .001		< .001		< .001	
PMERQ_SS_Dis	4.29 (1.03)	*Pearson's r*	0.083		0.156	**	0.130	*
		p-value	0.160		0.008		0.027	
PMERQ_SM_Eng	4.49 (0.87)	*Pearson's r*	0.272	***	0.209	***	0.258	***
		p-value	< .001		< .001		< .001	
PMERQ_SM_Dis	3.77 (1.13)	*Pearson's r*	0.119	*	0.198	***	0.172	**
		p-value	0.041		< .001		0.003	
PMERQ_AD_Eng	3.84 (0.94)	*Pearson's r*	0.247	***	0.415	***	0.359	***
		p-value	< .001		< .001		< .001	
PMERQ_AD_Dis	3.99 (1.12)	*Pearson's r*	0.104		0.199	***	0.165	**
		p-value	0.077		< .001		0.005	
PMERQ_CG_Eng	4.21 (1.03)	*Pearson's r*	0.336	***	0.373	***	0.382	***
		p-value	< .001		< .001		< .001	
PMERQ_CG_Dis	3.92 (0.99)	*Pearson's r*	0.249	***	0.366	***	0.333	***
		p-value	< .001		< .001		< .001	
PMERQ_RM_Eng	3.80 (1.12)	*Pearson's r*	0.248	***	0.334	***	0.315	***
		p-value	< .001		< .001		< .001	
PMERQ_RM_Dis	3.82 (1.03)	*Pearson's r*	0.006		0.045		0.028	
		p-value	0.923		0.449		0.637	
CNS	3.92 (0.83)	*Pearson's r*	0.501	***	0.471	***	0.523	***
		p-value	< .001		< .001		< .001	
Nature visits	4.24 (4.21)	*Pearson's r*	0.355	***	0.332	***	0.369	***
		p-value	< .001		< .001		< .001	

Note. LS = Location Selection; SS = Situation Selection; PMERQ = Process Model of Emotion Regulation Questionnaire; SM = Situation Modification; AD = Attentional Deployment; CG = Cognitive Change; RM = Response Modulation; Eng = Engagement; Dis = Disengagement; CNS = Connectedness with Nature Scale; * $p < .05$, ** $p < .01$, *** $p < .001$

4.2.3. Discussion – Study 1

This study aimed to develop and validate the "Location Selection in Nature Scale", a tool designed to assess how individuals intentionally select natural environments to regulate their emotions.

To address the first objective, a set of 20 items was created based on Russell's Circumplex Model of Affect (1980), selecting four primary emotional dimensions: low-arousal positive emotions, low-arousal negative emotions, high-arousal positive emotions, and high-arousal negative emotions. This framework effectively captures the potential impact of natural environments across these varied emotional states, with five items developed for each dimension, resulting in an initial item pool.

For the second objective, a preliminary exploration of the scale's structure was conducted, identifying two distinct factors through exploratory and confirmatory factor analyses. The identified factors, labelled "down-regulation" (which focuses on regulating high-arousal negative emotions and supporting low-arousal positive emotions) and "up-regulation" (which emphasizes amplifying high-arousal positive emotions and mitigating low-arousal negative emotions), align with established theories of affect and emotion regulation. To further validate the scale's structure, alternative models were tested, with the results confirming that the two-factor structure with up- and down-regulation provided the best fit to the data. These findings highlight the scale's capacity to capture how individuals utilize nature, providing valuable insights into the emotional benefits of nature-based interactions.

In support of H_1, results indicated that both the full scale and the identified factors exhibit high internal consistency, confirming that the items within each factor are strongly correlated and reliably measure the underlying constructs.

Furthermore, consistent with H_2, the initial findings demonstrated good convergent validity, revealing meaningful relationships with constructs such as connectedness to nature and nature visits, as well as established emotion regulation measures. These findings underscore the potential of this scale to capture how individuals use nature to manage emotional states, offering valuable insights into the emotional impact of nature-based interactions.

While these preliminary findings support the scale’s validity and reliability, further validation is needed to solidify its psychometric properties. To this end, an additional independent sample was collected, aimed at confirming the two-factor structure through confirmatory factor analysis and exploring further validity metrics, thus establishing a robust foundation for the scale’s broader application.

4.3. Study 2—Scale finalization and validity

Building on the promising findings from Study 1, which demonstrated the initial reliability and validity of the Location Selection in Nature Scale, Study 2 aimed to further refine and validate the scale's psychometric properties. While the preliminary results provided a strong basis for the scale's two-factor structure, additional validation is essential to ensure its robustness and applicability.

This study intended to finalize the Location Selection in Nature Scale by confirming the factor structure identified in the initial study through the use of CFA with an independent sample. In the process of scale development, it is essential to confirm the structure derived from EFA using CFA with a different dataset (Schumacker & Lomax, 2010). This approach ensures that the factor structure identified in the EFA is validated with new data, reinforcing the scale's reliability and applicability. EFA is typically employed to uncover latent structures when the relationships among items are unknown (Brown, 2006; Schumacker & Lomax, 2010), while CFA is applied when the factor structure is theoretically established or has been previously tested (Bandalos & Finney, 2010; Büyüköztürk, 2002; Kline, 2013).

Following this standard practice, a second administration of the Location Selection in Nature Scale was conducted to further validate the factor structure identified in Study 1. Thus, this second study aimed to confirm the two-factor structure of the scale through CFA, assess its reliability, and further establish its validity.

Moreover, two alternative models were tested to evaluate the appropriateness of other potential structural configurations, including a one-factor model and a hierarchical bifactor model, in order to confirm that the two-factor structure remained the best fit for the data.

In addition to testing for convergent validity, as in the first study, divergent validity was assessed to ensure the scale's distinctiveness from unrelated constructs (i.e., personality traits).

Test-retest reliability and predictive validity of the scale were also assessed through a follow-up survey conducted two weeks after the initial survey with a sub-sample of participants.

Test-retest reliability, also referred to as the coefficient of stability, was employed to evaluate the consistency of participants' scores over time (Raykov, 2011). This was done by comparing their scores at baseline with those from a follow-up survey, using Pearson correlations to analyse the degree of stability.

Predictive validity refers to the extent to which a scale can accurately forecast future behaviours or outcomes it is theoretically linked to (Fowler, 1995). In this case, the Location Selection in Nature Scale was expected to predict future emotional regulation behaviours in natural environments and related well-being outcomes.

To examine this, the follow-up survey measured participants' affect, time spent in nature for emotion regulation, anxiety and depression symptoms, and satisfaction with life. To analyse predictive validity, Pearson correlations and regression analyses were conducted using the location selection scores collected at Time 1 (first survey) and the expected outcomes measured at Time 2 (follow-up survey). Stronger and significant correlations or causal effects would indicate greater predictive validity of the scale in forecasting these future outcomes.

Aim and hypotheses. The primary goal of the present study was to further validate the Location Selection in Nature Scale. To achieve this objective, the study examined the scale's factorial structure, internal and test-retest reliability, as well as its construct and predictive validity.

Specifically, the following hypotheses were proposed:

H_1) The factor structure of the LS Scale, consisting of two factors—up-regulation and down-regulation—identified in Study 1, would be replicated through confirmatory factor analysis, providing evidence for factorial validity.

H_2) The LS Scale and its factors demonstrate good internal consistency, indicating the scale's reliability.

H_3) The LS Scale and its factors demonstrate convergent validity, showing strong correlations with related constructs (i.e., emotion regulation strategies, connectedness to nature, and time spent in nature).

H_4) The LS Scale and its factors show divergent validity, indicated by low correlations with unrelated constructs (i.e., personality traits).

H_5) The LS Scale and its factors demonstrate good test–retest reliability, as indicated by a high correlation between scores at Time 1 and scores obtained after a two-week interval (Time 2), suggesting the scale's temporal stability.

H_6) The LS Scale and its factors at Time 1 correlate with and predict relevant constructs (i.e., time spent in nature for emotion regulation, as well as affect, life satisfaction, and symptoms of anxiety and depression) at Time 2, providing evidence for predictive validity.

4.3.1. Method – Study 2

Sample. Data collection was carried out via *Prolific*, with participants receiving $1.25 for approximately 10 minutes of survey participation.

The initial sample included 325 participants, but 23 were excluded from the analysis: 15 for failing one or two attention checks, and 8 for not completing the survey. As a result, the final sample consisted of 302 participants.

The average participant age was 37.4 years (*SD* = 12.2), ranging from 18 to 80 years. Gender distribution was nearly equal, with 146 females (48.3%), 151 males (50%), 4 participants identifying as other (1.3%), and 1 participant preferring not to disclose (0.3%).

All participants were residing in the United States at the time of the study, and all reported English as their primary language. Regarding education, most participants held a bachelor's degree (40.1%), a master's degree (13.2%), or a high school diploma (40.7%), while smaller percentages had a doctorate (2%), a professional degree (2.3%), or less than a high school diploma (1.7%). The majority were employed (48.3%

full-time, 14.6% part-time, 7.9% self-employed), with others being students (6.6%) or unemployed (9.3% seeking work and 5.6% not seeking work), and some participants identifying as homemakers (2.6%) or retired (4.6%).

Given that two separate data collections were conducted for this phase (with half of the sample completing only the first survey, and the other half invited to complete a follow-up survey two weeks later), preliminary analyses were performed to ensure that the two sub-samples were comparable in terms of socio-demographic characteristics and nature connectedness. No significant differences were found between the two groups in terms of age (t (300) = 0.809, p = .419), gender (χ^2 = 0.027, p = .869), education level (χ^2 = 0.240, p = .624), employment status (χ^2 = 0.098, p = .754), nature connectedness (t (300) = 1.466, p = .144), nature visits (t (300) = 0.838, p = .403), and childhood nature contact (t (300) = 0.722, p = .471). These results indicate that the two samples were comparable across key variables, which allowed for the merging of the datasets for the current analyses and supported the validity of using the specific subsample for the test-retest reliability analysis.

Of the 152 participants invited to complete the second survey, 130 responded. However, 1 participant did not finish the survey, and 5 failed the attention check, resulting in a final sample of 125 participants (61 females, 61 males, 3 other) for the analyses of test-retest reliability and predictive validity. The participants had an average age of 37.9 years (SD = 12.3), with ages ranging from 18 to 78 years.

Procedure. In the main survey, participants completed the short version of the Location Selection in Nature Scale (12 items, 6 per factor; see **Appendix B.8**) with response options ranging from 1 (strongly disagree) to 7 (strongly agree).

In addition to completing the Location Selection in Nature Scale, participants filled out the same measures of Connectedness with Nature scale (α = .910), Process Model of Emotion Regulation Questionnaire (α = .730 – .836), Situation Selection scale (engagement, α = .827; and disengagement, α = .842), nature exposure and socio-demographic questions as in Study 1, with the addition of the Big Five Inventory-10 (BFI-10; Rammstedt & John, 2007) to assess personality traits for divergent validity.

The BFI-10 comprises 10 items, with two items dedicated to each of the five personality traits (see **Appendix B.9**): extraversion (α = .582), agreeableness (α = .427), conscientiousness (α = .455), neuroticism (α = .746), and openness (α = .426). Participants rated how well the statements described their personality, using a scale from 1 (disagree strongly) to 5 (agree strongly).

In the follow-up survey conducted two weeks later, participants were asked to complete the Location Selection in Nature Scale again. The following measures were also included to assess predictive validity:

- *Time in Nature for Emotion Regulation* (*ad hoc* theoretically driven items): This *ad hoc* measure consisted of four items focusing on participants' recent behaviours related to spending time in nature to regulate emotions and manage various emotional states, in line with the conceptualization of arousal and valence (see **Appendix B.10**). For example, participants were asked: "In the past two weeks, how often have you visited nature to manage stress and anxiety?". Response options ranged from 0 (never) to 6 (every day).
- *IWP Multi-Affect Indicator* (Warr & Parker, 2010): This 16-item measure assessed different emotional states conceptualized according to arousal and valence, asking participants to indicate how often they felt the several emotions in their daily life over the past two weeks (see **Appendix B.11**). Responses were scored from 1 (never) to 7 (always), with negative items reverse-scored to ensure that higher scores represented higher well-being. Mean values were calculated for various types of affects, including single-quadrant scores (activated negative affect, activated positive affect, low activation negative affect, low-activation positive affect) and double-quadrant scores (activated negative affect and low-activation positive affect, α = .913;

low activation negative affect and activated positive affect, $\alpha = .855$). The double-quadrant scores were utilized for analysis as they align with the two-factor structure of the Location Selection in Nature Scale.

- *Ultra-Brief Screening Scale for Anxiety and Depression* (Kroenke et al., 2009): This 4-item scale asked participants how often they had been bothered by anxiety ($\alpha = .881$) and depression-related ($\alpha = .818$) problems over the past two weeks (see **Appendix B.12**), using response options from 0 (not at all) to 3 (nearly every day).

- *Satisfaction With Life Scale* (SWLS; Diener et al., 1985): This scale included five statements about the satisfaction with their life ($\alpha = .932$), with which participants could express their agreement or disagreement (see **Appendix B.13**), using a Likert scale from 1 (strongly disagree) to 7 (strongly agree).

4.3.2. Results – Study 2

H_1) *Confirmatory Factor Analysis.* The CFA was conducted to evaluate the fit of the hypothesized two-factor model of down-regulation and up-regulation.

The factor loadings and associated statistics are summarized in **Table 4.8**.

All factor loadings for the indicators were statistically significant ($p < .001$), indicating robust associations between each indicator and its corresponding latent factor:

- *Down-regulation* exhibited standardized loadings ranging from 0.775 to 0.913.
- *Up-regulation* displayed standardized loadings ranging from 0.761 to 0.897.

The covariance between Factor 1 and Factor 2 was found to be 0.918 ($SE = 0.014$, 95% CI [0.891, 0.945], $p < .001$). This significant covariance suggests a strong positive relationship between these two factors. The model also demonstrated moderately good fit according to the fit indices: $RMSEA = 0.133$ (90% CI [0.119, 0.146]), $CFI = 0.923$, $TLI = 0.905$, and $SRMR = 0.0412$.

Table 4.8. *Factor loadings for the 2-factors structure of the short version of the LS Scale (Study 2)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
Down-regulation	N-H_1	1.45	0.073	1.30	1.59	19.8	< .001	0.893
	N-H_2	1.47	0.072	1.33	1.62	20.4	< .001	0.909
	N-H_3	1.43	0.077	1.28	1.58	18.6	< .001	0.859
	P-L_1	1.38	0.067	1.25	1.51	20.6	< .001	0.913
	P-L_2	1.20	0.076	1.06	1.35	15.9	< .001	0.775
	P-L_3	1.34	0.069	1.20	1.48	19.3	< .001	0.880
Up-regulation	N-L_1	1.33	0.087	1.16	1.50	15.4	< .001	0.761
	N-L_2	1.34	0.088	1.17	1.51	15.3	< .001	0.761
	N-L_3	1.30	0.071	1.17	1.44	18.4	< .001	0.857
	P-H_1	1.41	0.071	1.27	1.54	19.9	< .001	0.897
	P-H_2	1.35	0.082	1.19	1.52	16.5	< .001	0.802
	P-H_3	1.37	0.082	1.21	1.54	16.7	< .001	0.808

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions;
P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Overall, these results seem to support the validity of the hypothesized two-factor structure for the reduced version of the scale. However, as in Study 1, the high and significant covariance suggests a strong positive relationship between the two factors, raising the question of whether a more parsimonious one-factor solution could be appropriate. To explore this, alternative models were tested to assess the fit of a more parsimonious solution.

Specifically, two alternative models were considered: (1) a one-factor model, with a general factor including all items; and (2) a hierarchical bifactor model, with one general second-order factor and two first-order factors of down-regulation and up-regulation. Goodness-of-fit was assessed using the same indices as in Study 1.

Factor loadings for the one-factor model showed that all items significantly loaded onto the proposed general factor, with standardized coefficients ranging from 0.716 to 0.901, all p's < 0.001 (see **Appendix B.14**).

The goodness-of-fit indices for the two alternative models as well as the two-factor model representing down-regulation and up-regulation are reported in **Table 4.9**.

The one-factor model showed worse fit indices compared to the two-factor model, with a higher RMSEA, lower CFI, TLI, and a higher AIC and BIC, indicating that the two-factor model better represented the data. The hierarchical bifactor model performed well, with similar fit indices to the two-factor model with down- and up-regulation, but had a slightly higher AIC and BIC, suggesting it was more complex without offering significant improvements in model fit.

In conclusion, the two-factor model with clusters (down-regulation and up-regulation) seems to provide a better balance of model fit and parsimony compared to the one-factor and hierarchical models.

Table 4.9. *Goodness-of-fit indexes for the three tested models (Study 2)*

Model	χ^2 (df)	RMSEA (90% CI)	SRMR	CFI	TLI	AIC	BIC	ECVI
Two factors – clusters	334 * (53)	.133 * (.119, .146)	.041	.923	.905	10463	10601	1.352
1. One factor	444 * (54)	.155 * (.142, .168)	.051	.894	.870	10571	10704	1.710
2. Hierarchical bi-factorial model (clusters + general)	334 * (52)	.134 * (.121, .148)	.041	.923	.902	10465	10606	1.359

Note. * p < .001; χ^2 = chi-square; df = degree of freedom; RMSEA = Root Mean Square Error of Approximation; CI = confidence interval; SRMR = Standardized Root Mean Square Residual; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ECVI = Expected Cross-Validation Index.

H2) *Reliability analysis.* A reliability analysis was conducted to evaluate the internal consistency of the sub-scales, through Cronbach's alpha. The down-regulation sub-scale demonstrated excellent reliability with $\alpha = 0.949$. Similarly, the up-regulation sub-scale exhibited strong internal consistency, with a Cronbach's alpha of $\alpha = 0.924$. The overall scale, incorporating items from both factors, also showed high internal consistency with $\alpha = 0.961$. These results suggest that both sub-scales have strong internal reliability, as hypothesized, indicating that the items within each are highly correlated and reliably measure the intended constructs. Additionally, the high internal consistency supports the use of a general total score, as it indicates that the combined items across both sub-scales effectively measure an overarching construct.

H3) *Convergent validity.* The convergent validity of the Location Selection subscales was examined in relation to existing emotion regulation scales, specifically the Situation Selection (SS) scale, and the Process Model of Emotion Regulation Questionnaire (PMERQ), and in relation to variables related to nature connectedness (CNS) and time in nature in the last 2-weeks, assessing the correlations between these scales. Correlations with descriptive statistics are presented in **Table 4.10**.

Overall, the Location Selection (LS) scores demonstrated significant correlations with almost all the investigated variables, supporting the hypothesized scale's convergent validity.

Specifically, both the up-regulation and down-regulation sub-scales, as well as the total score, demonstrated significant positive correlations with all the engagement components of the SS and the PMERQ scales. However, the analysis revealed some non-significant correlations between the Location Selection scores and certain variables. Specifically, no significant relationships were observed between the LS scores and the disengagement component of the SS scale, in contrast to Study 1, where notable associations were found. Furthermore, there were no significant associations between all the LS scores and the PMERQ's disengagement subscales of situation selection and response modulation. Also, no significant correlations were observed for the LS general score and the down-regulation factor with the disengagement situation modification subscale of PMERQ. These findings suggest that location selection is more strongly associated with engagement-oriented processes rather than disengagement-related strategies. This distinction underscores the active nature of location selection, which inherently involves making a deliberate choice to engage with an environment, rather than withdrawing or avoiding situations. Thus, these results overall align with the conceptualization of location selection as a proactive process involving the choice to engage with a particular environment to regulate emotions.

Finally, results showed strong positive associations between the Location Selection scores and measures of connectedness to nature and recent nature visits.

H_4) *Divergent validity.* The analysis of divergent validity between the Location Selection subscales and personality traits revealed predominantly small correlations, as expected (**Table 4.11**).

Significant positive correlations were found between the Location Selection scores and traits such as agreeableness, extraversion, conscientiousness, and openness, indicating some degree of association. In contrast, neuroticism showed a small negative correlation with the up-regulation subscale, and no significant correlations with the down-regulation or total scores. These findings align with previous research on nature relatedness (Nisbet et al., 2009), which reported similar positive correlations with extraversion, agreeableness, conscientiousness, and openness, and a weak negative correlation with neuroticism.

Overall, these results suggest that while the Location Selection subscales are modestly related to personality traits, they retain a distinct conceptual focus, as hypothesized, thereby supporting the scale's divergent validity.

Table 4.10. *Descriptive statistics (means and standard deviations in parentheses) and correlations analyses for convergent validity of the short version of the LS Scale (Study 2)*

	Mean (*SD*)		LS up-regulation		LS down-regulation		LS total score	
SS_Eng	4.34 (0.61)	*Pearson's r*	0.251	***	0.282	***	0.277	***
		p-value	< .001		< .001		< .001	
SS_Dis	4.02 (0.77)	*Pearson's r*	0.011		0.034		0.023	
		p-value	0.844		0.560		0.685	
PMERQ_SS_Eng	3.69 (1.09)	*Pearson's r*	0.221	***	0.162	**	0.200	***
		p-value	< .001		0.005		< .001	
PMERQ_SS_Dis	4.23 (1.04)	*Pearson's r*	0.048		0.036		0.044	
		p-value	0.405		0.532		0.447	
PMERQ_SM_Eng	4.40 (0.91)	*Pearson's r*	0.298	***	0.309	***	0.316	***
		p-value	< .001		< .001		< .001	
PMERQ_SM_Dis	3.77 (1.13)	*Pearson's r*	0.132	*	0.043		0.091	
		p-value	0.022		0.457		0.114	
PMERQ_AD_Eng	3.65 (1.04)	*Pearson's r*	0.334	***	0.279	***	0.319	***
		p-value	< .001		< .001		< .001	
PMERQ_AD_Dis	3.99 (1.06)	*Pearson's r*	0.146	*	0.120	*	0.139	*
		p-value	0.011		0.036		0.016	
PMERQ_CG_Eng	4.07 (1.02)	*Pearson's r*	0.428	***	0.369	***	0.416	***
		p-value	< .001		< .001		< .001	
PMERQ_CG_Dis	3.87 (1.01)	*Pearson's r*	0.271	***	0.251	***	0.272	***
		p-value	< .001		< .001		< .001	
PMERQ_RM_Eng	3.79 (1.16)	*Pearson's r*	0.298	***	0.250	***	0.286	***
		p-value	< .001		< .001		< .001	
PMERQ_RM_Dis	3.88 (1.08)	*Pearson's r*	0.054		0.040		0.049	
		p-value	0.349		0.485		0.394	
CNS	3.74 (0.91)	*Pearson's r*	0.526	***	0.541	***	0.556	***
		p-value	< .001		< .001		< .001	
Nature visits	4.41 (4.48)	*Pearson's r*	0.325	***	0.317	***	0.335	***
		p-value	< .001		< .001		< .001	

Note. LS = Location Selection; SS = Situation Selection; PMERQ = Process Model of Emotion Regulation Questionnaire; SM = Situation Modification; AD = Attentional Deployment; CG = Cognitive Change; RM = Response Modulation; Eng = Engagement; Dis = Disengagement; CNS = Connectedness with Nature Scale; * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.11. *Descriptive statistics (means and standard deviations in parentheses) and correlations analyses for divergent validity of the short version of the LS Scale (Study 2)*

	Mean (*SD*)		LS up-regulation		LS down-regulation		LS total score	
BF_Agreeableness	3.52 (1.42)	*Pearson's r*	0.129	*	0.148	**	0.144	*
		p-value	0.026		0.010		0.012	
BF_Extraversion	2.57 (1.03)	*Pearson's r*	0.256	***	0.208	***	0.242	***
		p-value	< .001		< .001		< .001	
BF_Conscientiousness	3.77 (0.88)	*Pearson's r*	0.262	***	0.271	***	0.278	***
		p-value	< .001		< .001		< .001	
BF_Neuroticism	3.11 (1.12)	*Pearson's r*	-0.122	*	-0.065		-0.098	
		p-value	0.033		0.261		0.090	
BF_Openness	3.67 (0.95)	*Pearson's r*	0.193	***	0.213	***	0.211	***
		p-value	< .001		< .001		< .001	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

H5) *Test–retest reliability.* The temporal stability of the Location Selection in Nature Scale was assessed by correlating baseline scores (T_1) with scores on the same measure after a two-week interval (T_2). The test–retest correlations for the up-regulation and down-regulation sub-scales, as well as the total score, demonstrated significant and robust stability over time, as hypothesized, with correlation coefficients ranging from $r = .766$ to $r = .851$ (see **Table 4.12**).

Table 4.12. *Descriptive statistics (means and standard deviations in parentheses) and correlations analyses for test–retest reliability of the short version of the LS Scale (Study 2)*

			LS up-regulation T_1		LS down-regulation T_1		LS total score T_1	
	Mean (*SD*)		4.69 (1.49)		5.33 (1.54)		5.01 (1.48)	
LS up-regulation T_2	4.60 (1.43)	*Pearson's r*	0.801	***	0.766	***	0.803	***
		p-value	< .001		< .001		< .001	
LS down-regulation T_2	5.24 (1.50)	*Pearson's r*	0.792	***	0.840	***	0.837	***
		p-value	< .001		< .001		< .001	
LS total score T_2	4.92 (1.41)	*Pearson's r*	0.826	***	0.834	***	0.850	***
		p-value	< .001		< .001		< .001	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

H_6) *Predictive validity.* Predictive validity of the Location Selection in Nature Scale was examined through a follow-up survey administered two weeks after the initial data collection. Participants' scores on nature visits for emotion regulation, affect, anxiety, depression, and satisfaction with life were used as outcome measures to assess the predictive power of the scale.

First, correlational analyses were conducted to examine the relationships between the variables of interest (**Table 4.13**).

Results revealed that location selection scores at T_1 were positively and significantly associated with nature visits for both up-regulation and down-regulation at T_2. These moderate to large correlations indicate that individuals with higher scores on the location selection subscales were more likely to visit nature for emotion regulation over the following two weeks.

Regarding affect, significant correlations were found between the location selection scores and the IWP scores of low activation negative affect and activated positive affect at T_2. However, no significant correlations were observed between location selection scores and the IWP scores of activated negative affect and low-activation positive affect, suggesting that the scale is more strongly related to positive-high and negative-low emotional states.

No significant correlations were found between location selection scores and anxiety or depression symptoms at T_2, indicating that the scale may not be directly associated with ill-being symptoms over time.

However, significant positive correlations were observed between location selection scores and satisfaction with life, indicating that individuals who actively chose nature for emotional regulation at T_1 reported higher life satisfaction at T_2.

Table 4.13. *Descriptive statistics (means and standard deviations in parentheses) and correlations analyses for predictive validity of the short version of the LS Scale (Study 2)*

	Mean (*SD*)		LS up-regulation T_1	LS down-regulation T_1	LS total score T_1
Nature visits for up-regulation T_2	2.90 (1.59)	*Pearson's r*	0.582 ***	0.563 ***	0.587 ***
		p-value	< .001	< .001	< .001
Nature visits for down-regulation T_2	3.32 (1.72)	*Pearson's r*	0.584 ***	0.609 ***	0.612 ***
		p-value	< .001	< .001	< .001
IWP (P-H + N-L) T_2	4.71 (1.08)	*Pearson's r*	0.379 ***	0.339 ***	0.368 ***
		p-value	< .001	< .001	< .001
IWP (P-L + N-H) T_2	4.40 (1.20)	*Pearson's r*	0.066	0.019	0.043
		p-value	0.464	0.835	0.633
Anxiety symptoms T_2	1.05 (0.89)	*Pearson's r*	0.082	0.129	0.108
		p-value	0.366	0.153	0.230
Depression symptoms T_2	0.82 (0.89)	*Pearson's r*	-0.063	-0.074	-0.070
		p-value	0.486	0.414	0.438
SWLS T_2	4.24 (1.62)	*Pearson's r*	0.368 ***	0.303 ***	0.343 ***
		p-value	< .001	< .001	< .001

Note. LS = Location Selection; IWP = IWP Multi Affect Indicator; N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions; SWLS = Satisfaction With Life Scale.
* $p < .05$, ** $p < .01$, *** $p < .001$

Regression analyses further supported these findings (**Table 4.14**). Specifically, results showed that both the up-regulation and down-regulation sub-scales significantly predicted nature visits for up- and down-regulation. For affect outcomes, the up-regulation and down-regulation sub-scales significantly predicted IWP scores of low-activation negative affect and activated positive affect. However, neither subscale significantly predicted the IWP scores of activated negative affect and low-activation positive affect, anxiety, or depression symptoms in the last two weeks. Lastly, findings revealed that satisfaction with life was positively predicted by both the up-regulation and the down-regulation sub-scales.

In summary, the Location Selection in Nature Scale demonstrated robust predictive validity for emotion regulation behaviours in natural environments, low-activation negative affect and activated positive affect, and life satisfaction, but weaker predictive capacity for activated negative affect and low-activation positive affect, as well as for anxiety and depression symptoms.

Table 4.14. *Linear regression models for predictive validity of the short version of the LS Scale (Study 2)*

Predictors	R^2	*B*	*SE*	95% CI		*t*	*p*	*β*	95% CI	
				Lower	*Upper*				*Lower*	*Upper*
Dependent variable: ***Nature visits for up-regulation***										
LS up-regulation	.339	.628	.079	.471	.784	7.947	<.001	.582	.437	.728
intercept		-.058	.389	-.829	.713	-.149	.882			
LS down-regulation	.317	.587	.078	.433	.740	7.560	<.001	.563	.416	.711
intercept		-.239	.431	-1.093	.614	-.555	.580			
Dependent variable: ***Nature visits for down-regulation***										
Predictors	R^2	*B*	*SE*	95% CI *Lower*	95% CI *Upper*	*t*	*p*	*β*	95% CI *Lower*	95% CI *Upper*
LS up-regulation	.341	.682	.085	.513	.851	7.977	<.001	.584	.439	.729
intercept		.112	.421	-.722	.946	.265	.791			
LS down-regulation	.371	.688	.081	.528	.847	8.526	<.001	.609	.468	.751
intercept		-.356	.448	-1.243	.532	-.793	.429			
Dependent variable: ***IWP (P-H + N-L)***										
Predictors	R^2	*B*	*SE*	95% CI *Lower*	95% CI *Upper*	*t*	*p*	*β*	95% CI *Lower*	95% CI *Upper*
LS up-regulation	.144	.278	.061	.157	.400	4.55	<.001	.379	.214	.544
intercept		3.400	.302	2.802	3.997	11.26	<.001			
LS down-regulation	.115	.241	.060	.121	.360	3.40	<.001	.339	.171	.507
intercept		3.424	.334	2.762	4.086	10.24	<.001			
Dependent variable: ***IWP (P-L + N-H)***										
Predictors	R^2	*B*	*SE*	95% CI *Lower*	95% CI *Upper*	*t*	*p*	*β*	95% CI *Lower*	95% CI *Upper*
LS up-regulation	.004	.053	.073	-.091	.198	.734	.464	.066	-.112	.244
intercept		4.143	.359	3.432	4.854	11.535	<.001			
LS down-regulation	.000	.015	.071	-.125	.154	.209	.835	.019	-.160	.197
intercept		4.316	.392	3.540	5.092	11.011	<.001			
Dependent variable: ***Anxiety symptoms***										
Predictors	R^2	*B*	*SE*	95% CI *Lower*	95% CI *Upper*	*t*	*P*	*β*	95% CI *Lower*	95% CI *Upper*
LS up-regulation	.007	.049	.054	-.058	.157	.907	.366	.082	-.096	.259
intercept		.820	.268	.290	1.350	3.060	.003			
LS down-regulation	.017	.075	.052	-.028	.179	1.44	.153	.129	-.048	.306
intercept		.651	.290	.076	1.225	2.24	.027			
Dependent variable: ***Depression symptoms***										
Predictors	R^2	*B*	*SE*	95% CI *Lower*	95% CI *Upper*	*t*	*p*	*β*	95% CI *Lower*	95% CI *Upper*
LS up-regulation	.004	-.038	.054	-.145	.069	-.698	.486	-.063	-.241	.115
intercept		.998	.267	.470	1.526	3.741	<.001			
LS down-regulation	.005	-.043	.052	-.146	.061	-.819	.414	-.074	-.252	.104
intercept		1.049	.290	.474	.1.623	3.613	<.001			

Dependent variable: *Satisfaction with life*										
Predictors	R^2	*B*	*SE*	*95% CI*		*t*	*p*	*β*	*95% CI*	
				Lower	*Upper*				*Lower*	*Upper*
LS up-regulation	.135	.403	.092	.221	.585	4.39	<.001	.368	.202	.534
intercept		2.340	.453	1.444	3.237	5.17	<.001			
LS down-regulation	.092	.312	.091	.141	.501	3.53	<.001	.303	.133	.473
intercept		2.522	.506	1.521	3.523	4.99	<.001			

Note. LS = Location Selection; IWP = IWP Multi Affect Indicator; N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions; SWLS = Satisfaction With Life Scale.

4.3.3. Discussion – Study 2

This study focused on the further refinement and validation of the Location Selection in Nature Scale, building upon the findings of the first study to confirm the factor structure and assess the scale's reliability and validity.

The two-factor structure—representing the selection of nature for up-regulation and down-regulation of emotions—was confirmed using confirmatory factor analysis, reinforcing the robustness of the scale's theoretical foundation (H_1). By applying CFA to a new sample, this study ensured the reliability and replicability of the factor structure initially identified through exploratory factor analysis on the first data collection. Moreover, the results of alternative models testing showed that the two-factor structure with up- and down-regulation consistently provided the best fit to the data, reinforcing its robustness and supporting its validity over other potential structural configurations.

In line with H_2, the scale and its factors exhibited high internal consistency, further substantiating its reliability.

Additionally, the evaluation of convergent and divergent validity provided further support for the scale's robust psychometric properties. The Location Selection in Nature Scale displayed robust correlations with related constructs, such as existing emotion regulation measures and nature connectedness, affirming its convergent validity (H_3).

At the same time, it showed modest, yet expected, correlations with personality traits, confirming that the scale captures a distinct construct rather than reflecting broader, more stable personality factors (H_4).

The evaluation of test-retest reliability showed that the scale consistently measured the same constructs over time, with high correlations between the baseline and follow-up scores, in line with the H_5. This temporal stability highlights the reliability of the scale in capturing individuals' tendencies to select nature for emotional regulation across different time points.

A relevant addition to this study was also the assessment of predictive validity (H_6), which examined the scale's ability to forecast future behaviours and outcomes associated with emotional regulation in nature. The results indicated that individuals who scored higher on the location selection subscales were more likely to visit nature to regulate their emotions and experience enhanced well-being outcomes, particularly in terms of life satisfaction, low activation negative affect and activated positive affect. However, the findings also suggested that the scale may not directly predict changes in anxiety or depression symptoms over short periods, highlighting the complexity of mental health outcomes and the need for further exploration of these relationships.

Overall, this study successfully finalized the Location Selection in Nature Scale, confirming its factor structure and establishing its reliability and validity. The scale shows strong potential for future research and practical applications in understanding how individuals use natural environments for emotional regulation and the subsequent impact on well-being. The insights gained from this study contribute to the growing body of literature on the benefits of nature and offer a reliable tool for measuring this specific aspect of emotional regulation.

4.4. Study 3—Italian translation

Following the initial development and refinement of the Location Selection in Nature Scale, this study adapts the validated, shorter version of the scale for use in Italy. The adaptation process aligns the scale with Italian linguistic and cultural context, essential for the subsequent empirical studies of this thesis.

A rigorous translation procedure, including forward and back-translation, was employed to maintain the scale's conceptual integrity while making it accessible to Italian-speaking respondents. This adaptation allows for a culturally relevant tool to explore how natural settings support emotion regulation in Italian contexts.

Aim and hypotheses. The purpose of this study was to adapt and validate the Location Selection in Nature Scale for Italian-speaking populations. The Italian version of the LS Scale was tested for factorial structure, internal reliability, and both convergent and divergent validity, as for the English version.

The following hypotheses were proposed:

H_1) The Italian adaptation of the LS Scale would replicate the two-factor structure—up-regulation and down-regulation—identified in prior studies (S_1 and S_2), as evidenced through confirmatory factor analysis.

H_2) The Italian adaptation of the LS Scale and its factors would demonstrate strong internal consistency, confirming the scale's reliability.

H_3) The Italian version of the LS Scale and its factors exhibit convergent validity, demonstrated by significant correlations with related constructs (i.e., emotion regulation strategies, connectedness to nature, and time spent in nature).

H_4) The Italian version of the LS Scale and its factors display divergent validity, as shown by low correlations with unrelated constructs (i.e., personality traits).

Scale adaptation. This study focuses on the adaptation and translation of the scale into Italian, following standard guidelines (e.g., Cruchinho et al., 2024) adopting the forward and back-translation approach. Forward and back translation is the most recommended method in scales' translation protocols (Beaton et al., 2000; Wild et al., 2005). This process requires at least two independent translators: one translates the instrument into the target language, while the other translates this version back into the source language (Peters & Passchier, 2006).

The adaptation of the scale was organized into the following phases: 1) forward translation, 2) back translation, 3) harmonization, and 4) psychometric validation.

Phase 1 and 2. A first translator conducted the forward translation of the original instrument from English to Italian. Then, a different bilingual translator, who was not familiar with the construct of the scale, performed the back-translation from Italian to English. Both forward translation and back translation were conducted independently.

Phase 3. The harmonization process followed, where all versions of the measurement instrument—the original version, the translated version, and the back-translated version—were compared by the translators involved. This comparison aimed to identify possible ambiguities and discrepancies and to determine the most appropriate translation (Sousa & Rojjanasrirat, 2011). Any differences or shifts in meaning between the two English versions were highlighted. After identifying these inconsistencies, the two translators collaboratively resolved them, adjusting the Italian version as necessary to ensure that all translated items accurately reflect the original content's meaning while being linguistically and culturally appropriate.

Phase 4. For the psychometric evaluation, the Italian scale was assessed similarly to the English version. Initially, an exploratory factor analysis was performed to identify potential translation errors or cultural differences that could impact the scale's structure. Following this, the confirmatory factor analysis was conducted to further confirm the structure of the Italian version of the scale. Moreover, as done in

Study 2, two alternative models, including a one-factor model and a hierarchical bifactor model, were tested to confirm that the two-factor structure remained the best fit for the data. The reliability of the scale and identified subscales was assessed using Cronbach's α. Additionally, convergent and divergent validity were evaluated through Pearson correlations.

4.4.1. Method – Study 3

Sample. Data collection was carried out via *Prolific*, with participants receiving $1.25 for approximately 10 minutes of survey participation.

The initial sample included 326 participants, but 18 were excluded from the analysis: 12 for failing one or two attention checks, and 6 for not completing the survey. As a result, the final sample consisted of 308 participants.

The average participant age was 35.2 years (*SD* = 10.8), ranging from 21 to 72 years. Gender distribution was nearly equal, with 144 females (46.8%), 157 males (51%), 5 participants identifying as other (1.6%), and 2 participants preferring not to disclose (0.6%).

All participants were residing in the Italy at the time of the study, except for one, and all reported Italian as their primary language. Regarding education, most participants held a bachelor's degree (26.6%), a master's degree (31.8%), or a high school diploma (35.1%), while smaller percentages had a doctorate (3.6%), a professional degree (1.3%), or less than a high school diploma (1.6%). The majority were employed (41.6% full-time, 9.4% part-time, 10.1% self-employed), with others being students (20.8%) or unemployed (10.7% seeking work and 3.9% not seeking work), and some participants identifying as homemakers (2.6%) or retired (1.9%).

Procedure. Participants completed the Italian adaptation of the Location Selection in Nature Scale (12 items, 6 per factor; items are reported in **Table 4.15**) with response options ranging from 1 (strongly disagree) to 7 (strongly agree), as in the original instrument (see **Appendix B.15**).

In addition to the scale, participants completed the same measurement tools adopted for the English version in Study 2:

- Situation Selection Items (Webb et al., 2018; Italian back-translation, see **Appendix B.16**)
- Process Model of Emotion Regulation Questionnaire (PMERQ; Olderbak et al., 2022; Italian back-translation, see **Appendix B.17**)
- Connectedness to Nature Scale (CNS-14; Mayer & Frantz, 2004; Italian version: Lovati et al., 2023, see **Appendix B.18**)
- Nature Exposure: 2 items from the People and Nature Survey (Italian back-translation, see **Appendix B.19**)
- Childhood Nature Exposure: 3 items from the Blue Health Survey (Italian back-translation, see **Appendix B.20**)
- Big Five Inventory-10 (BFI-10; Rammstedt & John, 2007; Italian version: Guido et al., 2015, see **Appendix B.21**)
- Socio-demographic questions: age, gender, number of children in the household, education, employment status, primary language, and proficiency in Italian if it is not their primary language.

Table 4.15. *Italian adaptation of the LS Scale*

CODE	ITEMS
N-H_1	Visito la natura quando voglio staccare dallo stress.
N-H_2	Vado nella natura quando voglio sentirmi meno teso.
N-H_3	Vado nella natura quando voglio sentirmi meno ansioso.
N-L_1	Visito la natura quando voglio sentirmi meno annoiato.
N-L_2	Visito la natura quando voglio sentirmi meno affaticato.
N-L_3	Visito la natura quando voglio sentirmi meno cupo.
P-H_1	Visito la natura quando voglio sentirmi più allegro.
P-H_2	Vado nella natura quando voglio sentirmi più entusiasta.
P-H_3	Vado nella natura quando voglio sentirmi più energico.
P-L_1	Vado nella natura quando voglio sentirmi più rilassato.
P-L_2	Visito la natura quando voglio sentire un senso di tranquillità.
P-L_3	Vado nella natura quando voglio sentirmi più calmo.

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

4.4.2. Results – Study 3

Exploratory Factor Analysis. Preliminary assumption checks were conducted, with Bartlett's test of sphericity yielding χ^2 = 3720, *df* = 66, *p* < .001, and the Kaiser-Meyer-Olkin (*KMO*) measure of sampling adequacy at 0.945, ranging from 0.918 to 0.974. These results confirmed that the data were suitable for factor analysis.

An exploratory factor analysis (EFA), guided by parallel analysis, was performed on the Italian adaptation of the scale. This analysis identified two primary factors based on significant factor loadings (> 0.4), consistent with the factors identified in the EFA of the short version of the scale in Study 1.

The factor loadings and uniqueness values for each item are detailed in **Table 4.16**.

- *Factor 1*: This factor includes items related to negative high arousal emotions and positive low arousal emotions, accounting for 41.8% of the variance.
- *Factor 2*: This factor comprises items associated with negative low arousal emotions and positive high arousal emotions, explaining 31.5% of the variance.

Overall, the two-factor solution accounts for a cumulative 73.3% of the variance, demonstrating a solid structure for the Italian adaptation of the scale.

Table 4.16. *Factor loadings for EFA based on parallel analysis for the Italian adaptation of the LS Scale (Study 3)*

	Factor		
	1	**2**	**Uniqueness**
N-L_1		0.774	0.376
N-L_2		0.577	0.383
N-L_3		0.526	0.366
N-H_1	0.831		0.158
N-H_2	0.788		0.167
N-H_3	0.645		0.271
P-L_1	0.942		0.144
P-L_2	0.948		0.251
P-L_3	0.870		0.262
P-H_1		0.696	0.249
P-H_2		0.981	0.197
P-H_3		0.707	0.384

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

H_1) *Confirmatory Factor Analysis.* The Confirmatory Factor Analysis was performed to assess the fit of the proposed two-factor model, which includes down-regulation and up-regulation. The factor loadings are detailed in **Table 4.17**.

All factor loadings for the indicators were statistically significant ($p < .001$), indicating strong relationships between each indicator and its corresponding latent factor:

- *Down-regulation* showed standardized loadings ranging from 0.837 to 0.931.
- *Up-regulation* had standardized loadings between 0.779 and 0.879.

The covariance between Factor 1 and Factor 2 was 0.860 (SE = 0.019, 95% CI [0.823, 0.897], $p < .001$), reflecting a substantial correlation between the factors. The model fit was moderately good, with fit indices as follows: $RMSEA$ = 0.117 (90% CI [0.103, 0.130]), CFI = 0.940, TLI = 0.926, and $SRMR$ = 0.0371.

Table 4.17. *Factor loadings for the 2-factors structure on the Italian adaptation of the LS Scale (Study 3)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
Down-regulation	N-H_1	1.53	0.0708	1.39	1.67	21.6	< .001	0.931
	N-H_2	1.44	0.0687	1.30	1.57	20.9	< .001	0.916
	N-H_3	1.47	0.0814	1.31	1.63	18.1	< .001	0.839
	P-L_1	1.48	0.0687	1.35	1.62	21.6	< .001	0.931
	P-L_2	1.25	0.0679	1.12	1.39	18.4	< .001	0.849
	P-L_3	1.32	0.0732	1.18	1.46	18.0	< .001	0.837
Up-regulation	N-L_1	1.33	0.0817	1.17	1.50	16.3	< .001	0.790
	N-L_2	1.36	0.0831	1.20	1.52	16.4	< .001	0.790
	N-L_3	1.40	0.0848	1.23	1.56	16.5	< .001	0.794
	P-H_1	1.43	0.0741	1.29	1.58	19.3	< .001	0.879
	P-H_2	1.42	0.0772	1.27	1.57	18.4	< .001	0.854
	P-H_3	1.32	0.0826	1.16	1.48	16.0	< .001	0.779

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Overall, these results strongly support the validity of the proposed two-factor structure for the Italian adaptation of the scale. However, as observed in the previous studies for the validation of the scale, the high and significant covariance suggests a strong positive relationship between the two factors, raising the question of whether a more parsimonious one-factor solution could adequately represent the data.

To investigate this, alternative models as in Study 2 were tested, including: (1) a one-factor model, where all items loaded onto a general factor, and (2) a hierarchical bifactor model, which included one general second-order factor and two first-order factors representing down-regulation and up-regulation. Goodness-of-fit was assessed using the same indices applied in Studies 1 and 2.

Factor loadings for the one-factor model showed that all items significantly loaded onto the proposed general factor, with standardized coefficients ranging from 0.704 to 0.916, all *p*'s < 0.001 (see **Appendix B.22**).

The goodness-of-fit indices for the two alternative models and the original two-factor model (down-regulation and up-regulation) are presented in **Table 4.18**.

Table 4.18. *Goodness-of-fit indexes for the three tested models (Study 3)*

Model	χ^2 (df)	RMSEA (90% CI)	SRMR	CFI	TLI	AIC	BIC	ECVI
Two factors – clusters	275 * (53)	.117 * (.103, .130)	.037	.940	.926	10726	10864	1.132
1. One factor	522 * (54)	.168 * (.155, .181)	.056	.874	.846	10972	10992	1.929
2. Hierarchical bi-factorial model (clusters + general)	275 * (51)	.119 * (.106, .133)	.037	.940	.922	10730	10875	1.145

Note. * $p < .001$; χ^2 = chi-square; df = degree of freedom; RMSEA = Root Mean Square Error of Approximation; CI = confidence interval; SRMR = Standardized Root Mean Square Residual; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ECVI = Expected Cross-Validation Index.

The two-factor model (down-regulation and up-regulation) achieved the best balance of fit and parsimony among the tested models, supporting this model as the best fit for the data. The hierarchical bifactor model showed similar fit indices in terms of CFI, TLI and SRMR, but had slightly higher AIC and ECVI values compared to the two-factor model. While the bifactor model provides an alternative representation of the data, its added complexity does not result in a meaningful improvement in model fit.

In contrast, the one-factor model demonstrated poorer fit across all indices, with the highest RMSEA and SRMR, along with lower CFI and TLI. The AIC and ECVI values were also the highest among the tested models, indicating that a one-factor solution does not adequately capture the structure of the scale.

In summary, the two-factor model with clusters (down-regulation and up-regulation) provides the best balance of model fit and parsimony compared to the one-factor and hierarchical bifactor models. These findings support the validity of the two-factor structure for the Italian adaptation of the scale while highlighting the distinctiveness of the down-regulation and up-regulation dimensions.

H_2) ***Reliability analysis.*** A reliability analysis was performed to assess the internal consistency of the sub-scales using Cronbach's alpha.

The sub-scale of down-regulation showed excellent reliability with $\alpha = 0.955$. The sub-scale of up-regulation also demonstrated strong internal consistency, with $\alpha = 0.921$. The overall scale, which includes items from both factors, exhibited high internal consistency with $\alpha = 0.960$.

These findings indicate that both sub-scales are internally reliable, as anticipated, with items within each sub-scale being highly correlated and consistently measuring the intended constructs. Additionally, the high internal consistency supports the use of a general total score, suggesting that the combined items from both sub-scales effectively measure an overarching construct of location selection, as expected.

H_3) ***Convergent validity.*** As with the original English version, the convergent validity of the Italian adaptation of the scale was assessed by examining the correlations between its subscales and other established measures of emotion regulation (SS and PMERQ), nature connectedness (CNS), and recent time spent in nature. Correlations with descriptive statistics for the variables of interest are presented in **Table 4.19**.

Consistent with findings from Study 2 using the original scale, positive associations were identified between LS scores and the engagement component of the SS scale, but not with the disengagement component.

In terms of emotion regulation strategies measured through the PMERQ scale, the significant correlations between all the LS scores and other measures were observed primarily with the engagement component of the situation selection and situation modification strategies, and the engagement component of cognitive change. Additionally, LS for up-regulation and LS total score showed significant correlations with the disengagement component of attentional deployment, while the LS total score was also associated with the engagement component of attentional deployment.

Regarding nature-related constructs, strong and positive associations were found between all LS scores and connectedness with nature and recent nature visits, indicating that higher scores on the LS Scale were strongly linked to greater nature-relatedness and more frequent engagement with natural environments.

In conclusion, the Italian adaptation of the Location Selection in Nature Scale exhibited acceptable convergent validity, in relation to nature-related constructs and specific emotion regulation strategies, as posited. The weaker correlations with disengagement strategies' measures likely reflect the scale's targeted focus on nature-specific emotional processes, distinguishing it from general emotion regulation tools.

Table 4.19. *Descriptive statistics (means and standard deviations in parentheses) and correlations for convergent validity for the Italian adaptation of the LS Scale (Study 3)*

	Mean (*SD*)		**LS up-regulation**		**LS down-regulation**		**LS total score**	
SS_Eng	4.27 (0.61)	*Pearson's r*	0.239	***	0.294	***	0.279	***
		p-value	< .001		< .001		< .001	
SS_Dis	3.94 (0.80)	*Pearson's r*	0.035		0.078		0.059	
		p-value	0.539		0.173		0.299	
PMERQ_SS_Eng	3.77 (1.04)	*Pearson's r*	0.220	***	0.109		0.173	**
		p-value	< .001		0.055		0.002	
PMERQ_SS_Dis	4.00 (1.16)	*Pearson's r*	-0.041		-0.001		-0.022	
		p-value	0.477		0.987		0.704	
PMERQ_SM_Eng	4.24 (0.87)	*Pearson's r*	0.166	**	0.176	**	0.180	**
		p-value	0.003		0.002		0.002	
PMERQ_SM_Dis	3.26 (1.16)	*Pearson's r*	0.014		0.003		0.009	
		p-value	0.806		0.952		0.873	
PMERQ_AD_Eng	3.42 (0.98)	*Pearson's r*	0.109		0.109		0.114	*
		p-value	0.056		0.057		0.045	
PMERQ_AD_Dis	3.47 (1.15)	*Pearson's r*	0.118	*	0.096		0.113	*
		p-value	0.038		0.092		0.048	
PMERQ_CG_Eng	3.84 (1.07)	*Pearson's r*	0.221	***	0.195	***	0.218	***
		p-value	< .001		< .001		< .001	
PMERQ_CG_Dis	3.41 (1.06)	*Pearson's r*	-0.020		-0.077		-0.051	
		p-value	0.727		0.175		0.369	
PMERQ_RM_Eng	3.54 (1.18)	*Pearson's r*	0.102		0.087		0.099	
		p-value	0.073		0.130		0.083	
PMERQ_RM_Dis	3.64 (1.17)	*Pearson's r*	-0.080		-0.070		-0.079	
		p-value	0.160		0.223		0.169	
CNS	3.55 (0.83)	*Pearson's r*	0.549	***	0.547	***	0.575	***
		p-value	< .001		< .001		< .001	
Nature visits	4.22 (4.33)	*Pearson's r*	0.360	***	0.346	***	0.370	***
		p-value	< .001		< .001		< .001	

Note. LS = Location Selection; SS = Situation Selection; PMERQ = Process Model of Emotion Regulation Questionnaire; SM = Situation Modification; AD = Attentional Deployment; CG = Cognitive Change; RM = Response Modulation; Eng = Engagement; Dis = Disengagement; CNS = Connectedness with Nature Scale; * $p < .05$, ** $p < .01$, *** $p < .001$

H_4) *Divergent validity.* The divergent validity of the Italian adaptation of the Location Selection scale was assessed by examining its correlations with personality traits (**Table 4.20**), as for the original scale.

Conscientiousness and openness were found to have moderate, significant positive correlations with both the Location Selection sub-scales and the total score. This indicates that individuals with higher levels of conscientiousness and openness tend to select locations that support both emotional up-regulation and down-regulation, as well as reporting higher overall scores on the scale.

Agreeableness exhibited a significant but small positive correlation specifically with the up-regulation sub-scale. This suggests a slight relationship between higher agreeableness and a preference for locations that facilitate emotional up-regulation.

In contrast, neuroticism displayed a small negative association with the up-regulation score but did not show significant correlations with the down-regulation or total Location Selection scores.

Extraversion, however, did not show any significant correlations with any of the Location Selection dimensions or the overall score, indicating that extraversion does not appear to be closely related to the selection of locations based on emotional regulation needs.

These findings are consistent with Nisbet's (2009) observations and overall align with those from Study 2 using the original scale, which indicated stronger associations between agreeableness and all location selection scores, as well as significant correlations with extraversion.

Overall, given the small associations found, these results suggest that the Location Selection scale captures distinct constructs from the personality traits measured, supporting its divergent validity.

Table 4.20. *Descriptive statistics (means and standard deviations in parentheses) and correlations for divergent validity for the Italian adaptation of the LS Scale (Study 3)*

	Mean (*SD*)		LS up-regulation		LS down-regulation		LS total score	
BF_Agreeableness	3.13 (0.90)	*Pearson's r*	0.115	*	0.059		0.091	
		p-value	0.043		0.303		0.110	
BF_Extraversion	2.40 (0.95)	*Pearson's r*	0.059		-0.001		0.030	
		p-value	0.301		0.980		0.599	
BF_Conscientiousness	3.56 (0.79)	*Pearson's r*	0.171	**	0.182	**	0.185	**
		p-value	0.003		0.001		0.001	
BF_Neuroticism	3.14 (1.11)	*Pearson's r*	-0.121	*	-0.056		-0.093	
		p-value	0.033		0.331		0.105	
BF_Openness	3.65 (0.99)	*Pearson's r*	0.156	**	0.184	**	0.179	**
		p-value	0.006		0.001		0.002	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

4.4.3. Discussion – Study 3

The adaptation and translation of the Location Selection in Nature Scale into Italian represent a significant advancement in expanding the accessibility and applicability of this instrument across diverse countries and cultural contexts. By adhering to established guidelines for translation and adaptation, particularly the forward and back-translation approach, this study ensures that the scale maintains fidelity to the original while being linguistically and culturally relevant for Italian speakers.

The psychometric evaluation confirmed a robust two-factor structure for the Italian adaptation, aligning with H_1 and the theoretical framework of the original scale. Both exploratory and confirmatory factor analyses confirmed that the factors relating to emotional up-regulation and down-regulation were reliably measured, as evidenced by strong factor loadings that indicate significant relationships between each item and its corresponding latent factor. Moreover, the results of the alternative models testing showed that the two-factor structure remained the best fit for the data, further supporting the robustness and appropriateness of the scale's structure.

Additionally, the high internal consistency coefficients for both sub-scales provide strong evidence of the scale's reliability, as hypothesized (H_2), affirming its utility for assessing the use of natural environments for emotional regulation purposes among Italian-speaking populations.

Findings regarding convergent and divergent validity further enhance the scale's overall robustness. Consistent with H_3, the significant correlations with nature-related constructs, such as connectedness to nature and recent visits to natural settings, highlight the scale's emphasis on nature-specific emotional processes. However, the weaker correlations with broader emotion regulation strategies highlight the distinctiveness of the Location Selection Scale in capturing unique dimensions of emotional regulation that may not be addressed by more generalized measures.

The results concerning divergent validity demonstrate the scale's ability to capture distinct constructs, as indicated by the few and weak correlations observed between location selection scores and personality traits, supporting H_4. This suggests that the Location Selection Scale effectively distinguishes itself from personality measures, thereby reinforcing its specificity and relevance to the domain of nature-related emotional regulation.

In conclusion, this study validates the Italian adaptation of the Location Selection in Nature Scale, establishing it as a valuable resource for researchers and practitioners investigating the intersection of emotional regulation and nature within the Italian context. This adaptation significantly contributes to the expanding body of literature that emphasizes the crucial role of nature in promoting psychological well-being.

4.5. Study 4 —Applied use of the scale: An empirical study

The Location Selection Scale was initially developed to focus on the general use of nature for emotion regulation purposes. A subsequent objective was to evaluate the potential scale's applicability in specific environmental contexts. The goal was to determine whether the scale could assess how individuals select various spaces—both natural and otherwise—to manage negative emotions, specifically for up-regulation and down-regulation, and potentially differentiate between environments based on their perceived effectiveness as places for emotion regulation.

To achieve this, an empirical study was conducted using the scale in the context of natural spaces. This study was part of a larger research project focused on the *Certification of Health Parks* (Assoverde, 2023[a]). In this context, the term "Health Parks" refers to urban green areas designed with specific characteristics proven to positively impact users' perceptions, health, and well-being (Assoverde, 2023[b]).

4.5.1. Rationale – Study 4

The importance of urban green spaces is widely recognized across global health initiatives. For instance, the Parma Declaration by the World Health Organization (WHO, 2010) emphasized ensuring that every child has access to safe and healthy environments, including green spaces for physical activity and play. This commitment aligns with United Nations Sustainable Development Goal 11.7 (SDGs; WHO, 2015), which promotes inclusive, safe, resilient, and sustainable cities, aiming to provide universal access to green and public spaces in urban areas. Similarly, the WHO Action Plan for implementing the European Strategy for Noncommunicable Diseases promotes the establishment of accessible green spaces for leisure-time physical activity and encouragement of behaviour modification (WHO, 2012).

In this regard, *Assoverde* (*Associazione Italiana dei Costruttori del Verde*; i.e., Italian Association of Green Builders, www.assoverde.it/) plays a crucial role in advocating for the creation of sustainable and health-promoting natural spaces as a response to climate change and the growing challenges of urbanization in Italy. *Assoverde* collaborates with institutions, universities, research entities, professional orders, and private companies to safeguard green and blue spaces through an interdisciplinary network. Their efforts are evident in events like the *Health Parks: Criteria for Certification* conference, which highlights the potential of urban green areas. Alongside *Confagricoltura*, they have developed the "*Libro Bianco del Verde*" (i.e., White Paper on Green), a comprehensive analysis aimed at scientifically defining the benefits of nature contact and promoting a sustainable green infrastructure, under a multi-disciplinary framework (Assoverde, 2023[a]).

Recognizing the importance of urban nature in addressing health issues, recent research confirms that urban nature, particularly urban parks, can significantly contribute to public well-being (Keniger et al., 2013). However, not all natural environments are equally regenerative and beneficial (Herzog et al., 2003). Differences in landscape types (Liu, 2016), landscape elements (White et al., 2010), and spatial characteristics (Peschardt & Stigsdotter, 2013; Li et al., 2023) can result in varying impacts on aesthetic preference, regenerative perception, and health promotion. The concept that urban green spaces serve not only aesthetic purposes, but also significantly contribute to the well-being of communities, underpins the work for the definition and certification of Health Parks, promoted by *Assoverde* and *Confagricoltura*. This initiative aims to define the characteristics that public green spaces must possess to be recognized as Health Parks and emphasizes territorial planning to maximize the benefits derived from contact with nature, either by improving existing parks or designing new ones.

A literature review on this topic identified several indicators relevant to the psychological effects of parks on users' well-being. For each indicator, the following details were established, in order to use them as parameters for attributing a certification of Health Park (Képos, 2023): requirements (i.e., necessary quality for certification), critical thresholds (i.e., minimum acceptable levels), and measurements (i.e., quantifiable design characteristics).

Among the proposed indicators for the characteristics of parks recognized as Health Parks are specific elements such as blue elements, floral coverage, floral chromatic biodiversity, and faunal biodiversity. This research focuses on these indicators, investigating how they influence people's evaluations, and highlighting their importance in promoting various benefits associated with nature, as demonstrated by prior studies. **Table 4.21** shows the classification of these case study indicators, used as Certification's criteria. These elements were selected on the basis of prior literature that has highlighted their significant evidence-based role in influencing the impact of urban green spaces.

Table 4.21. *Classification of case study indicators for the Certification of Health Parks adopted in Study 4*

Indicators	Requirement	Measurement parameter	Critical threshold	
			New constructions	*Existing park renovations*
Blue elements	Optional but important	Yes / No (presence/absence) Presence of static water elements (e.g., lakes) and/or dynamic water elements (e.g., fountains)	Blue elements $f \geq 1$	Blue elements $f \geq 1$
Floral coverage	Essential	- Percentage of spontaneous and cultivated flowers - Monochrome or polychrome	Minimum 25% flower coverage, preferably with vibrant colours	The requirement must be fulfilled within the limit of 10%.
Floral chromatic biodiversity	Essential	% flowering extension with multiple colours	Minimum 15% flowering extension	Minimum 10% flowering extension
Faunal biodiversity	Essential	- Number of avian species (summer period) - Number of habitats	- Minimum 10 avian species, optimal if >18 - Presence of diverse habitats $f \geq 1$	- Minimum 10 avian species, optimal if >18 - Presence of diverse habitats $f \geq 1$

Blue elements. Blue spaces have a well-documented positive impact on human health and well-being, influencing factors such as perception, preference, emotions, and restoration (Völker & Kistemann, 2011).

Water features within urban parks, such as rivers, ponds, and fountains, significantly enhance aesthetic appeal and are highly valued by the public for their ability to promote physical activity, social interaction, and emotional bonding (Jo & Jeon, 2021; Zhang et al., 2021), as well as for their cooling effects (White et al., 2021). These elements play a crucial role in alleviating stress and encouraging relaxation and contemplation (Kabisch et al., 2017), as also evidenced by the findings of Review 2 in **Chapter 3** on virtual reality scenarios. This highlights their significance as key components in the design of urban green spaces aimed at enhancing well-being.

Research indicates that blue elements contribute to psychological restoration by lowering physiological stress indicators, such as blood pressure and heart rate, while fostering positive emotional states and reducing negative emotions (Tang et al., 2017; Park & Jo, 2016). They also serve as key areas for leisure and recreational activities, increasing the frequency and duration of park visits, particularly for vulnerable groups like children and the elderly (Li et al., 2022; Völker & Kistemann, 2013).

The integration of blue spaces in urban planning not only enhances the visual satisfaction of park users but also strengthens their emotional attachment to these environments, leading to higher public satisfaction (Li et al., 2022; Völker & Kistemann, 2011).

Floral coverage. The presence of diverse and abundant flowerbeds in urban parks significantly enhances user preferences and satisfaction, playing a vital role in the overall well-being of park visitors (van Vliet et al., 2020; Zhang et al., 2021). These floral resources beautify the environment and profoundly impact users' mental and physical health by alleviating stress and promoting relaxation (Zhang et al., 2021).

Research indicates that flowers in urban settings positively predict mood states, particularly for women, who report stronger emotional responses to floral elements

(Pazhouhanfar, 2018). A significant percentage of participants express feelings of tranquillity and love when encountering flowers, highlighting the emotional connection to these natural elements (Rahnema et al., 2019). Moreover, flower-bearing plant species tend to be more appealing to park visitors than merely ornamental leafy plants, underscoring the importance of aesthetic diversity in urban landscaping (Rahnema et al., 2019).

Floral coverage, particularly when exceeding 25%, significantly enhances the aesthetic appeal and attractiveness of parks (Todorova et al., 2004). Additionally, the number of trees and the presence of diverse flowerbeds significantly impact participants' preferences for park design (van Vliet et al., 2020). In particular, flower clusters play a crucial role in alleviating feelings of pressure and promoting relaxation among community park users (Zhang et al., 2021). A higher floral coverage of around 30% not only supports the aesthetic aspect but also fosters micro-faunal biodiversity, benefiting the ecological balance of urban green spaces (Lindemann-Matthies & Bose, 2007; Hoyle et al., 2017).

This diversity not only enhances the visual appeal of parks but also supports urban biodiversity. Studies show that the abundance and variety of flowerbeds positively influence the presence of flower-visiting insects, including essential pollinators (Matteson et al., 2013; Wenzel et al., 2020; Cohen et al., 2021).

Floral chromatic biodiversity. Floral chromatic biodiversity plays a crucial role in influencing psychophysical states. Numerous studies emphasize the positive impacts of urban green spaces on human physiology and psychology, particularly through their floral characteristics.

The diversity of flower colours can evoke varied emotional responses, with cool colours like blue and violet promoting relaxation, while warm colours such as yellow and orange are associated with uplifting mood and reducing stress levels (Krisantia et al., 2021; Neale et al., 2021; Xie, Liu & Elsadek, 2021). Also, research shows that higher proportions of cool colours and vibrant vegetation significantly increase aesthetic preference and emotional valence among visitors (Zhuang et al., 2021).

The interplay between flower colour diversity and species richness is also critical, as it affects not only human responses but also the attraction of pollinators (Hoyle et al., 2018). In particular, higher flower colour diversity has been shown to enhance aesthetic enjoyment and well-being, encouraging people to prefer plant communities that feature multiple colours and species (Tomitaka et al., 2021).

The aesthetic appeal of colourful flowering landscapes correlates positively with perceptions of biodiversity, indicating that people often use colour diversity as a cue for assessing overall floral richness (Hoyle et al., 2017; Gonçalves et al., 2021). This suggests that urban green spaces designed with high chromatic biodiversity can significantly enhance user satisfaction and promote emotional well-being, highlighting the need for strategic landscaping that prioritizes diverse and vibrant flower colours.

Faunal biodiversity. Faunal biodiversity, particularly the presence of diverse bird species, significantly contributes to alleviating anxiety, stress, and depression among individuals. Research indicates that environments hosting different bird species enhance psychological well-being and overall satisfaction, providing therapeutic benefits through the visual and auditory experiences of nature, thereby increasing the restorative potential of these spaces (Fisher et al., 2021; Fuller et al., 2007).

Urban settings often serve as the primary interface between people and nature, where bird species can have a pronounced impact on well-being. Studies reveal that residents value the aesthetic and ecological roles of neighbourhood birds, and perceptions of species richness are linked to positive emotional responses (Belaire et al., 2015). However, many individuals may not accurately recognize the diversity of bird species present, which can limit their connection to local wildlife and reduce the psychological benefits derived from nature (Ishibashi et al., 2020).

Enhancing urban biodiversity through the introduction of more diverse bird populations can facilitate greater engagement with nature. For instance, a study found a strong correlation between levels of avian biodiversity and positive emotional responses among park visitors, suggesting that environments perceived as wildlife-rich elicit happier feelings (Cameron et al., 2020). Furthermore, the connection between perceived biodiversity and well-being emphasizes the importance of public awareness and appreciation of local fauna (Gonçalves et al., 2021).

Overall, promoting avian diversity in urban green spaces not only fosters ecological balance but also enriches the psychological experiences of urban dwellers.

Based on this evidence, the present research aims to empirically test the effects of these specific environmental indicators on participants' evaluations, compared to a baseline condition where these indicators are absent. The indicators were chosen for this study based on their strong visual impact and feasibility of integration into experimental images.

Aim and hypotheses. The aim of this study was threefold: to evaluate the scale's structure, to explore the impact of the indicators within the manipulated images, and to investigate the associations among the variables of interest.

The primary objective was to evaluate the structure of the applied Italian version of the Location Selection in Nature Scale and to assess its alignment with the two factors identified in the main validation studies. To achieve this, the Italian adaptation of the scale was tested for both factorial structure and internal reliability. Additionally, the study aimed to test measurement invariance across the experimental stimuli, ensuring that the scale functions consistently across different environmental images.

To guide this evaluation, the following hypotheses were proposed:

H1) The applied Italian adaptation of the LS Scale would replicate the two-factor structure—up-regulation and down-regulation—identified in previous studies, as demonstrated through exploratory and confirmatory factor analysis.

H2) The shortened applied Italian adaptation of the LS Scale and its factors would exhibit strong internal consistency, thereby confirming the scale's reliability.

H3) Measurement invariance would be established across the different experimental images, confirming that the scale measures the same construct consistently across varying environmental stimuli.

The secondary goal was to explore the images and assess the impact of the presence of different indicators on the variables of interest. In this case, the overarching hypothesis posited that the presence of the indicators in the manipulated images and scenarios would result in higher and/or more positive ratings compared to the baseline image. So, it was expected that participants would rate manipulated images with indicators more favourably compared to the baseline image, in terms of perceived restorativeness of the place, the degree pleasantness and relaxation associated to the place, desire to visit the place, uniqueness and aesthetics, cognitive and behavioral regenerative qualities, pleasantness and relaxation of emotional reactions, and the selection of the place for emotional regulation. No specific hypotheses were made regarding differences among the various manipulated images and scenarios.

For the purpose of this doctoral thesis, only the variables directly related to the core focus of the project are discussed in this context. These key variables include: the selection of specific locations for the purpose of emotion regulation (i.e., location selection), the perceived restorativeness of these locations, the degree of pleasantness and relaxation that individuals associate with these spaces, and the pleasantness and relaxation of the emotional responses elicited by these environments.

Specifically, the following hypotheses were formulated for these variables:

H_4) The manipulated images with the indicators were expected to be perceived as more suitable for emotion regulation, both up-regulation (H_{4a}) and down-regulation (H_{4b}), compared to the baseline image.

H_5) The manipulated images with the indicators were assumed to receive higher ratings for perceived restorativeness compared to the baseline image.

H_6) The manipulated images with the indicators were anticipated to be perceived as more pleasant (H_{6a}) and relaxing (H_{6b}) compared to the baseline image.

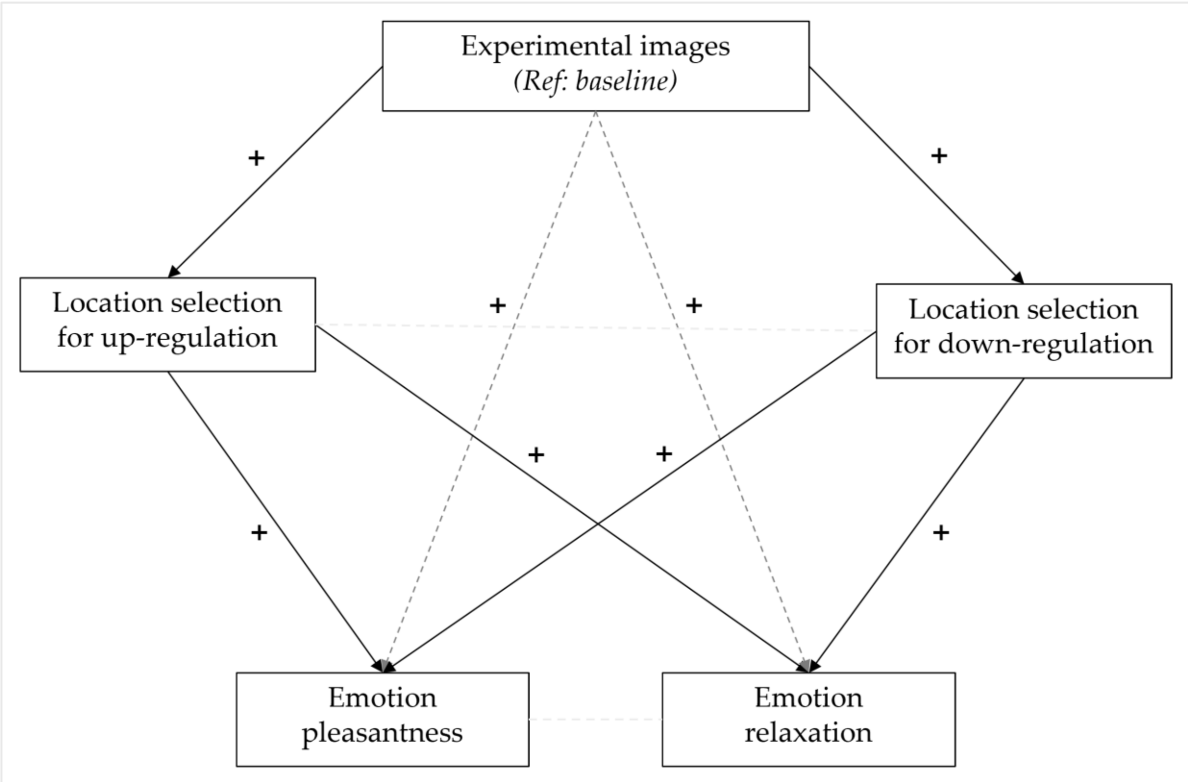
H_7) The manipulated images with the indicators were hypothesized to elicit higher levels of pleasantness (H_{7a}) and activate more relaxing (H_{7b}) emotional reactions compared to the baseline image.

A third objective of this study was to investigate the associations among key variables related to location selection and to examine the potential explanatory mechanisms underlying these relationships. Specifically, this research aimed to elucidate how the location selection variables—both up-regulation and down-regulation—interact with other significant constructs, such as perceived restorativeness, pleasantness, and relaxation. By exploring these associations, this study seeks to enhance the understanding of the role of location selection in shaping emotional experiences within natural environments.

H_8) It was anticipated that the location selection variables, both up-regulation and down-regulation, would show significant and positive associations with the other key variables: place perceived restorativeness (H_{8a}), place's pleasantness (H_{8b}) and relaxation (H_{8c}), and pleasantness (H_{8d}) and relaxation (H_{8e}) of emotional reactions.

H_9) Location selection for up-regulation and down-regulation simultaneously mediates the relationship between experimental environmental stimuli (images) and emotional reactions (**Figure 4.3**). Specifically, exposure to the different environmental stimuli (i.e., blue element, floral coverage, chromatic biodiversity, and faunal biodiversity) would influence location selection for up-regulation and down-regulation, which in turn would enhance emotional pleasantness and relaxation.

Figure 4.3. *Simplified conceptual model with hypothesized parallel mediation paths (H_9) tested in Study 4, linking experimental images to emotional outcomes with mediation through LS variables*



Note. Solid line: direct effects; dashed line: indirect effects;
+ : expected positive association; - : expected negative association.

4.5.2. Method – Study 4

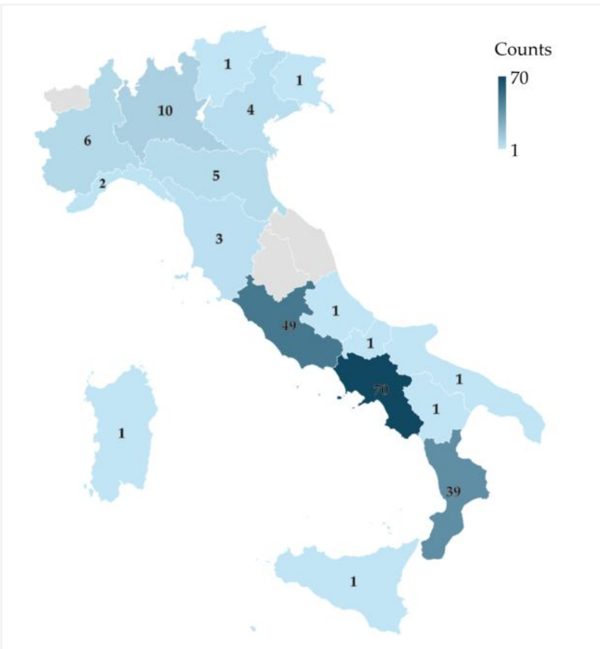
Sample. In this study, a diverse sample of 200 participants (122 female, 77 male) was collected. To recruit participants, the link to the questionnaire was shared via social media channels. The average age of the participants was 35.9 years (SD_{age} = 14.3), reflecting a wide age range from 18 to 71 years. This indicates that the sample included both younger and older individuals, although most were in their mid-thirties. In terms of education, the participants had varied levels of educational attainment.

A significant portion of the sample, 34.0%, held a high school diploma, while 33.0% had completed a Master's degree. Additionally, 18.5% had a Bachelor's degree, and 11.0% had pursued further post-graduate education. A small percentage had only completed middle school (3.0%), and just one participant (0.5%) reported having only an elementary school education.

The participants' occupational statuses were also varied. Nearly half of the sample, 48.5%, were employed, making it the largest occupational group. Students comprised 32.5% of the sample, followed by 9.0% who were both students and workers. A small percentage of participants were either retired (3.5%) or unemployed (3.5%), and 3.0% reported "Other" as their occupation.

All participants resided in Italy, except for 6 individuals who were Italians living abroad. **Figure 4.4** illustrates the distribution of participants across different residential regions in Italy. Regarding residential characteristics, the majority of participants, 47.5%, lived in small towns or cities, while 36.0% resided in large cities. A smaller portion, 12.5%, lived in the suburbs of large cities, and just 4.0% lived in rural areas.

Figure 4.4. *Distribution of participants' residential regions*



Procedure. A within-subject methodology was used for the study, where all participants evaluated six experimental images based on their perception of the presented location and the emotions it elicited, using a questionnaire. The questionnaire, which took approximately 20 minutes to complete, was developed and distributed through the *Qualtrics* online platform. The link to the questionnaire was shared with a clear instruction that it could only be completed on a computer or similar devices, excluding other types of electronic devices. This requirement was set to ensure that the images were viewed on screens of sufficient size, allowing participants to properly focus on the details.

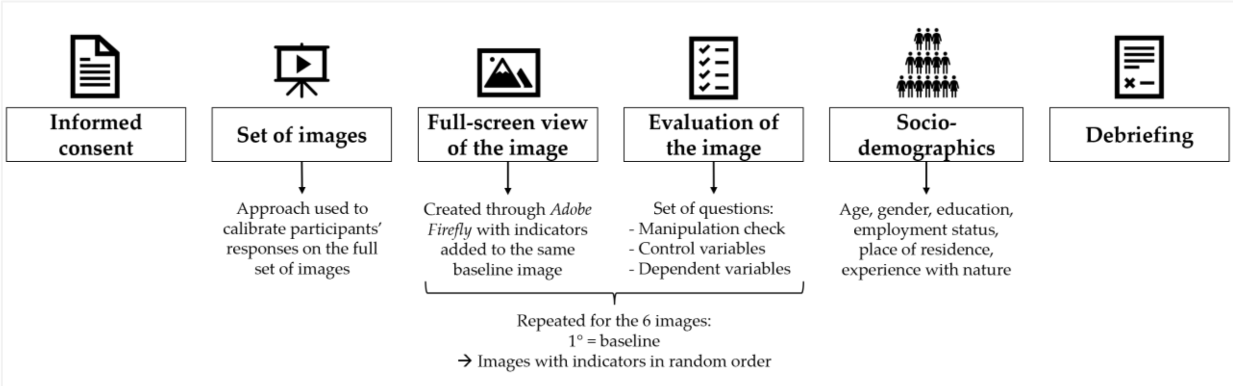
The questionnaire was structured into modules with various sections repeated for the evaluation of each experimental image (**Figure 4.5**).

In the first part, after obtaining informed consent, participants were shown six images in a short introductory video, where each image was displayed for 2 seconds, separated by a black screen. This approach, previously used in studies like Twedt and colleagues (2016), allows participants to calibrate their responses by viewing all the images before beginning individual evaluations.

Following this introduction, the baseline image was presented first for evaluation, followed by the assessment of the five manipulated images, which were displayed in a randomized order. After viewing each image, participants were asked to answer questions about the characteristics and elements of the depicted environment, as well as their personal perceptions of the scenario. Throughout the questionnaire, participants had the option to view again the image being evaluated in full screen.

After images' assessments, participants were asked to provide socio-demographic information, including age, gender, education level, employment status, and place of residence. Additionally, respondents' experience with nature was measured, considering factors such as the naturalness of their current and childhood residence, frequency of visits to natural places, and their connection with nature. These data were used to describe sample characteristics but are not analysed here.

Figure 4.5. *Diagram of the survey procedure adopted in Study 4*



Before proceeding with the main study's data collection, a pilot test (N = 11, 5 males and 6 females, M_{age} = 34.3, SD_{age} = 12.8) was conducted on the experimental images and the adopted procedure. The purpose of this pilot was to ensure that the manipulated images were perceived as intended and to gather feedback from participants regarding any potential issues with the procedure.

Measures. The following measurement instruments were used:

- *Manipulation check items (ad-hoc).* To ensure the appropriateness of the image manipulations, manipulation check questions were used to assess the participants' perceived presence of each indicator in the images. It was expected that the perceived level of an indicator would be higher in the image where the indicator had been deliberately manipulated compared to the baseline image. Conversely, it was anticipated that the perceived level of an unmanipulated indicator would remain consistent with that of the baseline image. This approach was critical for validating that the manipulations had the intended effect on participants' perceptions.

For each indicator, an individual item was included in the questionnaire (see **Appendix B.23**). Participants were asked to indicate the extent to which they noticed the presence of the following elements in the depicted scene: blue elements, flowers, animals, and colours. They rated their perception of these elements using a Likert scale ranging from 0 (not at all) to 10 (completely).

- *Location selection for emotion regulation* (adapted items from the Italian version of the Location Selection scale, see **Appendix B.24**). To evaluate location selection for emotion regulation in relation to specific environmental stimuli, items were adapted from the original Location Selection scale. This adaptation aimed to tailor the scale to assess participants' preferences for selecting specific environments to manage their emotions. A total of eight items were chosen, with four items representing each factor: up-regulation and down-regulation. Specifically, two representative items for each target emotion (based on valence and arousal) were selected from the Italian adaptation of the Location Selection Scale. The items were then modified to suit this context of application, incorporating statements such as "*I would visit this place when I want to feel calmer*" and "*I would go to this place when I want to feel more energetic*". Participants responded using the same response-options as in the original scale, indicating their level of agreement with each statement on a scale from 1 (completely disagree) to 7 (completely agree), with 4 representing neutrality.

- *Place perceived restorativeness* (PRS, Hartig et al., 1996; Italian validated version by Pasini et al., 2009). To assess participants' perceived restorativeness of the virtual environments, a shortened version of the Perceived Restorativeness Scale (5-items) was used to measure how restorative the environments depicted in the images are perceived to be (see **Appendix B.25**). The PRS is based on four theoretical restorative factors proposed by Kaplan's Attention Restoration Theory (Kaplan, 1995): being-away, fascination, extent, and compatibility. Additionally, one item was included to gauge the participant's perceived likelihood that the environment could promote restoration. Each item was rated on a Likert scale, where participants indicated their level of agreement with statements about the environment, with scores ranging from 0 (not at all) to 10 (completely). The overall perceived restorativeness score was then calculated as the average of the five items (α = .792 to .843 across images) with higher scores indicating a greater perceived restorative quality of the environment.

- *Pleasantness and relaxation of the spaces* (adapted from the Affective Quality of Place, Mehrabian & Russell, 1974; Italian version: Perugini et al., 2002). To assess participants' perceptions of the environments in terms of pleasantness and relaxation, 6 items were used, employing a semantic differential response format ranging from -3 to +3, with pairs of opposing adjectives at each end (see **Appendix B.26**). Specifically, the environments were evaluated based on two dimensions: pleasantness and relaxation. For pleasantness, three items were used, featuring adjective pairs such as *unpleasant-pleasant* (α = .754 to .890 across images). For relaxation, another three items were included, using pairs like *stressful-relaxing* (α = .784 to .905 across images). The average scores for each dimension were calculated and considered for analysis, providing a clear measure of how the participants perceived the environments in terms of both their overall appeal and their capacity to promote relaxation.

- *Pleasantness and relaxation of the emotional responses* (adapted from the Self-Assessment Manikin scale; SEM, Bradley & Lang, 1994). To assess the emotional reactions related to the environments, six items were used. These items were structured as semantic differentials, using pairs of opposing adjectives and a response scale ranging from -3 to +3 (see **Appendix B.27**). Specifically, the emotional reactions were measured in terms of valence and arousal. For valence, three items were used to capture the emotional tone of the participants' responses, with pairs such as *sad-happy* (α = .816 to .875 across images). For arousal, another three items measured the level of emotional activation, using pairs like *agitated-relaxed* (α = .839 to .913 across images). The average scores for each dimension were calculated and considered for analysis. This approach allowed for the analysis of how participants emotionally responded to the environments, providing insights into both the positive or negative quality of the emotions (valence) and the intensity or calmness of the emotional state (arousal).

Experimental images. The manipulation of independent variables, specifically the indicators, was carried out using Adobe's artificial intelligence tool, i.e., *Adobe Firefly*. This AI, through its generative fill function, allows for the replacement of parts of an image with desired elements while maintaining continuity and coherence with the surrounding context.

Using this method, a series of images was created, all based on a common background of an urban park, which served as the baseline (also generated by the same software). Each image was modified by adding only one of the selected variables for analysis. Specifically, six images were created and used for the study:

- the baseline image depicted an urban park without any indicators (**Figure 4.6**),
- one image included a blue element, specifically a body of water (**Figure 4.7**),
- two images illustrated floral coverage with yellow flowers at 25% (**Figures 4.8**) and 50% coverage (**Figures 4.9**),
- one image represented floral colour diversity, featuring yellow, red, and blue flowers while maintaining a consistent 50% floral coverage (**Figure 4.10**),
- one image highlighted the indicator of faunal biodiversity (**Figure 4.11**).

Figure 4.6. *Baseline image of an urban park*

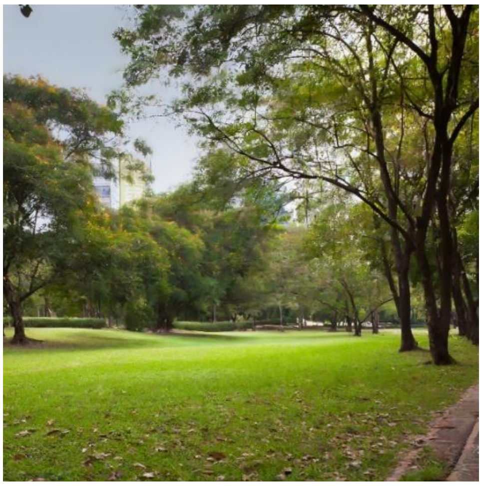


Figure 4.7. *Image of blue element*

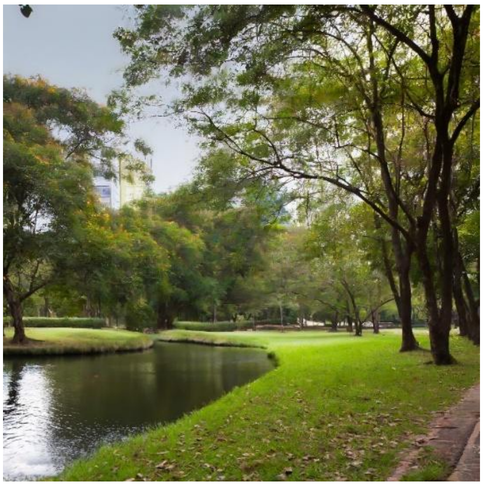


Figure 4.8. *Image of 25% floral coverage*

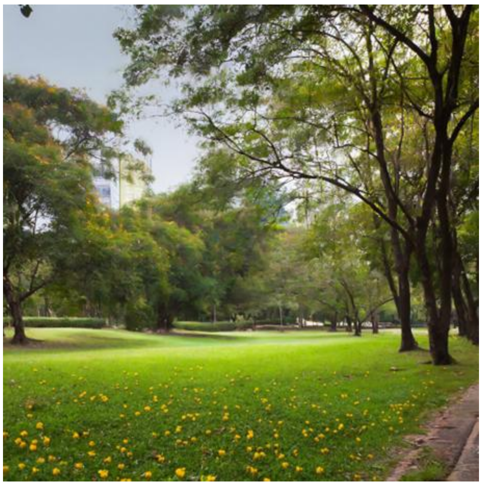


Figure 4.9. *Image of 50% floral coverage*

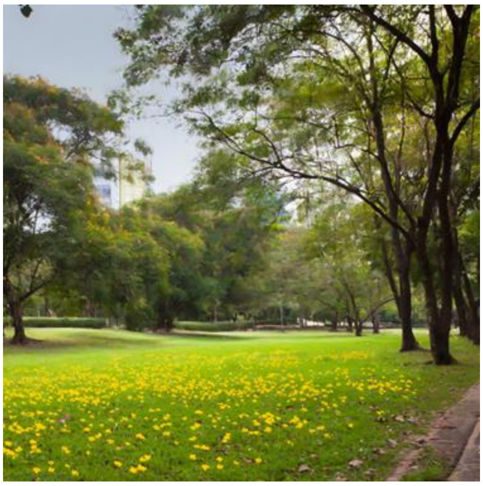


Figure 4.10. *Image of floral chromatic biodiversity*

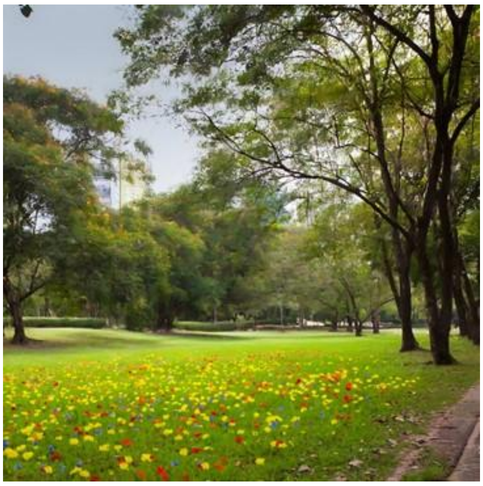
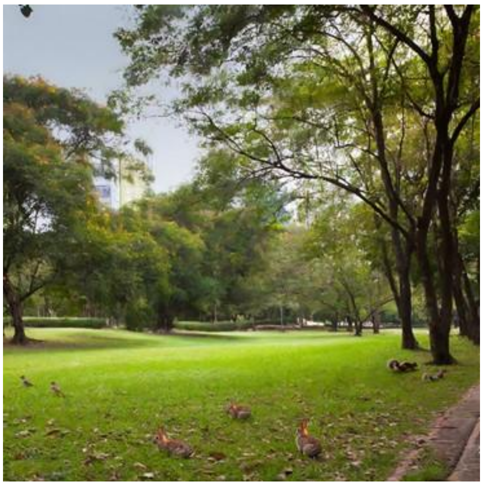


Figure 4.11. *Image of faunal biodiversity*



Analytic strategies. To analyse the data, the first step involved conducting manipulation checks through a series of repeated measures ANOVAs. These analyses assessed the effects of the image manipulations, in order to verify that the participants effectively perceived the presence of the manipulated indicators in the corresponding experimental images.

Subsequently, analyses were conducted to evaluate the structure of the scale (H_1). The data from the location selection scale were examined to determine whether the two factors identified in previous studies would also be validated in this adapted shortened version which focused on hypothetical use of specific locations. To address this, an initial Exploratory Factor Analysis (EFA) was performed, followed by a Confirmatory Factor Analysis (CFA) to verify the structure that emerged.

Reliability analyses were then carried out for the entire scale, as well as for the individual subscales, to ensure consistent measurement across items (H_2). Analyses were conducted separately for the full dataset and for the data corresponding to each experimental image. For the purpose of brevity, only detailed results from the complete dataset are presented in the main text of the thesis.

Additionally, measurement invariance across the different experimental stimuli (images) was tested to confirm that the scale functions consistently across various environmental contexts (H_3). Multi-group confirmatory factor analysis (MGCFA) was conducted, following a structured approach to evaluate configural, metric, and scalar invariance, assessing fit indices such as ΔCFI, ΔRMSEA, and ΔSRMR to ensure that the scale measures the same construct equivalently across the different images.

For hypotheses testing about differences among the investigated images (H_4 – H_7), repeated measures ANOVAs were conducted for each of the dependent variables to compare the baseline image with the other experimental images. To identify significant differences between the experimental images, post hoc comparisons were performed using *Tukey*'s method.

Correlation analyses were then performed to explore how the location selection variables are related to the other relevant constructs associated with the evaluated environments (H_8). Finally, a Structural Equation Model was performed to further explore these associations and test the potential mediating role of location selection for up- and down-regulation, in the effect of place perceived restorativeness on the emotional reactions to the place, in terms of pleasantness and relaxation (H_9).

4.5.3. Results – Study 4

Manipulation check. Descriptive analyses of the manipulation check variables for the six experimental images are presented in **Table 4.22.**

Table 4.22. *Descriptive statistics for manipulation check items across experimental images: means and standard deviations in parentheses (Study 4)*

Image	Elements			
	Blue	*Flowers*	*Colours*	*Animals*
Baseline	0.47 (1.55)	1.24 (2.36)	4.41 (2.65)	0.43 (1.28)
Blue element	7.62 (2.36)	1.03 (1.72)	4.61 (2.33)	0.40 (1.12)
Floral coverage 25%	0.28 (0.82)	5.85 (2.56)	5.23 (2.27)	0.37 (0.97)
Floral coverage 50%	0.35 (1.01)	6.64 (2.60)	5.69 (2.22)	0.41 (1.07)
Chromatic biodiversity	0.31 (1.04)	8.00 (2.13)	7.63 (1.94)	0.49 (1.52)
Faunal biodiversity	0.43 (1.39)	1.23 (2.17)	4.58 (2.37)	6.61 (2.60)

To evaluate the effectiveness of the image manipulations, repeated measures ANOVA was conducted for each manipulation check variable, including the perception of blue elements, flowers, colours and animals across the different experimental images. The expectation was that the perceived level of these elements would be significantly higher in the images specifically manipulated to include them, compared to the baseline image, while the perceived level of non-manipulated indicators would remain similar across all images.

Blue element. The analysis revealed that the experimental image factor had a statistically significant effect on the perception of blue elements, $F(5, 199) = 980$, $\eta^2 = 0.777$, $p < .001$. Post-hoc comparisons further clarified that the baseline image ($M = 0.47$, $SD = 1.55$) was perceived as containing significantly fewer blue elements compared to the image explicitly manipulated to include blue elements ($M = 7.62$, $SD = 2.36$), $t(199) = -35.98$, *mean difference* =

-7.15, $p_{tukey} < .001$. Moreover, the blue element image was rated as having significantly more blue elements than all other experimental images, specifically: 25% floral coverage (*M* = 0.28, *SD* = 0.82), *t*(199) = 40.86, *mean difference* = 7.34, $p_{tukey} < .001$; 50% floral coverage (*M* = 0.35, *SD* = 1.01), *t*(199) = 40.39, *mean difference* = 7.27, $p_{tukey} < .001$; chromatic biodiversity (*M* = 0.31, *SD* = 1.04), *t*(199) = 38.45, *mean difference* = 7.31, $p_{tukey} < .001$; faunal biodiversity (*M* = 0.43, *SD* = 1.39), *t*(199) = 38.45, *mean difference* = 7.31, $p_{tukey} < .001$. In contrast, there were no significant differences in the perception of blue elements between the baseline and other non-blue manipulated images, such as those featuring different levels of floral coverage or faunal biodiversity. This result highlights that the manipulations of blue elements were successfully perceived by participants, while the baseline and non-blue images did not elicit significant differences in perceived blue features.

Flowers. To assess the effectiveness of image manipulations regarding the presence of flowers, repeated measures ANOVA was performed on the manipulation check variable associated with floral elements. The analysis showed that the experimental image factor had a statistically significant effect on the perception of flowers, $F(5, 199) = 564$, $\eta^2 = 0.620$, $p < .001$. This indicates a strong impact of the manipulations on participants' perception of floral elements. Specifically, post hoc comparisons revealed that the baseline image (*M* = 1.24, *SD* = 2.36) was perceived as having significantly fewer flowers compared to the images with 25% floral coverage (*M* = 5.85, *SD* = 2.56), *t*(199) = -20.22, *mean difference* = -4.61, $p_{tukey} < .001$; 50% floral coverage (*M* = 6.64, *SD* = 2.60), *t*(199) = -22.22, *mean difference* = -5.40, $p_{tukey} < .001$; and chromatic biodiversity (*M* = 8.00, *SD* = 2.13), *t*(199) = -31.96, *mean difference* = -6.76, $p_{tukey} < .001$.

Furthermore, the image with 50% floral coverage was rated as having significantly more flowers than the image with 25% floral coverage, *t*(199) = -5.43, *mean difference* = -0.79, $p_{tukey} < .001$. Similarly, the image representing chromatic biodiversity was rated as having more flowers compared to both the 25% floral coverage image, *t*(199) = -14.15, *mean difference* = -2.15, $p_{tukey} < .001$, and 50% floral coverage image, *t*(199) = -9.77, *mean difference* = -1.36, $p_{tukey} < .001$.

Moreover, results showed that the image with blue elements was perceived as having significantly fewer flowers compared to the image with 25% floral coverage, $t(199) = -23.91$, *mean difference* = -4.82, $p_{tukey} < .001$. Similarly, the image with blue elements had significantly fewer perceived flowers than the image with 50% floral coverage, $t(199) = -27.17$, *mean difference* = -5.61, $p_{tukey} < .001$. The image representing chromatic biodiversity was perceived as having significantly more flowers compared to the image with blue elements, $t(199) = -37.13$, *mean difference* = -6.97, $p_{tukey} < .001$. Further, the image with 25% floral coverage was rated as having significantly more flowers than the image representing faunal biodiversity, $t(199) = 20.99$, *mean difference* = 4.62, $p_{tukey} < .001$. Similarly, the image with 50% floral coverage was perceived as having significantly more flowers compared to the image representing faunal biodiversity, $t(199) = 23.80$, *mean difference* = 5.41, $p_{tukey} < .001$. Finally, the image representing faunal biodiversity was rated as having significantly fewer flowers than the image representing chromatic biodiversity, $t(199) = -33.06$, *mean difference* = -6.77, $p_{tukey} < .001$. Overall, these results highlight the effectiveness of the manipulations in altering the perception of floral elements across the various experimental images.

Colours. The manipulation check for the colour-related elements across the experimental images was analysed using a repeated measures ANOVA. The results indicated a significant effect of the experimental images on the perceived presence of colours, $F(5, 199) = 127$, $p < .001$, $\eta^2 = 0.188$. This suggests the presence of statistically significant differences between experimental images in terms of colours.

Post-hoc comparisons further examined the specific differences between images. The baseline image ($M = 4.41$, $SD = 2.65$) was perceived as having significantly fewer colours compared to the image with 25% floral coverage ($M = 5.23$, $SD = 2.27$), $t(199) = -5.36$, *mean difference* = -0.82, $p_{tukey} < .001$. Similarly, the baseline image was rated as having significantly fewer colours than the image with 50% floral coverage ($M = 5.69$, $SD = 2.22$), $t(199) = -8.09$, *mean difference* = -1.28, $p_{tukey} < .001$. Additionally, the baseline image had significantly fewer perceived colours compared to the image representing chromatic biodiversity ($M = 7.63$, $SD = 1.94$), $t(199) = -17.63$, *mean difference* = -3.22, $p_{tukey} < .001$. When comparing the image with blue elements ($M = 4.61$, $SD = 2.33$) to others, it was found that it also had significantly fewer perceived colours than the image with 25% floral coverage, $t(199) = -4.59$, *mean difference* = -0.63, $p_{tukey} < .001$, and the image with 50% floral coverage, $t(199) = -7.34$, *mean difference* = -1.09, $p_{tukey} < .001$. Furthermore, the image with blue elements had significantly fewer colours than the image representing chromatic biodiversity, $t(199) = -17.91$, *mean difference* = -3.03, $p_{tukey} < .001$.

Comparisons between the images with different levels of floral coverage revealed that the image with 25% floral coverage had significantly fewer colours than the image with 50% floral coverage, $t(199) = -3.68$, *mean difference* = -0.46, $p_{tukey} = .004$. However, the image with 25% floral coverage had significantly more perceived colours than the image representing faunal biodiversity ($M = 4.58$, $SD = 2.37$), $t(199) = 4.46$, *mean difference* = 0.66, $p_{tukey} < .001$. The image with 50% floral coverage also had significantly more perceived colours than the image representing faunal biodiversity, $t(199) = 7.05$, *mean difference* = 1.12, $p_{tukey} < .001$. Lastly, the image representing faunal biodiversity was perceived as having significantly fewer colours compared to the image representing chromatic biodiversity, $t(199) = -18.36$, *mean difference* = -3.06, $p_{tukey} < .001$. These findings demonstrate that the experimental manipulations effectively altered the perception of colour in the different images, with the chromatic biodiversity image consistently being rated as having the highest colour intensity among the conditions.

Animals. The manipulation check for the presence of animal-related elements across the experimental images was assessed using a repeated measures ANOVA. The results revealed a significant effect of the image type on the perceived presence of animals, $F(5, 199) = 680$, $\eta^2 = 0.696$, $p < .001$, indicating that the manipulations were effective in altering participants' perceptions of animal content.

Post-hoc comparisons provided further insights into the differences between specific image conditions. However, the baseline image ($M = 0.43$, $SD = 1.28$) had a significantly lower perceived presence of animals compared to the image representing faunal biodiversity ($M = 6.61$, $SD = 2.60$), $t(199) = -30.89$, *mean difference* = -6.18, $p_{tukey} < .001$. No significant difference was found between the baseline image and the images representing blue elements (M = 0.40, SD = 1.12), 25% floral coverage (M = 0.37, SD = 0.97), with 50% floral coverage (M = 0.41, SD = 1.07), and chromatic biodiversity (M = 0.49, SD = 1.52).

Comparisons involving the image with blue elements also showed no significant differences from the images with 25% floral coverage, with 50% floral coverage, and chromatic biodiversity. However, the image with blue elements was perceived to have significantly fewer animals compared to the image with faunal biodiversity, $t(199) = -30.75$, *mean difference* = -6.21, $p_{tukey} < .001$.

For the images with different levels of floral coverage, the image with 25% floral coverage had no significant difference compared to the image with 50% floral coverage. Instead, both images were significantly different from the image representing faunal biodiversity, with the image with 25% floral coverage being perceived as having significantly fewer animals compared to the faunal biodiversity image, $t(199) = -32.07$, *mean difference* = -6.24, $p_{tukey} < .001$, and the image with 50% floral coverage also showing a significant difference $t(199) = -31.16$, *mean difference* = -6.20, $p_{tukey} < .001$. The image with faunal biodiversity was perceived to have significantly more animals compared to the image representing chromatic biodiversity, $t(199) = 29.71$, *mean difference* = 6.12, $p_{tukey} < .001$.

These findings highlight that the manipulation of animal-related content in the images was effective, with the faunal biodiversity image being consistently rated as having the highest presence of animals compared to the other images.

Taken together, the results indicated that all the images were perceived as intended based on the manipulations of the indicators. **Table 4.23** provides a summary of the post-hoc comparisons.

Table 4.23. *Summary of the post-hoc comparison results for the manipulation check variables (Study 4)*

		Blue	Flowers	Colours	Animals
	Blue element	√ (<)	X	X	X
	Floral coverage 25%	X	√ (<)	√ (<)	X
Baseline	***Floral coverage 50%***	X	√ (<)	√ (<)	X
	Chromatic biodiversity	X	√ (<)	√ (<)	X
	Faunal biodiversity	X	X	X	√ (<)

Note. x = non-significant difference; √ = significant difference between the conditions corresponding to the cell for the dependent variable in the column; < = baseline has lower values than the manipulated image, > = baseline has higher values than the manipulated image.

$H_{1\text{–}3}$) Evaluation of the applied version of the Location Selection Scale.

Exploratory factor analyses were conducted on both the full dataset and separately for each experimental image. Consistent with previous scale analyses, the EFA employed the 'minimum residual' extraction method with an *oblimin* rotation.

For the full dataset, initial assumption checks confirmed the suitability of the data for factor analysis, as indicated by Bartlett's test of sphericity ($\chi^2 = 8604$, $df = 28$, $p < .001$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, which ranged from 0.860 to 0.955.

The EFA identified two distinct factors based on parallel analysis and significant factor loadings (above 0.4). The factor loadings on the full set of data are presented in **Table 4.24**. These factors aligned with the structure identified in the original Location Selection scale. Factor 1, labelled "up-regulation", included items related to negative low arousal and positive high arousal emotions, explaining 41.8% of the variance. Factor 2, labelled "down-regulation", comprised items related to negative high arousal and positive low arousal emotions, explaining 35.1% of the variance.

Together, the two factors accounted for a cumulative 76.9% of the variance.

Table 4.24. *Factor loadings for EFA based on parallel analysis of the adapted shortened Italian version of the LS Scale using the full set of data (Study 4)*

	Factor		
	1	**2**	**Uniqueness**
N-L_1	0.905		0.173
N-L_2	0.728		0.285
N-H_1		0.614	0.341
N-H_2		0.831	0.332
P-L_1		0.828	0.289
P-L_2		0.947	0.154
P-H_1	0.930		0.150
P-H_2	0.964		0.125

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Confirmatory factor analysis was conducted to evaluate the fit of the hypothesized two-factor model (**Table 4.25**). All factor loadings for the indicators were statistically significant (p < .001), indicating strong associations between each indicator and its respective latent factor. Specifically, Factor 1 (up-regulation) exhibited standardized loadings ranging from 0.879 to 0.946, while Factor 2 (down-regulation) displayed standardized loadings ranging from 0.776 to 0.868.

The covariance between Factor 1 and Factor 2 was 0.690 (*SE* = 0.018, 95% *CI* [0.655, 0.726], p < .001), suggesting a moderate positive relationship between the two factors. Moreover, the model demonstrated good fit according to fit indices: *RMSEA* = 0.0894 (90% *CI* [0.077, 0.102]), *CFI* = 0.983, *TLI* = 0.969, and *SRMR* = 0.0341.

These findings collectively support the validity of the hypothesized two-factor structure (i.e., up-regulation and down-regulation) for the shortened applied Italian adaptation of the Location Selection in Nature Scale (H_1).

Given the findings from prior studies validating the scale and the moderate covariance between factors observed in this data, no additional alternative models for the scale structure were evaluated in this study.

Table 4.25. *Factor loadings for the 2-factors structure of the adapted shortened Italian version of the LS Scale (Study 4)*

				95% Confidence Interval				
Factor	Indicator	*Estimate*	*SE*	*Lower*	*Upper*	*z*	*p*	*Stand. Estimate*
Up-regulation	N-L_1	1.28	0.031	1.22	1.34	41.3	< .001	0.946
	N-L_2	1.31	0.037	1.24	1.38	35.9	< .001	0.882
	P-H_1	1.21	0.033	1.14	1.27	36.8	< .001	0.879
	P-H_2	1.19	0.032	1.13	1.25	37.5	< .001	0.887
Down-regulation	N-H_1	1.34	0.040	1.26	1.41	33.2	< .001	0.868
	N-H_2	1.41	0.042	1.32	1.49	33.2	< .001	0.850
	P-L_1	1.26	0.043	1.17	1.34	29.4	< .001	0.776
	P-L_2	1.33	0.040	1.25	1.41	33.2	< .001	0.838

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Reliability analyses were conducted on the full scale as well as on the two identified factors. Consistent with the original scale and H_2, the results demonstrated strong internal consistency. The up-regulation factor showed a high Cronbach's alpha of α = .943, indicating excellent reliability. The down-regulation factor also exhibited strong reliability, with a Cronbach's alpha of α = .905. The full scale overall demonstrated robust internal consistency as well, with a Cronbach's alpha of α = .928.

Exploratory factor analysis, confirmatory factor analysis, and reliability analyses were conducted separately for the data corresponding to each experimental image. The results consistently confirmed a two-factor model structure, mirroring the findings from the full dataset (see **Appendix B.28**).

To further confirm that the scale functions equivalently across different experimental conditions, additional confirmatory factor analyses were performed to test for measurement invariance (H_3). Measurement invariance assesses whether a scale measures the same construct in the same way across groups, time points, or varying conditions, such as distinct environmental stimuli (Chen & West, 2008; Davidov et al., 2014; Horn & McArdle, 1992; Millsap, 2012). Establishing invariance ensures that comparisons across these contexts are meaningful and not biased by inconsistencies in the scale's properties.

This is in line with previous studies that have highlighted the importance of testing for measurement invariance in experimental research on environmental contexts. For instance, Laumann, Gørling, and Stormark (2001) examined the invariance of scales measuring restorative components across natural and urban settings, as well as across different modes of presentation. Similarly, Pasini et al. (2014) tested the invariance of the PRS-11 scale across images depicting various environments. These studies emphasized the necessity of ensuring that scale properties remain stable across different experimental conditions to ensure robust and valid comparisons.

In this study, the measurement invariance of the two-factor model of the Location Selection scale—comprising up-regulation and down-regulation factors—was tested across six experimental images using the adapted shortened Italian version of the scale. A multi-group confirmatory factor analysis (MGCFA) was conducted, following a structured bottom-up approach to evaluate three levels of invariance: configural, metric, and scalar.

Configural invariance, the least restrictive model, tests whether the same factor structure (number of factors and corresponding items) holds across groups without imposing equality constraints on parameters. This stage establishes structural equivalence across conditions. Metric invariance introduces constraints on factor loadings, ensuring that the relationships between latent variables and their corresponding items are equivalent across groups. This level allows comparisons of unstandardized regression coefficients and covariances across groups. Finally, scalar invariance, the most restrictive model, imposes additional constraints on item intercepts, ensuring that differences in latent means can be meaningfully interpreted as true differences rather than artifacts of measurement inconsistency.

Measurement invariance across experimental images for each model was established based on the following criteria: $\Delta CFI < 0.01$, $\Delta RMSEA < 0.015$, and $\Delta SRMR < 0.030$ for metric invariance, or $\Delta SRMR < 0.015$ for scalar invariance (Putnick & Bornstein, 2016; Bikos, 2022).

Table 4.26 presents the goodness-of-fit indices for each model, including chi-square, CFI, RMSEA, SRMR, and differences in fit indices ($\Delta\chi^2$, ΔCFI, ΔRMSEA, and ΔSRMR). The configural model (M1) demonstrated an acceptable fit, confirming that the factor structure was consistent across the six image conditions. The metric model (M2) introduced constraints on factor loadings, and the changes in fit indices were minimal, supporting measurement unit equivalence. The scalar model (M3) added intercept constraints, and the fit indices remained within acceptable thresholds, confirming that the scale allowed meaningful comparisons of latent means across conditions.

These findings confirm that the LS scale maintains its structural integrity and measurement properties across the six experimental images, demonstrating strong configural, metric, and scalar invariance, as hypothesized (H_3). The results validate the scale's robustness for comparing emotion regulation processes across diverse environmental contexts, ensuring that differences in responses can be attributed to the characteristics of the stimuli rather than to inconsistencies in measurement.

Table 4.26. *Measurement invariance across images conditions for the two-factor model with up-regulation and down-regulation on the adapted shortened Italian version of the LS scale*

Model	χ^2 (df)	CFI	RMSEA (90% CI)	SRMR	Comparison	$\Delta\chi^2$ (Δ df)	Δ CFI	Δ RMSEA	Δ SRMR	Retain
M1) Configurial	425 * (114)	.964	.117 * (.105, 129)	.056	–	–	–	–	–	–
M2) Metric	459 * (144)	.964	.105 * (.094, .115)	.062	M2 vs. M1	34 (30)	.000	-.012	.006	Y
M3) Scalar	502 * (174)	.963	.097 * (.087, .107)	.063	M3 vs. M2	43 (30)	-.001	-.008	.001	Y

Note. * $p < .001$; χ^2 = chi-square; df = degree of freedom; RMSEA = Root Mean Square Error of Approximation; CI = confidence interval; SRMR = Standardized Root Mean Square Residual; CFI = Comparative Fit Index.

Hypotheses testing on differences among the experimental images

A series of repeated measures ANOVAs were conducted on the variables of interest in order to verify the hypotheses. **Table 4.27** presents the means and standard deviations of all the variables across the six experimental images.

Table 4.27. *Descriptive statistics for the variables of interest across the experimental images: means and standard deviations in parentheses (Study 4)*

Variables	Images					
	Baseline	*Blue element*	*Floral coverage 25%*	*Floral coverage 50%*	*Chromatic biodiversity*	*Faunal biodiversity*
LS up-regulation	4.10 (1.37)	4.67 (1.40)	4.37 (1.37)	4.49 (1.36)	4.77 (1.40)	4.78 (1.46)
LS down-regulation	5.34 (1.36)	5.67 (1.28)	5.29 (1.22)	5.33 (1.16)	5.44 (1.20)	5.24 (1.43)
Place restorativeness	6.20 (1.95)	6.67 (1.64)	6.28 (1.78)	6.43 (1.77)	6.64 (1.80)	6.50 (1.92)
Place pleasantness	1.56 (1.19)	2.05 (0.99)	1.79 (1.03)	1.88 (1.04)	2.10 (1.01)	1.89 (1.07)
Place relaxation	1.86 (1.25)	2.12 (1.00)	1.90 (1.03)	1.95 (1.10)	1.96 (1.08)	1.75 (1.26)
Emotion pleasantness	0.51 (1.29)	1.02 (1.27)	1.01 (1.18)	1.25 (1.16)	1.46 (1.22)	1.40 (1.21)
Emotion relaxation	1.72 (1.14)	1.93 (1.10)	1.74 (1.09)	1.75 (1.10)	1.80 (1.12)	1.66 (1.23)

H_4) *Location selection for up-regulation and down-regulation*

First, a repeated measures ANOVA was conducted to evaluate the impact of the experimental images on participants' perceptions of their suitability of location selection for up-regulation. The analysis revealed a significant effect of the experimental images on location selection for up-regulation, $F(5, 199) = 21.5$, $\eta^2 = 0.030$, $p < .001$. To further explore these differences, post hoc Tukey's tests were performed.

Results showed that participants rated the baseline image significantly lower in terms of up-regulation than all the other images with the indicators. Specifically, the baseline was perceived as significantly less suitable for up-regulation, compared to the image with 25% floral coverage, $t(199) = -3.74$, *mean difference* = -0.26, $p_{tukey} = .003$; the image with 50% floral coverage, $t(199) = -4.59$, *mean difference* = -0.39, $p_{tukey} < .001$; the image with chromatic floral biodiversity, $t(199) = -6.99$, *mean difference* = -0.67, $p_{tukey} < .001$; the image containing the blue element, $t(199) = -6.70$, *mean difference* = -0.56, $p_{tukey} < .001$; and the image with faunal biodiversity, $t(199) = -7.26$, *mean difference* = -0.68, $p_{tukey} < .001$.

Analyses about the comparisons among the manipulated images with the indicators revealed additional significant differences. In particular, the image with floral coverage 25% was perceived as significantly less suitable for up-regulation compared to the chromatic floral biodiversity image, $t(199) = -5.29$, *mean difference* = -0.41, $p_{tukey} < .001$; the blue element image, $t(199) = -3.81$, *mean difference* = -0.30, $p_{tukey} = .003$; and the faunal biodiversity image, $t(199) = -4.90$, *mean difference* = -0.42, $p_{tukey} < .001$. Moreover, the image with floral coverage 50% was considered as a location less suitable for up-regulation than the image with chromatic floral biodiversity, $t(199) = -4.50$, *mean difference* = -0.29, $p_{tukey} < .001$; and the faunal biodiversity image, $t(199) = -3.59$, *mean difference* = -0.30, $p_{tukey} = .005$. No significant differences were found between the other experimental images.

The analysis supports the hypothesis that manipulated Images with specific indicators were perceived as more suitable for up-regulation than the baseline image (H_{4a}). Overall, the most effective images seem to be those featuring chromatic floral biodiversity and faunal biodiversity.

Similarly, a repeated measures ANOVA was conducted to evaluate the impact of the experimental images on participants' perceptions of their suitability for down-regulation in location selection. The analysis revealed a significant effect of the experimental images on down-regulation suitability, $F(5, 199) = 8.56$, $\eta^2 = 0.012$, $p < .001$. To further explore these differences, post hoc Tukey's tests were performed.

Results indicated that participants did not rate the baseline image significantly differently from most of the other images in terms of down-regulation suitability. Specifically, the baseline image was only perceived as significantly less suitable for down-regulation when compared to the image containing the blue element, $t(199) = -3.79$, *mean difference* = -0.34, $p_{tukey} = .003$. Comparisons among the manipulated images revealed additional significant differences. The image with 25% floral coverage was perceived as significantly less suitable for down-regulation compared to the blue element image, $t(199) = -5.52$, *mean difference* = -0.38, $p_{tukey} < .001$. Additionally, the image with 50% floral coverage was also rated significantly lower than the blue element image, $t(199) = -4.83$, *mean difference* = -0.34, $p_{tukey} <$ .001. Similarly, the chromatic floral biodiversity image was rated lower than the blue element image, $t(199) = -3.50$, *mean difference* = -0.23, $p_{tukey} = .008$. Finally, the image with the blue element was also perceived as significantly more suitable for down-regulation compared to the faunal biodiversity image, $t(199) = 5.22$, *mean difference* = 0.43, $p_{tukey} < .001$.

The findings provide partial support for the hypothesis (H_{4b}), showing that while the blue element image was perceived as more suitable for down-regulation compared to the baseline and other manipulated images, differences between the other images and the baseline were not consistent across all comparisons.

H_5) *Place perceived restorativeness*

A repeated measures ANOVA was conducted to assess the impact of the experimental images on participants' perceptions of perceived restorativeness. The analysis revealed a significant effect of the experimental images on perceived restorativeness, $F(5, 199) = 7.02$, $\eta^2 = 0.009$, $p < .001$. Post hoc Tukey's tests were conducted to further investigate these differences.

The results indicated that the baseline image was perceived as significantly less restorative compared to two of the manipulated images with indicators. Specifically, the baseline image was rated significantly lower in restorativeness than the image with chromatic floral biodiversity, $t(199) = -3.57$, *mean difference* = -0.44, $p_{tukey} = .006$, and the image containing the blue element, $t(199) = -4.78$, *mean difference* = -0.47, $p_{tukey} < .001$. However, no significant differences were found between the baseline and the images with 25% and 50% floral coverage, or faunal biodiversity.

Additional comparisons among the manipulated images revealed that the image with 25% floral coverage was rated as significantly less restorative than the chromatic floral biodiversity image, $t(199) = -3.84$, *mean difference* = -0.36, $p_{tukey} = .002$, and the blue element image, $t(199) = -4.28$, *mean difference* = -0.39, $p_{tukey} < .001$. No further significant differences were found across the manipulated images.

Overall, the analysis marginally supports the hypothesis that manipulated images with certain indicators are perceived as more restorative compared to the baseline image, with the most effective images being those featuring chromatic floral biodiversity and a blue element.

H_6) *Place perception: pleasantness and relaxation*

First, a repeated measures ANOVA was conducted to evaluate the impact of the experimental images on participants' perceptions of pleasantness. The analysis revealed a significant effect of the experimental images on perceived pleasantness, $F(5, 199) = 15.6$, $\eta^2 = 0.028$, $p < .001$. Post hoc Tukey's tests were performed to further explore these differences.

The results indicated that the baseline image was perceived as significantly less pleasant compared to all the manipulated images. Specifically, the baseline image was rated significantly lower in pleasantness than the image with 25% floral coverage, $t(199) = -3.37$, *mean difference* = -0.23, $p_{tukey} = .012$; the image with 50% floral coverage, $t(199) = -4.40$, *mean difference* = -0.32, $p_{tukey} < .001$; the image with chromatic floral biodiversity, $t(199) = -6.24$, *mean difference* = -0.54, $p_{tukey} < .001$; the image containing the blue element, $t(199) = -6.71$, *mean difference* = -0.50, $p_{tukey} < .001$; and the image with faunal biodiversity, $t(199) = -4.22$, *mean difference* = -0.34, $p_{tukey} < .001$.

Among the manipulated images, additional significant differences emerged. The image with 25% floral coverage was rated as significantly less pleasant than the chromatic floral biodiversity image, $t(199) = -4.30$, *mean difference* = -0.31, $p_{tukey} < .001$, and the blue element image, $t(199) = -4.28$, *mean difference* = -0.27, $p_{tukey} < .001$. The image with 50% floral coverage was also perceived as less pleasant than the chromatic floral biodiversity image, $t(199) = -4.07$, *mean difference* = -0.22, $p_{tukey} < .001$, and marginally less pleasant than the blue element image, $t(199) = -2.90$, *mean difference* = -0.18, $p_{tukey} = .047$.

The other comparisons did not show significant differences.

Overall, the analysis supports the hypothesis (H_{6a}) that the manipulated images with indicators were perceived as more pleasant than the baseline image, with the chromatic floral biodiversity and blue element images being rated as the most pleasant among the experimental conditions.

Then, a repeated measures ANOVA was conducted to assess the impact of the experimental images on participants' perceptions of relaxation. The analysis revealed a significant effect of the experimental images on perceived relaxation, $F(5, 199) = 5.99$, $\eta^2 = 0.011$, $p < .001$. Post hoc Tukey's tests were performed to further explore these differences.

The results indicated that the baseline image was perceived as significantly less relaxing compared to the image containing the blue element, $t(199) = -3.39$, *mean difference* = -0.28, $p_{tukey} = .011$. Additionally, among the manipulated images, the image with 25% floral coverage was rated as significantly less relaxing than the blue element image, $t(199) = -4.09$, *mean difference* = -0.23, $p_{tukey} < .001$. The image with 50% floral coverage was also perceived as less relaxing than the blue element image, $t(199) = -2.89$, *mean difference* = -0.18, $p_{tukey} = .048$. Lastly, the blue element image was found to be significantly more relaxing compared to the image with faunal biodiversity, $t(199) = 4.98$, *mean difference* = 0.39, $p_{tukey} < .001$.

In summary, the analysis partially supports the hypothesis (H_{4b}) that manipulated images with specific indicators were perceived as more relaxing than the baseline image, with the blue element image being rated as the most relaxing among the experimental images.

H_7) *Emotional responses: pleasantness and relaxation*

A repeated measures ANOVA was conducted to evaluate the impact of the experimental images on participants' emotional responses in terms of valence. The analysis revealed a significant effect of the experimental images on perceived pleasantness and positive emotional reactions, $F(5, 199) = 38.2$, $\eta^2 = 0.063$, $p < .001$. Post hoc Tukey's tests were performed to explore these differences in more detail.

Results indicated that the baseline image elicited significantly lower levels of positive emotional reactions compared to all the manipulated images. Specifically, the baseline image was rated with less pleasant emotional reaction than the image with 25% floral coverage, $t(199) = -6.81$, *mean difference* = -0.50, $p_{tukey} < .001$; the image with 50% floral coverage, $t(199) = -8.66$, *mean difference* = -0.73, $p_{tukey} < .001$; the image with chromatic floral biodiversity, $t(199) = -10.21$, *mean difference* = -0.95, $p_{tukey} < .001$; the image containing the blue element, $t(199) = -5.98$, *mean difference* = -0.52, $p_{tukey} < .001$; and the image with faunal biodiversity, $t(199) = -9.90$, *mean difference* = -0.89, $p_{tukey} < .001$.

Additional significant differences were observed among the manipulated images. The image with 25% floral coverage was rated with significantly less positive emotions than the image with 50% floral coverage, $t(199) = -3.56$, *mean difference* = -0.24, $p_{tukey} = .006$; the chromatic floral biodiversity image, $t(199) = -5.88$, *mean difference* = -0.45, $p_{tukey} < .001$; and the faunal biodiversity image, $t(199) = -5.22$, *mean difference* = -0.39, $p_{tukey} < .001$. The image with 50% floral coverage was also perceived with less pleasant emotions than the chromatic floral biodiversity image, $t(199) = -3.47$, *mean difference* = -0.22, $p_{tukey} = .008$. In contrast, the blue element image was perceived as less pleasant than the chromatic floral biodiversity, $t(199) = -5.17$, *mean difference* = -0.43, $p_{tukey} < .001$, and the faunal biodiversity images, $t(199) = -4.46$, *mean difference* = -0.37, $p_{tukey} < .001$.

Results support the hypothesis (H_{7a}) that manipulated images with indicators elicit more positive emotional reactions than the baseline image. Among the experimental conditions, images with chromatic floral biodiversity and faunal biodiversity seem to be particularly effective in enhancing pleasant emotional responses.

Similarly, a repeated measures ANOVA was conducted to assess the impact of the experimental images on participants' arousal, specifically focusing on relaxing emotional responses. The analysis revealed a significant effect of the experimental images on perceived relaxation, $F(5, 199) = 3.59$, $\eta^2 = 0.006$, $p = .003$. Post hoc Tukey's tests were performed to investigate these differences further.

Comparisons between the baseline image with the manipulated images with indicators did not yield significant differences. Among the manipulated images, the blue element image was rated with significantly more relaxing emotional reactions compared to the images with 25% floral coverage, $t(199) = 2.96$, *mean difference* = 0.20, $p_{tukey} = .040$; and the image with faunal biodiversity, $t(199) = 3.57$, *mean difference* = -0.28, $p_{tukey} = .006$. No significant differences were found between the other images.

These results suggest that while the blue element image was perceived with more relaxing emotions compared to some other images with indicators, overall differences in emotional relaxation were less pronounced. Thus, the hypothesis (H_{4b}) that manipulated images with specific indicators would elicit higher levels of emotional relaxation compared to the baseline image was not supported.

Hypotheses testing for the associations among the variables of interest.

Correlational and SEM analyses were conducted to explore the hypothesized associations between the variables of interest.

H_8) *Correlations among the variables of interest*

Correlational analyses conducted on the data from each experimental image largely supported the hypothesized associations. Correlation tables for each experimental image are provided in **Appendix B.29**. Specifically, for all experimental images, both up-regulation and down-regulation were strongly positively correlated with perceived restorativeness (H_{8a}), place perception in terms of pleasantness (H_{8b}) and relaxation (H_{8c}), and emotional reactions in terms of pleasantness (H_{8d}) and relaxation (H_{8e}).

The only instance of a non-significant correlation was observed in the baseline image. Specifically, the correlation between place perception relaxation and location selection for down-regulation did not reach significance, suggesting that this particular association was weaker in the baseline condition.

Correlations were generally higher for manipulated images with the indicators compared to the baseline image, which exhibited weaker associations.

H_9) *Structural Equation Modeling*

Based on the observed positive correlations, a Structural Equation Modeling (SEM) analysis was conducted to investigate the relationships among environmental stimuli (manipulated through images), location selection for emotion regulation variables (up-regulation and down-regulation), and emotional outcomes, specifically emotional valence (pleasantness) and emotional arousal (relaxation). To account for the relative impact of each experimental condition, the baseline image—depicting an urban park without specific elements—was used as the reference category. This approach allowed for the effects of the manipulated images (blue element, floral coverage at 25% and 50%, chromatic biodiversity, and faunal biodiversity) to be evaluated in comparison to the baseline.

The analysis aimed to evaluate both direct and indirect effects of the predictors on emotional outcomes and assess the overall model fit. A total of 1,190 observations were included in the analysis, with Maximum Likelihood (ML) estimation used to generate parameter estimates.

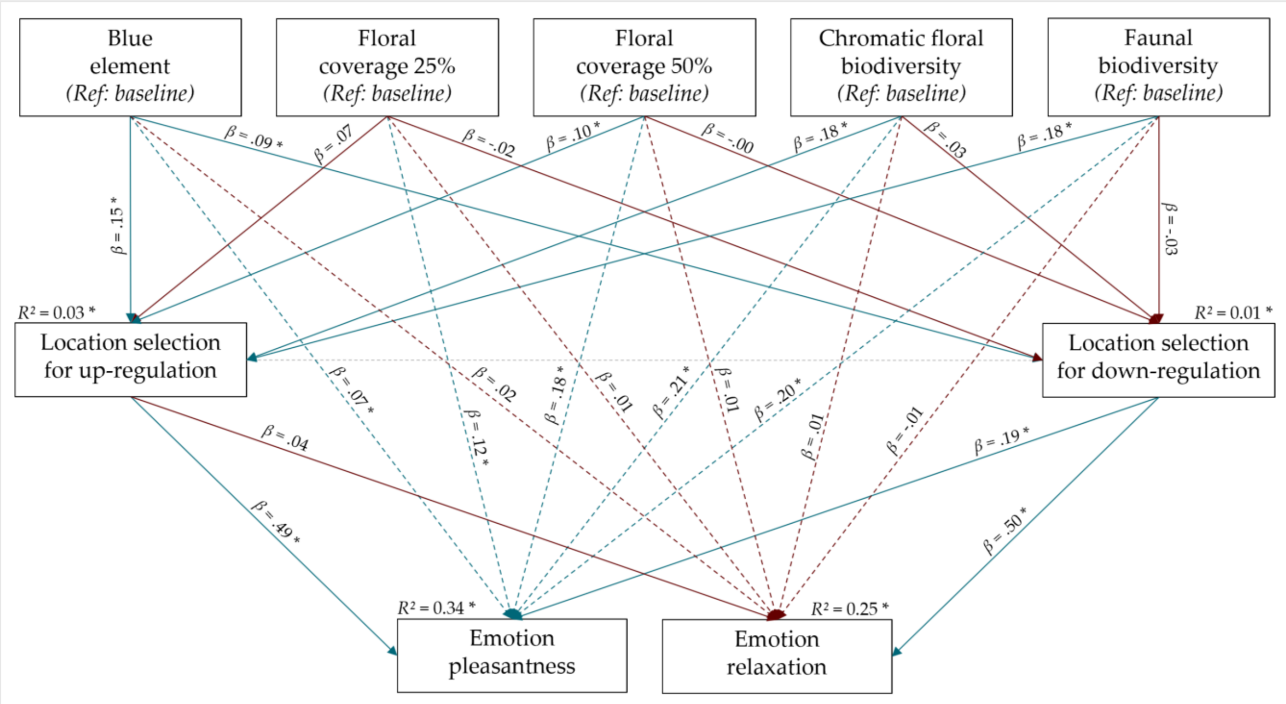
The hypothesized model tested whether location selection variables mediated the relationship between the experimental conditions (images) and emotional outcomes. The structural model included direct paths from the images to the emotion regulation variables (up-regulation and down-regulation) and emotional outcomes, as well as mediated paths through the emotion regulation variables.

The fit indices indicated that the model did not provide an optimal fit to the data, as suggested by the significant chi-square statistic (χ^2 (1) = 646.260, $p < .001$). Although the chi-square statistic is sensitive to large sample sizes, other indices further supported this result. The *RMSEA* was 0.736 (90% *CI*: 0.689, 0.785), which exceeds the acceptable threshold of 0.08, indicating a poor fit. Similarly, the *CFI* was 0.655, below the recommended cutoff of 0.90, and the *SRMR* was 0.108, also exceeding the ideal threshold of 0.08.

The model accounted for 33.7% of the variance in emotional valence ($R^2 = 0.337$, $p < .001$) and 24.9% in emotional arousal ($R^2 = 0.249$, $p < .001$). Variance explained in the mediating variables was smaller, with location selection for up-regulation ($R^2 = 0.029$, $p < .001$) and location selection for down-regulation ($R^2 = 0.012$, $p = .015$) showing relatively modest explanatory power.

Analysis revealed several key findings regarding the relationships between variables. **Figure 4.12** illustrates the parallel mediation model with standardized coefficients.

Figure 4.12. *Conceptual parallel mediation model (H₉) with standardized coefficients tested in Study 4, linking experimental images to emotional outcomes with mediation through LS variables*



Note. Solid line: direct effects; dashed line: indirect effects; green lines: statistically significant effects; red lines: non-significant effects; *: significant effects ($p < .050$).

The parameter estimates for the direct effects are detailed in **Table 4.28**.

Concerning the emotional outcomes, results showed that the experimental images significantly influenced emotional pleasantness, with the image with chromatic biodiversity having the strongest positive effect ($\beta = 0.206$, $p < .001$), followed by the image with faunal biodiversity ($\beta = 0.198$, $p < .001$). Images with blue element, 25% and 50% floral coverage also had significant, albeit weaker, effects on valence (β ranging from 0.071 to 0.182). Instead, none of the images had significant direct effects on emotional arousal ($p > .05$).

The analysis revealed significant direct effects of the experimental images on location selection for up-regulation and down-regulation, highlighting how specific environmental features influence the perceived suitability of locations for emotion regulation. Specifically, for location selection for up-regulation, the results showed that all images, except for 25% floral coverage, had significant positive effects. The strongest effect was observed for the image with faunal biodiversity (β = 0.178, p < .001), followed closely by the image with chromatic floral biodiversity (β = 0.175, p < .001). Image with blue element (β = 0.146, p < .001) and with 50 % floral coverage (β = 0.099, p = .007) also contributed significantly. These findings suggest that environments featuring diverse visual and natural elements, such as fauna or chromatic variation, are more likely to be perceived as suitable for up-regulation, reflecting their capacity to amplify positive arousing emotional states or mitigate low-arousal negative emotions. For location selection for down-regulation, the effects were more modest and less consistent. Image with blue element (β = 0.091, p = .014) showed a significant positive effect, indicating its perceived suitability for reducing high-arousal negative emotions and fostering low-arousal positive states. However, the effects of other images were nonsignificant (p > .05). These results suggest that while certain environmental features, such as water elements, may be effective for down-regulation, other characteristics might not strongly influence this dimension of emotion regulation.

Overall, these findings indicate that environmental stimuli differentially impact location selection for emotion regulation. Locations with features that are visually stimulating or biodiverse appear particularly effective for up-regulation, while elements like blue spaces may better support down-regulation. These distinctions emphasize the importance of specific environmental characteristics in shaping individuals' emotion regulation strategies.

Finally, findings showed that location selection for up-regulation had a robust positive effect on emotional pleasantness (β = 0.488, p < .001), but no significant effect on relaxation (p = .157). Instead, location selection for down-regulation was found to positively influence emotional relaxation (β = 0.495, p < .001) and had a smaller, yet significant, effect on emotional pleasantness (β = 0.189, p < .001).

Table 4.28. *Parameter estimates for the direct effects of the parallel mediation model (H_9) tested in Study 4*

				95% Confidence Intervals				
Dependent	**Predictor**	***Estimate***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
Emotion pleasantness	Blue element	0.225	0.108	0.015	0.427	0.071	2.083	0.037
Emotion pleasantness	Floral coverage 25%	0.397	0.102	0.186	0.585	0.124	3.890	< .001
Emotion pleasantness	Floral coverage 50%	0.582	0.100	0.373	0.768	0.182	5.828	< .001
Emotion pleasantness	Chromatic biodiversity	0.659	0.102	0.449	0.838	0.206	6.481	< .001
Emotion pleasantness	Faunal biodiversity	0.633	0.102	0.421	0.838	0.198	6.202	< .001
Emotion pleasantness	LS up-regulation	0.412	0.029	0.354	0.468	0.488	14.059	< .001
Emotion pleasantness	LS down-regulation	0.176	0.032	0.110	0.237	0.189	5.508	< .001
Emotion relaxation	Blue element	0.029	0.033	-0.038	0.093	0.036	0.860	0.390
Emotion relaxation	Floral coverage 25%	0.433	0.034	0.363	0.502	0.495	12.593	< .001
Emotion relaxation	Floral coverage 50%	0.055	0.095	-0.133	0.237	0.018	0.579	0.562
Emotion relaxation	Chromatic biodiversity	0.041	0.099	-0.147	0.235	0.014	0.415	0.678
Emotion relaxation	Faunal biodiversity	0.024	0.104	-0.181	0.221	0.008	0.231	0.818
Emotion relaxation	LS up-regulation	0.019	0.104	-0.187	0.223	0.006	0.178	0.858
Emotion relaxation	LS down-regulation	-0.027	0.108	-0.231	0.185	-0.009	-0.249	0.804
LS up-regulation	Blue element	0.550	0.138	0.288	0.838	0.146	3.999	< .001
LS up-regulation	Floral coverage 25%	0.265	0.133	0.013	0.531	0.070	1.993	0.046
LS up-regulation	Floral coverage 50%	0.376	0.136	0.116	0.649	0.099	2.762	0.006
LS up-regulation	Chromatic biodiversity	0.674	0.144	0.395	0.960	0.178	4.688	< .001
LS up-regulation	Faunal biodiversity	0.665	0.130	0.424	0.930	0.175	5.101	< .001
LS down-regulation	Blue element	0.313	0.131	0.072	0.577	0.091	2.378	0.017
LS down-regulation	Floral coverage 25%	-0.054	0.127	-0.293	0.202	-0.016	-0.427	0.670
LS down-regulation	Floral coverage 50%	-0.014	0.128	-0.267	0.250	-0.004	-0.109	0.913
LS down-regulation	Chromatic biodiversity	0.092	0.126	-0.128	0.340	0.027	0.732	0.464
LS down-regulation	Faunal biodiversity	-0.115	0.142	-0.385	0.179	-0.033	-0.809	0.419

The analysis of indirect effects examined how the experimental images influenced emotional responses (valence and arousal) through location selection for up-regulation and down-regulation. These results provide insights into the mediating role of location selection in shaping emotional outcomes across different environmental stimuli. The parameters for the indirect effects are outlined in **Table 4.29**.

For emotional pleasantness, significant positive indirect effects were observed for multiple environmental conditions, mediated primarily through location selection for up-regulation. Specifically, the blue element condition exhibited a significant indirect effect on pleasantness through both location selection for up-regulation (β = 0.071, p < .001) and location selection for down-regulation (β = 0.017, p = .019). This indicates that environments dominated by blue features foster perceptions of suitability for emotion regulation, which, in turn, enhances emotional pleasantness. Results also revealed that the condition with 25% floral coverage showed a smaller but significant indirect effect through up-regulation (β = 0.034, p = .048), while the condition with 50% floral coverage demonstrated a stronger effect (β = 0.048, p = .007). Similarly, the chromatic floral biodiversity condition displayed a strong positive indirect effect on pleasantness through up-regulation (β = 0.086, p < .001), highlighting the role of visual diversity in enhancing emotional experiences. The faunal biodiversity condition also significantly influenced pleasantness via up-regulation (β = 0.087, p < .001), suggesting that interactions with biodiverse environments amplify positive emotional states.

For emotional arousal, the analysis revealed a distinct pattern of indirect effects. The image featuring blue elements had a significant positive indirect effect through location selection for down-regulation (β = 0.045, p = .015), indicating that water-based environments are perceived as calming, reducing high-arousal emotional states. Similarly, the image highlighting chromatic floral biodiversity also exerted a significant positive indirect effect on emotional arousal through down-regulation (β = 0.013, p = .472), though the effect size was relatively small. Notably, the image with faunal biodiversity demonstrated no significant indirect effects on emotional arousal through either up-regulation (β = 0.006, p = .175) or down-regulation (β = −0.017, p = .370). Likewise, the floral coverage images (both 25% and 50%) exhibited nonsignificant indirect effects for both pathways, suggesting that such environments may not strongly influence emotional relaxation or activation indirectly via location selection mechanisms.

These findings illustrate the nuanced pathways through which specific environmental features influence emotional responses. Locations perceived as suitable for up-regulation are more likely to enhance emotional valence, particularly when they feature elements like chromatic or faunal biodiversity. Conversely, locations suitable for down-regulation tend to foster emotional relaxation, with blue spaces showing the most pronounced effects. This highlights the importance of environmental characteristics in shaping emotion regulation processes and their subsequent impact on emotional outcomes.

Additionally, the results highlight the dual role of location selection for up-regulation and down-regulation in mediating the relationship between environmental features and emotional responses, supporting the presence of two distinct factors within the scale. These two factors reflect potentially different underlying mechanisms: up-regulation, which enhances positive emotional arousal and pleasantness, and down-regulation, which mitigates high-arousal negative emotions and fosters relaxation.

This dual-process framework not only reinforces the theoretical distinction between up- and down-regulation strategies but also demonstrates their complementary roles in shaping emotional experiences. By showing how these two mechanisms mediate the effects of specific environmental features, the model provides valuable insights into the differential pathways through which nature can influence emotional well-being. These findings further validate the conceptualization of location selection as a nuanced and multidimensional process, highlighting the importance of designing environments that cater to both amplification and attenuation of emotional states.

While the results provide important insights into the relationships among the variables, the moderate fit suggests potential avenues for improving the model. This may include incorporating additional covariates or refining the hypothesized relationships to better capture the complexity of the underlying processes. It is also possible that some unmeasured factors or contextual variables could influence the relationships among location selection, environmental features, and emotional responses, which could explain the moderate fit indices. Despite these limitations, the model provides a valuable foundation for understanding the mediating role of location selection variables in emotion regulation processes.

Table 4.29. *Parameter estimates for the indirect effects of the parallel mediation model (H_9) tested in Study 4*

			95% Confidence Intervals				
Description	***B***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
Blue element ⇒ LS upregulation ⇒ Emotion pleasantness	0.226	0.059	0.117	0.347	0.071	3.820	< .001
Blue element ⇒ LS upregulation ⇒ Emotion relaxation	0.016	0.020	-0.021	0.056	0.005	0.804	0.422
Blue element ⇒ LS downregulation ⇒ Emotion pleasantness	0.055	0.026	0.012	0.113	0.017	2.117	0.034
Blue element ⇒ LS downregulation ⇒ Emotion relaxation	0.135	0.058	0.029	0.250	0.045	2.347	0.019
Floral coverage 25% ⇒ LS upregulation ⇒ Emotion pleasantness	0.109	0.055	0.006	0.223	0.034	1.980	0.048
Floral coverage 25% ⇒ LS upregulation ⇒ Emotion relaxation	0.008	0.011	-0.011	0.033	0.003	0.712	0.477
Floral coverage 25% ⇒ LS downregulation ⇒ Emotion pleasantness	-0.010	0.023	-0.054	0.037	-0.003	-0.413	0.679
Floral coverage 25% ⇒ LS downregulation ⇒ Emotion relaxation	-0.023	0.055	-0.128	0.084	-0.008	-0.426	0.670
Floral coverage 50% ⇒ LS upregulation ⇒ Emotion pleasantness	0.155	0.057	0.048	0.270	0.048	2.714	0.007
Floral coverage 50 ⇒ LS upregulation ⇒ Emotion relaxation	0.011	0.014	-0.015	0.041	0.004	0.783	0.434
Floral coverage 50 ⇒ LS downregulation ⇒ Emotion pleasantness	-0.002	0.023	-0.045	0.046	-0.001	-0.107	0.915
Floral coverage 50 ⇒ LS downregulation ⇒ Emotion relaxation	-0.006	0.056	-0.119	0.109	-0.002	-0.108	0.914
Chromatic biodiversity ⇒ LS upregulation ⇒ Emotion pleasantness	0.274	0.057	0.169	0.393	0.086	4.770	< .001
Chromatic biodiversity ⇒ LS upregulation ⇒ Emotion relaxation	0.019	0.023	-0.026	0.066	0.006	0.828	0.408
Chromatic biodiversity ⇒ LS downregulation ⇒ Emotion pleasantness	0.016	0.023	-0.022	0.065	0.005	0.701	0.483
Chromatic biodiversity ⇒ LS downregulation ⇒ Emotion relaxation	0.040	0.054	-0.056	0.144	0.013	0.733	0.463
Faunal biodiversity ⇒ LS upregulation ⇒ Emotion pleasantness	0.278	0.063	0.152	0.403	0.087	4.425	< .001
Faunal biodiversity ⇒ LS upregulation ⇒ Emotion relaxation	0.019	0.023	-0.027	0.065	0.006	0.828	0.407
Faunal biodiversity ⇒ LS downregulation ⇒ Emotion pleasantness	-0.020	0.025	-0.072	0.030	-0.006	-0.792	0.428
Faunal biodiversity ⇒ LS downregulation ⇒ Emotion relaxation	-0.050	0.062	-0.174	0.070	-0.017	-0.802	0.423

4.5.4. Discussion – Study 4

This study employed a within-subject experimental design to investigate the impact of key greenspace indicators on people's evaluations of urban parks through manipulated images. The research had three main objectives.

First, it sought to provide a contextual and shortened adaptation of the Location Selection in Nature scale, focusing on its applicability to the evaluation of specific environmental settings, and investigate the psychometric properties of this novel version. Specifically, the study aimed to assess the scale's structure and verify whether this applied version of the scale aligns with the two factors identified in previous validation studies: the up-regulation and down-regulation of emotions.

Second, the research aimed to explore how various environmental indicators affect participants' perceptions and emotional responses. The overarching hypothesis was that images featuring specific greenspace elements—such as flowers, chromatic floral biodiversity, faunal biodiversity, and blue elements—would be rated more positively in terms of location selection, place restorativeness, perception of pleasantness and relaxation of the place, as well as emotional reactions of pleasantness and relaxation, compared to a baseline image.

Third, the study aimed to investigate the associations among key variables related to location selection, specifically examining how up-regulation and down-regulation selection strategies mediate the relationship between environmental stimuli (images) and emotional outcomes such as pleasantness (valence) and relaxation (arousal). By exploring how these location selection strategies interact with these constructs, the study seeks to enhance understanding of the mechanisms through which different natural environments influence emotional experiences and how individuals select locations to regulate their emotions.

Concerning the applied shortened Italian version of the scale, the results validated the factorial structure, confirming its consistency in measuring the intended emotional regulation factors. Both exploratory and confirmatory factor analyses reinforced the robustness of the two-factor model, with location selection for up-regulation and down-regulation. These findings are consistent with H_1 and the prior studies (S_1 – S_3) and affirm the scale's applicability for assessing specific environments, demonstrating its utility in capturing how different greenspace elements, or more generally diverse natural spaces, may influence emotional processes. Furthermore, the high internal consistency coefficients for full scale and sub-scales offer robust support for the scale's reliability, aligning with H_2. Moreover, measurement invariance testing across the experimental images confirmed that the scale functions consistently across various environmental contexts, in line with H_3.

About the second aim of the study, range of results emerged regarding differences among the experimental images, summarized concisely in **Table 4.30**.

When examining the effects of specific environmental features in terms of location selection, the study confirmed significant effects of experimental images on both up-regulation and down-regulation suitability (H_4).

Specifically, the baseline image was rated as less suitable for up-regulation than all manipulated images, consistent with the hypothesis. Among the experimental images, those depicting chromatic floral biodiversity and faunal biodiversity were rated highest in their ability to support up-regulation. This finding suggests that these elements are particularly effective in promoting positive, high-arousal emotional states, aligning with research that emphasizes the benefits of biodiversity in nature for enhancing emotional well-being (Carrus et al., 2015; Fisher et al., 2021; Nghiem et al., 2021; Rozario et al., 2024; Shwartz et al., 2014). Similarly, colourful parks were generally perceived as more energizing than calming, even when compared to green parks, as seen in recent studies (Rapuano et al., 2022).

In contrast, down-regulation suitability showed fewer significant differences. Only the image featuring blue elements was rated as significantly more suitable for down-regulation compared to the baseline image. This finding aligns with previous literature highlighting the restorative and calming effects of blue elements (e.g., Völker & Kistemann, 2011; White et al., 2010; Cracknell et al., 2017; Deng et al., 2020; Aghabozorgi et al., 2024). This suggests that while specific environmental features, such as blue elements, effectively promote relaxation and emotional calm, other features did not demonstrate a clear influence on down-regulation suitability.

These results highlight the differential impact of greenspace elements on emotional regulation: while vibrant and diverse natural features tend to be more effective in supporting up-regulation, promoting activation and energy, calmer elements like still water (e.g., a pond) are more conducive to down-regulation, aiding in relaxation and stress reduction. However, it should be noted that not all water features are inherently calming. Dynamic features, such as waterfalls, may instead enhance up-regulation by generating a sense of energy and vitality, highlighting the nuanced role of specific environmental characteristics in emotion regulation processes.

This suggests that urban park designs should consider incorporating a mix of these features to accommodate varying emotional needs, optimizing both stimulation and relaxation for visitors; and/or to design different separate areas for achieving different purposes (e.g., a positively activating area, on the one side, and a positively relaxing area, on another side).

Significant differences in perceived restorativeness were also found (H_5), with the baseline image being rated lower than images with chromatic floral biodiversity and the blue element. However, no significant differences were observed between the baseline and the other experimental images. This finding partially supports the hypothesis, indicating that while certain images are perceived as more restorative, the effect is not uniformly applicable across all indicators.

In terms of place perception, results revealed that the manipulated elements significantly influenced participants' perceptions of pleasantness, with all manipulated images being rated more positively than the baseline, with those featuring chromatic floral biodiversity and blue elements being perceived as the most pleasant. This aligning with the hypothesis that these elements would enhance the aesthetic appeal of urban parks and suggests that visual diversity and the inclusion of water elements are particularly effective in enhancing the pleasantness of natural places (H_6).

In terms of relaxation, the analysis also supported H_6, albeit more selectively. The image with the blue element was rated as significantly more relaxing than the baseline and other images, indicating the strong calming effect of water or similar features in line with prior literature. While other indicators also contributed to relaxation, their impact was less pronounced and did not show significant differences from the baseline. This suggests that, although certain elements, like blue features, have a calming effect, their impact on relaxation may not be as strong or consistent as on pleasantness, and their effects are more variable. Overall, these findings underscore the importance of specific elements, like blue features and floral diversity, in creating urban parks that are both visually pleasing and relaxing, in line with prior literature.

Findings also showed that the experimental images significantly affected participants' emotional responses (H_7).

For pleasantness, all manipulated images with the indicators were rated more positively than the baseline, with chromatic floral biodiversity and faunal biodiversity being particularly pleasant. This supports the hypothesis that certain environmental features enhance positive emotional reactions.

However, when it came to emotional reactions in terms of relaxation, the findings were more nuanced. In this case, the blue element image was rated as more relaxing compared to those with 25% floral coverage and faunal biodiversity. However, there were no significant overall differences between the baseline and manipulated images, suggesting that the expected increase in relaxation from specific indicators was not strongly realized.

This pattern aligns with findings on place perception, where greenspace indicators consistently enhance the perception of pleasantness but have a more variable and less pronounced impact on relaxation. This suggests that while certain environmental features reliably improve pleasantness, their influence on relaxation is less stable and may depend on additional contextual factors.

Table 4.30. *Schematic summary of results for hypothesis testing (Study 4)*

	H_{4a}	**H_{4b}**	**H_5**	**H_{6a}**	**H_{6b}**	**H_{7a}**	**H_{7b}**
	LS – up-regulation	*LS – down-regulation*	*PRS*	*Place pleasantness*	*Place relaxation*	*Emotion pleasantness*	*Emotion relaxation*
Blue element	●	●	●	●	●	●	
Floral coverage 25%	●			●		●	
Floral coverage 50%	●			●		●	
Chromatic biodiversity	●		●	●		●	
Faunal biodiversity	●			●		●	

Note. ● = significant difference between the manipulated image with the indicator and the baseline.

Finally, concerning the associations among the variables of interest, correlational analyses supported the hypothesis that location selection variables (up-regulation and down-regulation) were positively associated with perceived restorativeness, place perception, and emotional reactions across all experimental images (H_8), with weaker associations for the baseline image.

Further, the SEM analysis provided insights into the environmental psychology mechanisms through which the different experimental images influence emotional responses, highlighting the mediating role of location selection variables (up-regulation and down-regulation) in this process (H_9).

The hypothesized model received partial support from the findings. Specifically, the results revealed significant insights into how environmental stimuli influence emotional outcomes through location selection for up-regulation and down-regulation. Notably, the indirect effects of various environmental features on emotional pleasantness were primarily mediated by location selection for up-regulation, with blue elements, chromatic biodiversity, and faunal biodiversity showing strong positive effects (compared to the baseline image). These findings suggest that visually stimulating and biodiverse environments are particularly effective in enhancing emotional pleasantness by amplifying positive high-arousal emotions and reducing negative low-arousal emotions. In contrast, location selection for down-regulation primarily influenced emotional relaxation, with significant indirect effects observed for the blue element condition, which facilitated emotional calming. However, other environmental conditions did not significantly affect emotional relaxation through this pathway.

Overall, these findings underscore the distinct roles of environmental features in supporting different emotion regulation potential, highlighting the importance of context-specific features such as water-based and biodiversity elements in modulating emotional experiences. This highlights the complexity of how nature-based environments interact with emotional regulation processes, offering valuable insights for designing spaces that optimize emotional well-being.

Findings align with the conceptualization of the two factors of location selection, where location selection for down-regulation involves managing high-arousal negative emotions and increasing low-arousal positive emotions, while location selection for up-regulation focuses on reducing low-arousal negative emotions and enhancing high-arousal positive emotions. Consequently, location selection for down-regulation seems to affect more the arousal component of emotional reactions, promoting emotional relaxation and calm. In contrast, location selection for up-regulation primarily influences the valence component, enhancing emotional pleasantness. This distinction underscores the nuanced roles that different environments play in supporting emotional regulation.

Results also affiliate closely with the conceptualization of emotion regulation as a context-sensitive capacity for modulating the intensity or duration of emotional responses (Gross & Thompson, 2007; Gross, Sheppes, & Urry, 2011). Specifically, the model demonstrates how different natural environments can influence both the arousal and valence dimensions of emotional experience by enhancing emotional regulation processes, bridging significant gaps in the literature on how environmental contexts aid emotional processes. This highlights an essential but often overlooked aspect of emotion regulation: the active attention to and management of arousal levels, as suggested by Phillips et al. (2003). This regulatory focus on arousal supports a more nuanced understanding of emotion management within natural contexts. Traditional emotion regulation research has often emphasized categorical approaches to emotion, such as labelling distinct emotional states. However, this model underscores the relevance of dimensional approaches, where emotional experience is understood as a continuum of arousal and pleasantness (Russell, 2003).

By considering both arousal and valence, this framework offers a more comprehensive understanding of how nature environments facilitate emotional regulation. This approach is especially pertinent to environmental psychology, as it reinforces the role of natural settings in shaping both emotional valence and arousal dimensions in ways that support well-being and emotional regulation. The study's findings align with a growing body of research suggesting that exposure to nature can positively influence a wide spectrum of emotional states (for reviews, see Li et al., 2023; McMahan & Estes, 2015). Specifically, natural environments have been shown to elevate high-arousal positive emotions, such as vigour, while also fostering low-arousal positive emotions, including calmness and relaxation. In addition, such settings are effective in reducing high-arousal negative emotions, such as perceived stress, anxiety, and anger, as well as low-arousal negative emotions, such as fatigue, sadness, and boredom.

The current model provides novel insights into how these effects may operate through distinct pathways of location selection—either for up-regulation or down-regulation of emotions—depending on the emotional goals associated with each environmental context. This dual-pathway approach emphasizes how natural environments can uniquely support both arousal modulation and valence enhancement, facilitating a broad spectrum of emotional benefits in a single experience. The proposed explanatory model also offers novel insights into the role of natural environments in emotion regulation and how these settings can simultaneously influence both emotional valence and arousal. This association between location selection for emotion regulation and emotional outcomes aligns with prior research highlighting that the motivations for seeking out nature often include the desire to enhance positive emotions while reducing negative ones. Specifically, individuals who turn to natural settings for emotional regulation tend to report benefits such as relaxation, mental clarity, and attentional restoration (Johnsen, 2013).

Despite these findings, there has been a lack of specific investigations examining the precise mechanisms through which natural environments affect the regulation of emotions. The current model addresses this gap by elucidating how the presence of particular elements in natural spaces contribute to both the modulation of emotional arousal and the enhancement of emotional valence. By framing these dynamics within a dual-pathway approach, the model underscores the complexity of emotional experiences in natural contexts and suggests the importance of considering both components of valence and arousal of emotion regulation.

Limitations and future research directions. Despite the valuable insights gained from this study, several limitations should be acknowledged.

First, the use of manipulated images in a within-subject experimental design, while controlled and systematic, may not fully capture the complexity of real-world experiences in natural environments. Participants' responses to images might differ from their reactions to actual physical settings, limiting the ecological validity of the findings.

Second, the study focused on a specific set of greenspace indicators—flowers, chromatic floral biodiversity, faunal biodiversity, and blue elements. While these elements are significant, other environmental features that might also influence place perception and emotional responses, such as soundscapes, air quality, or weather conditions, were not considered. Moreover, variations within the indicators tested may yield different effects, as different species of flowers, types of blue elements, colour variations, or the presence of different animals can influence emotional responses and people's perceptions in distinct ways. For example, research has shown that different types of freshwater environments might have varying potentials for stress reduction and restoration, with humans generally preferring rivers and ponds over swampy areas or large bodies of water (Herzog, 1985). This narrow focus may restrict the generalizability of the findings to other environmental settings or different types of greenspaces. Future research should explore a broader range of indicators as well as combinations of features to gain a more comprehensive understanding of their collective impact on place perception and emotional responses. Similarly, a broader exploration of the restorative potential of indicators' variations is necessary to better understand therapeutic landscapes and promote healthier environments.

Third, the sample used in the study may not represent the broader population. Variations in cultural backgrounds, personal experiences, and environmental preferences, which were not deeply explored in this research, could influence participants' perceptions. To address this, future studies should involve diverse samples from different cultural and demographic backgrounds to enhance the generalizability of the findings.

Fourth, while the adapted shortened Italian version of the Location Selection scale demonstrated reliability in this context, its application was limited to the evaluation of images and urban park settings. Although the study suggests that the scale has potential for generalizability across various environments, further research is needed to confirm its applicability in different contexts, real and virtual, such as rural or highly urbanized areas, and in settings with different types of natural or built elements.

Fifth, while the investigated mediation model provides useful insights into the relationships between environmental stimuli, location selection for emotion regulation, and emotional outcomes, the cross-sectional design of the study limits causal inferences, as the relationships between variables are correlational. Future research using longitudinal data would provide a better understanding of the causal directionality and long-term effects of environmental stimuli on location selection for emotion regulation. Additionally, the model fit indices suggested potential areas for enhancement, indicating that the model could be refined by exploring alternative specifications or incorporating additional variables to improve its explanatory power. Future studies should also consider potential mediators or moderators, such as individual characteristics, to better understand the pathways through which environmental features influence emotional outcomes.

Results of the present study opens new research avenues, including the exploration of additional indicators or combinations of multiple indicators to better understand their collective impact. Testing these indicators with diverse samples from different countries and contexts could provide further insights into their generalizability and applicability. Such investigations will help refine urban park designs and contribute to creating spaces that support a broader range of emotional needs and experiences.

In conclusion, the study validates the Location Selection scale as a robust tool for assessing how different environmental features influence emotional regulation. The scale's successful application in this research suggests that it is not only reliable for evaluating general location selection of nature for emotion regulation, but also versatile enough to be adapted to various other environmental contexts, highlighting its broader applicability. This opens opportunities for using the scale in diverse environments, such as urban streetscapes, residential areas, or even indoor spaces like offices and hospitals, where understanding the impact of environmental features on emotional well-being may be crucial. The scale's potential for generalizability makes it a valuable tool for research and environmental planning, enabling the evaluation and optimization of diverse environments to ensure they are both functional and supportive of emotional well-being.

Additionally, this study highlights the significant influence of specific greenspace elements on both place perception and emotional responses. The findings emphasize the importance of designing urban parks with a balanced mix of features that cater to both stimulation and relaxation, effectively addressing diverse emotional needs. These insights provide valuable guidance for urban planners and landscape designers in creating spaces that are not only visually appealing but also restorative.

4.6. Conclusion

This chapter offers a comprehensive exploration of the role of nature in emotion regulation processes, alongside the validation of the Location Selection in Nature Scale, through four interconnected studies.

Study 1 introduced a novel framework for understanding location selection as a fundamental aspect of emotion regulation, emphasizing the pivotal role of natural spaces in this process. Following this conceptualization, the development of the Location Selection in Nature Scale provided a specialized tool designed to assess the selection of natural environments based on emotional criteria, aligning with established theories of affect and emotion regulation. The findings from exploratory and confirmatory factor analyses supported a robust two-factor structure—down-regulation and up-regulation—highlighting the scale's capacity to capture complex emotional processes linked to nature. Additionally, five alternative models were tested, including a one-factor model, two-factor models based on valence or arousal, a four-factor model based on valence and arousal, and a hierarchical bifactor model. The results confirmed that the two-correlated-factor model (down-regulation and up-regulation) provided the best fit to the data.

Study 2 built upon the foundational work of the first study, confirming the scale's reliability and validity through a new sample. The results reinforced the two-factor structure and demonstrated the scale's predictive validity regarding emotional regulation behaviours in nature, as well as satisfaction with life and specific aspects of affect. Notably, the consistent performance of the scale over time further established its utility as a dependable measure for assessing how individuals select natural environments for emotion regulation purposes. Furthermore, two alternative models were tested (i.e., one-factor model and the hierarchical bifactor model) further confirming that the two-factor structure remained the best fit for the data.

Study 3 advanced the research by adapting and translating the Location Selection in Nature Scale into Italian, thus expanding its applicability across diverse cultural contexts. The psychometric evaluation confirmed the two factors of the scale and affirmed the scale's reliability and validity within the Italian-speaking population, demonstrating that it effectively measures the intended construct. Additionally, two alternative models, including the one-factor model and the hierarchical bifactor model, were tested to ensure that the two-factor structure remained the most appropriate representation of the data.

Study 4 validated the scale's broader applicability beyond general natural environments, demonstrating its robustness and measurement invariance in assessing the influence of various environmental features on the construct of location selection for emotional regulation. Further, measurement invariance was tested across the different experimental stimuli, confirming that the scale functions consistently across these conditions. The insights gained suggest that the scale can be utilized in diverse specific settings, including urban landscapes and indoor environments, enhancing our understanding of how different contexts can affect emotional well-being. Furthermore, the findings highlighted the significance of specific greenspace elements in shaping emotional responses, both in terms of valence and arousal, as well as in terms of regulation strategies, providing guidance for urban planners and landscape designers.

In summary, this chapter underscores the theorization of the novel concept of Location Selection and the development of a specific scale as a valuable instrument for researchers and practitioners interested in the interplay between emotional regulation and environmental contexts. The collective findings from the studies contribute to a nuanced understanding of how individuals engage with nature for emotional purposes, offering a solid foundation for future research and practical applications aimed at fostering psychological well-being through environmental design and management.

CHAPTER 5.

Experimental Studies on the Impact of Simulated Natural and Urban Environments on Emotion Regulation

5.1. Introduction

In recent years, research exploring the relationship between environmental contexts and emotional regulation has gained substantial attention, as highlighted in the literature review presented in **Chapter 2**. The growing body of research on this topic suggests that exposure to natural environments can have significant benefits on emotional functioning, including the increasing of positive emotions and reduction of negative ones, promotion of emotional restoration, as well as increased use of adaptive emotion regulation strategies and reduced use of maladaptive ones (e.g., Vitale & Bonaiuto, 2024; Ríos-Rodríguez et al., 2024).

Despite growing recognition of the benefits of natural environments on emotion regulation well-being, several significant gaps remain in the literature that merit attention. A notable omission in the literature is the lack of differentiation between various types of environments and their unique effects on emotional regulation processes. First, much of the existing research tends to treat nature as a monolithic category, with an emphasis on green spaces, such as forests and parks, while other environments like blue spaces (e.g., oceans, rivers, lakes) or hybrid spaces (urban nature) remain underexplored. The limited focus on specific types of environments, with a few exceptions, leaves open questions about how different natural landscapes might differentially affect emotional regulation. In particular, prior studies have seldom compared how unique features of natural spaces and landscape may influence regulatory strategies.

Moreover, in addition to the insufficient differentiation among various types of natural spaces, there is a growing but still underexplored area of research on the emotional regulatory potential of urban environments. While much of the literature has focused on the negative impact of urban spaces, which are frequently linked to heightened stress, anxiety, and negative emotions (Lederbogen et al., 2011; Costa-e-Silva & Steffen, 2019; Krefis et al., 2018; Ventimiglia & Seedat, 2019; Ventriglio et al., 2021), certain urban settings may also hold potential for emotional restoration. Specifically, culturally significant or historically valued spaces have been suggested as potentially restorative environments, capable of offering unique emotional benefits, depending on their design, aesthetic qualities, and cultural meaning (e.g., Karmanov & Hamel, 2008; Scopelliti et al., 2019). These environments may provide a sense of belonging, identity, or connection, which could positively influence emotion regulation processes, though this aspect remains underexplored. Further research is necessary to clarify the emotional regulatory potential of different urban environments, as well as the specific conditions under which they can serve as spaces for emotional restoration or stress reduction. A more nuanced understanding of the specific restorative properties of various natural and urban spaces is needed to fully appreciate their specific emotional benefits, moving beyond broad categorizations and toward an understanding of their unique restorative properties.

Furthermore, much of the research has focused on real-world natural settings, often neglecting the role that simulated environments, such as videos or virtual reality (VR), may play in replicating these effects. As technology becomes increasingly immersive, digital and virtual simulations of environments could offer accessible and controlled alternatives for studying the environmental impacts on emotion regulation. It is increasingly relevant to explore whether these mediated forms of interaction can elicit similar emotional and psychological benefits as actual nature exposure, especially in contexts where real-world nature exposure may be limited.

This chapter aims to address key gaps in the literature by presenting two experimental studies that investigate the impact of simulated natural and urban environments on emotion regulation following negative mood induction. Both studies employ virtual methodologies to simulate these environments through standard videos and VR technology, allowing for controlled comparisons of their effects on participants' emotional states and emotion regulation processes. In these studies, a negative mood induction procedure is employed to enhance ecological validity, ensuring that participants experience a genuine emotional state that necessitates effective emotion regulation. By placing participants in a depleted emotional state, the research aims to closely mirror real-life situations where individuals may struggle with managing negative emotions. In this context, simulated explorations of nature and urban environments are utilized as interventions for emotional recovery, providing participants with opportunities to engage in environments that may facilitate emotional regulation.

The first experimental study (Study 5) utilizes a within-subject design featuring 2D video stimuli of nature, urban street, and urban centre environments to assess how different settings influence emotional recovery following a negative mood induction procedure. By incorporating repeated measures of emotional states, the study provides valuable insight into how varying environmental contexts may support emotional restoration, with a particular focus on the specific emotion regulation strategies employed in each condition. Moreover, the study tests a theoretical model that posits a relationship between environmental context, place perceived restorativeness, the use of adaptive and maladaptive emotion regulation strategies, and subsequent emotional recovery.

Building on the findings from this initial study, the second experiment (Study 6) shifts to a between-subject design using immersive VR technology to investigate the effects of different virtual environments—both natural and urban—on emotion regulation. This study responds to the emerging interest in using VR as a tool for nature-based interventions in psychological and therapeutic contexts. By comparing multiple natural settings with an urban environment, the research also explores potential differences across these natural scenarios in terms of perceived restorativeness and location selection for emotional up-regulation and down-regulation, as well as their influence on emotional recovery.

Both studies aim to contribute to a deeper understanding of how simulated environmental contexts can support emotional recovery and regulation processes, especially in response to negative emotions. By addressing the under-explored potential of digital and virtual environments, these experiments provide valuable insights into the psychological mechanisms involved and the specific conditions that may maximize the effectiveness of these settings in promoting emotional well-being.

5.2. Study 5—A within-subject study using 2D videos

A first experimental study was designed to explore how different environmental settings, depicted in 2D videos, influence emotional states following two sequential negative mood induction procedures (MIP 1 and MIP 2).

Utilizing a within-subject design, each participant experienced three experimental conditions—nature videos, urban street videos, and urban centre videos—allowing for a direct comparison of the effects of each environment on emotional responses and regulatory processes. Emotional states were assessed at four distinct time points: before the first MIP (pre-MIP 1), immediately after the first MIP (post-MIP 1), after the second MIP (post-MIP 2), and following the viewing of the experimental videos (post-intervention).

Aim and hypotheses. The primary objective of this research was to evaluate how viewing videos of different environments affects emotional states following a negative mood induction. Specifically, the study focuses on the impact of nature, urban street, and urban centre videos on the reduction of negative emotions. Additionally, it investigates the emotion regulation strategies participants employ during these video conditions, examining how these strategies contribute to managing or alleviating negative emotions.

It is important to clarify that the Location Selection Scale had not yet been developed at the time this study was conducted, which is why it was not included in the measures used.

The research seeks to provide insights into how varying environmental contexts influence emotional restoration and whether the emotion regulation strategies differ across these conditions.

Specifically, the following hypotheses were formulated:

H_1) *Effect of intervention on negative emotions*: It was hypothesized that there would be a significant effect of intervention, such that, overall, participants would report a decrease in negative emotions in the post-test compared to the pre-test, as a result of watching the videos.

H_2) *Interaction effect between intervention and experimental condition on negative emotions*: It was hypothesized that the reduction in negative emotions from pre-test to post-test would vary based on the environment depicted in the video, indicating an interaction effect between the intervention and the experimental condition. Specifically, it was expected that participants would experience the greatest decrease in negative emotions after watching the nature video, a moderate decrease after the urban centre video, and little to no significant decrease after the urban street video.

H_3) *Return to baseline of negative emotions:* It was hypothesized that following the intervention, negative emotions would return to the baseline levels observed before the mood induction procedure (pre-MIP). Therefore, no significant differences were expected between negative emotions measured pre-MIP and those measured post-intervention. This effect was anticipated to be more pronounced in the nature condition, where a return to baseline was expected. In contrast, for the urban video conditions, it was predicted that negative emotions would remain elevated compared to baseline levels, reflecting a lesser degree of emotional recovery.

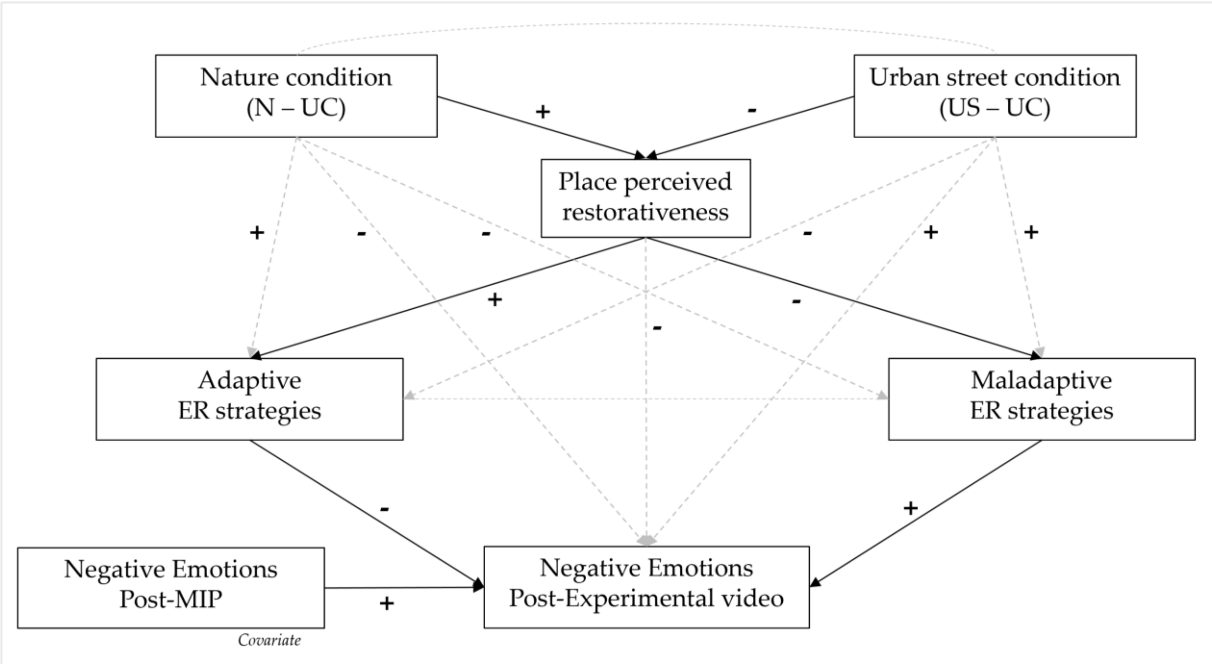
H_4) *Effect of the experimental condition on emotion regulation strategies*: It was expected that participants would report greater use of adaptive emotion regulation strategies (H_{4a}) and less use of maladaptive strategies (H_{4b}) in the nature video condition compared to the urban environment video conditions.

H_5) *Differences between trait and state emotion regulation strategies*: It was predicted that there would be observable differences in the use of emotion regulation strategies between trait (habitual) and state (situational) levels, with these differences potentially varying depending on the specific experimental condition.

H_6) *Serial-parallel mediation model with PRS and ER strategies*: In line with the theoretical framework suggesting that natural environments promote a reduction of negative emotions through restorative experiences, this study explores the potential mechanisms underlying this effect, through a serial-parallel mediation model. **Figure 5.1** presents a representation of the expected serial-parallel mediation model.

Experimental conditions (IV) were expected to influence participants' perceptions of the place restorativeness (M_1). This perception of restorativeness is anticipated to influence the use of adaptive and maladaptive emotion regulation strategies (M_2) in parallel, which are then predicted to affect the level of negative emotions experienced post-experiment (DV). Specifically, it was predicted that, for participants, the nature video condition would lead to a higher perception of restorativeness, which would be associated with increased use of adaptive emotion regulation strategies and decreased use of maladaptive strategies. This process is expected to result in lower levels of negative emotions post-experiment in the nature condition. In contrast, the urban street video condition was expected to lead to a lower perception of restorativeness, resulting in decreased use of adaptive strategies and increased use of maladaptive strategies, which in turn is anticipated to result in higher levels of negative emotions post-experiment. The urban centre condition (used as reference group) was anticipated to yield intermediate results, reflecting a partial restoration effect compared to the nature condition. The urban centre condition is expected to show a moderate perception of restorativeness, with corresponding effects on emotion regulation strategies and negative emotions, which lie between those observed for the nature and urban street conditions.

Figure 5.1. *Conceptual model with hypothesized serial-parallel mediation paths (H_6) tested in Study 5, linking experimental conditions to negative emotions post-intervention with mediation through PRS and ER strategies.*



Note. Solid line: direct effects; dashed line: indirect effects;
+ : expected positive association; - : expected negative association.

5.2.1. Method – Study 5

The experimental study utilized a 3 (experimental conditions: nature vs. urban centre vs. urban street) x 4 (emotions assessment: baseline vs. post-MIP 1 vs. post-MIP 2 vs. post-intervention) design. Each participant underwent three different conditions in a cross-over design, where they experienced nature, an urban street, and an urban centre over time. This approach allowed each participant to act as their own control, minimizing bias from individual differences.

To maintain the validity of the results and prevent carryover effects, each condition was separated by at least one week. This interval ensured that the influence of one condition did not affect the outcomes of subsequent conditions. Additionally, the order in which participants experienced the conditions was randomized to control for any potential order effects, thus preventing biases that could arise from the sequence of conditions presented.

Two pilot studies were conducted to evaluate the effectiveness and quality of the experimental videos depicting different environments, aiming to verify whether they were perceived as intended.

Initially, a first pilot study was carried out with only two experimental videos, representing a natural environment and an urban environment with a busy street. Based on the results, which indicated a significant difference in a potentially intervening variable, i.e., the perception of safety between the two environments, it was decided to add a third scenario representing the historic centre of an urban environment. This new scenario included elements of historical and cultural value, as literature suggests that such environments generally lead to a higher perception of safety compared to other types of urban settings (Scopelliti et al., 2019).

The details and findings of these pilot studies are reported in **Appendix C.1**.

Sample. The study used a sample of Italian young and middle-aged adults to examine the effects of different environmental contexts on emotional states and emotion regulation processes.

To determine the appropriate sample size for the main hypotheses of the study, an a *priori* power analysis was conducted using G*Power software (version 3.1.9.6). The analysis aimed to identify the minimum sample size required to achieve 80% power for detecting a medium effect size (f = 0.25) in a repeated measures ANOVA test (number of groups: 1; number of measures: 6; correlations between repeated measures: 0.3). To determine the effect size for the analyses, general guidelines (Cohen, 1988) for detecting a medium effect were used, as no similar studies on the variables of interest were found in the literature and no pilot study was conducted on the entire procedure. The results indicated that a minimum sample size of 26 participants would be needed to achieve this power level, assuming a significance level of $\alpha \leq 0.05$, and a test power of $1\text{-}\beta \geq 0.80$. Thus, the target was set at a sample size of at least 30 participants to ensure adequate power.

Participants were recruited through an online questionnaire administered via *Qualtrics*, using a snowball sampling method to extend reach through various platforms such as *Classroom*, *LinkedIn*, and *Facebook*.
Eligibility criteria required participants to: (1) consent to the study and sign the informed consent form, (2) consent to data processing, (3) be aged between 18 and 55 years, (4) understand Italian, and (5) commit to participating in all phases of the study, including three experimental conditions. Exclusion criteria included: (1) refusal to participate or consent to data processing, (2) age outside the 18 to 55-year range, (3) inability to understand Italian, or (4) unwillingness to complete all phases of the study.

Out of the 150 individuals who initially completed the recruitment survey, 94 proceeded to the first experimental condition. Of these, 70 participants continued to complete both the first and second experimental conditions, and 56 successfully completed all three experimental conditions, qualifying for inclusion in the final analysis. The final sample ranged in age from 18 to 53 years, with a mean age of 28.8 years (SD = 8.45) and comprised 14 males and 42 females.

Educationally, 26.7% of participants held a bachelor's degree, 33.3% had a master's degree, 10% possessed other post-diploma qualifications, and 30% had completed high school. Regarding employment status, 28.3% were students, 16.7% were working students, 43.3% were employed, and 5% were unemployed.

Procedure. The study involved completing four surveys: an initial recruitment survey followed by three additional surveys, each corresponding to one of the experimental conditions. Data were gathered between approximately May 12, 2023, and December 6, 2023. The study was approved by the Ethics Committee for Transdisciplinary Research of Sapienza University of Rome (ID: 50/2023), and informed consent was obtained from all participants before participation.

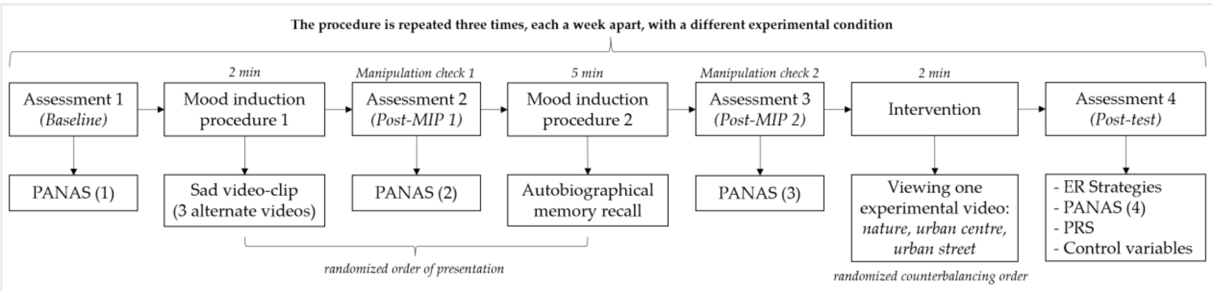
The initial phase of the study involved participants filling out a recruitment questionnaire, which collected general demographic information such as gender, age, education level, and professional status. Additionally, participants were asked to provide a personal contact reference, either an email address or phone number, for the distribution of subsequent questionnaires. This questionnaire also included measures to assess several aspects: emotion regulation strategies generally used by the participants (trait; see **Appendix C.2**), their well-being as measured by the WHO-Five Well-Being Index (WHO-5; Hofmann et al., 1998), their perceived connection to nature using the illustrated version of the Inclusion of Nature in Self Scale (IINS; Kleespies et al., 2021, adapted from Schulz, 2002), and the degree of naturalness of their childhood and current place of residence, along with the frequency and duration of their visits to natural environments.

After completing the initial phase, participants were given three questionnaires, each taking about 30 minutes to complete. The first experimental survey was distributed after recruitment, with subsequent surveys sent one week apart. However, participants not always completed the surveys on the same day they were received, and the time taken to complete each survey varied. On average, the first survey was totally completed in 2 days, the second survey in 3 days, and the third survey in 7 days.

Figure 5.2 provides a schematic visualization of the various stages of the experimental procedure for each survey. At the beginning of each questionnaire, participants' emotional states were measured to establish a baseline. The study then introduced the Mood Induction Procedure (MIP), which included two tasks: viewing a sad film excerpt and describing a negative autobiographical memory. Emotional states were reassessed between these two tasks to evaluate the impact of each procedure individually and their combined effect. Participants either viewed the video clip first followed by the autobiographical memory or vice versa, with the order randomized to ensure a balanced assessment.

After completing the mood induction procedure, participants underwent the intervention, which involved watching a two-minute video depicting one of three experimental scenarios: a busy urban street, a city centre, or a natural environment. Following the video, participants' emotions and emotion regulation strategies were assessed. They also evaluated the environment depicted in the video, focusing on its perceived restorativeness, presence of urban and natural elements (for manipulation checks), and answered additional control questions related to the specific environment they had viewed. To prevent any potential order effects, the sequence in which the videos for the mood induction procedure and experimental conditions were presented was randomized across the surveys.

Figure 5.2. *Diagram of the experimental procedure adopted in Study 5, with a factorial design 3 (experimental conditions) x 4 (emotions assessment)*



Mood Induction Procedure (MIP). Two tasks were used for the mood induction procedure.

- *Mood Induction Procedure (1)*: A short video of approximately 2 minutes, previously validated with an Italian sample (Maffei & Angrilli, 2019), was used to induce negative emotions. The selected videos were the ones most strongly associated with the emotion of sadness. The video represents a brief film excerpt (with Italian voice dubbing), specifically from *Million Dollar Baby* (2004), *The Road* (2009), *The Hours* (2002). To ensure that participants did not proceed with the questionnaire before the video had finished, a timer was implemented. After the video, participants were asked to complete a brief questionnaire (adapted from Li et al., 2021) in which they rated the level of pleasantness/unpleasantness experienced during the video (from 0 = completely unpleasant to 8 = completely pleasant), whether they had seen the film before (yes/no/don't remember), and whether they had looked away or closed their eyes for a long time during the viewing (yes/no).

- *Mood Induction Procedure (2):* A second mood induction procedure was for the recall and description of a negative event experienced by the participants. A timer was implemented to allow participants to proceed with the questionnaire only after a minimum of three minutes from accessing that page. The following introductory instructions were used: "*You are now asked to recall a negative experience in your life that you consider unresolved and particularly intense, in which you felt particularly sad, alone, hurt, or rejected. After reflecting on the event, you are asked to analyse the feelings associated with it and describe the experience in as much detail and vividness as possible, providing all the information that comes to mind. In your description, try to identify: the specific place where the experience occurred, the time period in which the experience took place, how you felt, describing the emotions you experienced at that moment, and the people involved (if applicable). You are invited to complete the narrative in about 5 minutes*".

Participants were then asked to indicate the level of pleasantness/unpleasantness experienced during the recall (from 0 = completely unpleasant to 8 = completely pleasant). This procedure was applied consistently across all three experimental conditions. This approach is similar to that employed by Berman et al. (2012), who used comparable instructions to induce rumination in a within-subject design, effectively eliciting rumination across two sessions without causing habituation.

Measures.

- *Positive and Negative Affect Schedule* (PANAS, Watson et al., 1988; Italian validated version: Terraciano et al., 2003): This scale includes 20 items, 10 of which assess negative emotions (NA; e.g., sad, nervous; α = .887 to .938 across experimental conditions and time points) and 10 assess positive emotions (PA; e.g., happy, proud; α = .873 to .943 across experimental conditions and time points). Each item was rated on a 5-point scale from 1 to 5 (1 = not at all; 5 = very much). The total scores were obtained by calculating the mean separately for the 10 positive items and the 10 negative items. For the PA total score, a higher score indicates greater positive emotions. For the NA total score, a higher score indicates greater negative emotions. In the present study, only the negative affect component was considered. This focus was due to the use of a mood induction procedure specifically designed to evoke negative emotions, which aligns with the study's examination of emotion regulation, and since the primary aim was to explore how individuals manage and respond to negative emotional states, as the main aspect of emotion regulation.

- *Emotion Regulation Strategies*: Items for measuring emotion regulation strategies were created ad-hoc by providing a brief definition of each and asking participants to indicate how much they felt they were using each behaviour/thought pattern at that moment on a scale from 0 to 100 (0 = not at all; 100 = very much). Specifically, 10 emotion regulation strategies were investigated, 4 of which pertain to strategies considered maladaptive (i.e., rumination, expressive suppression, cognitive avoidance, denial; α = .590 to .714 across experimental conditions) and 6 that have been shown to be adaptive (i.e., reappraisal, control problem-solving, emotional expression, positive reminiscence, positive thinking; α = .780 to .841 across experimental conditions). The mean scores of the items related to adaptive emotion regulation strategies and maladaptive strategies were calculated separately. This measure was used both in the recruitment questionnaire as a trait strategy and during the experimental phase as a state strategy, with the instruction being adapted based on the context of application.

- *Environmental characteristics* (items adapted from Aletta et al., 2019): Participants were asked to evaluate the environments viewed in the experimental videos regarding the presence of visual and auditory elements related to natural and urban aspects, as well as historical-cultural elements. 12 items were used, rated on a 7-point response scale evaluating the presence of different elements (0 = not at all; 6 = completely dominates). Three different mean scores were calculated for each of the investigated elements: natural (α = .543 to .766 across experimental conditions), urban (α = .681 to .774 across experimental conditions), historical-cultural value (α = .761 to .832 across experimental conditions). These scores served as manipulation check variables to assess the adequacy of the manipulations in terms of the perception of the environments in the experimental videos as natural or urban.

- *Environment perceptions* (items adapted from the Affective Quality of Place, Mehrabian & Russell, 1974): Participants' perceptions of the environment were measured with a semantic differential scale ranging from -3 to +3, with opposite adjectives presented at the extremes. Specifically, the environments were evaluated in terms of familiarity with the place (1 item; e.g., unfamiliar-familiar), and perceived safety (1 item; e.g., dangerous-safe). This measure was used as a control variable for the experimental videos.

- *Experience evaluation*: Participants were asked to evaluate their overall experience with the quality of the experimental videos they viewed. This assessment included five items related to the quality of audio and video (2 items) and playback smoothness (1 item), using a 7-point Likert scale ranging (0 = not at all; 6 = very much). Additionally, participants reported any issues encountered during viewing (1 item; e.g., playback interruptions or instability) on a 7-points response options' scale (0 = never; 6 = always). This measure was used as a control variable for the experimental videos.

- *Place perceived restorativeness, emotional reactions and place perceptions in terms of pleasantness and relaxation* were measured using the same items presented in **Chapter 4**, **Section 4.4.2**).

Reliability analyses were conducted on the measurement tools using Cronbach's α to ensure that scales with average item scores exhibited adequate internal consistency. For a full list of the scales used, along with their corresponding items and reliability coefficients, refer to the **Appendix C.2 – C.6**.

Experimental videos. The videos used in the study simulated walks through three distinct areas of Rome and were sourced from publicly available content on *YouTube*. Each video retained its original audio, which matched the depicted environment to enhance the immersive experience.

The first scenario showcased the natural setting of the botanic garden of Rome. This video featured a serene landscape with a flowing watercourse, a Japanese garden, and diverse vegetation and wildlife. The accompanying audio included the soothing sounds of birds chirping, rustling leaves, and the gentle flow of water, creating a calming and restorative atmosphere (**Figure 5.3**). The second scenario depicted the historic area around the Pantheon in Rome. This video illustrated a quiet urban environment characterized by classic architectural buildings, a sparse number of pedestrians, and some stores. The pedestrian-only zone meant there was no vehicular traffic, contributing to the scene's calm and historical atmosphere. Accordingly, the audio in this video featured a quiet ambiance with soft sounds of a few pedestrians conversing and occasional footsteps, without any car or traffic noises (**Figure 5.4**). The third scenario portrayed a busy street in the Barberini area of Rome, which was characterized by a high volume of pedestrians, moving vehicles, and motorbikes. The video included visual elements such as traffic lights, road signs, and storefronts, and the accompanying audio captured the sounds of city traffic and pedestrian activity, reflecting the dynamic and crowded nature of the urban environment (**Figure 5.5**).

Figure 5.3. *Representative view of the Nature video*

Figure 5.4. *Representative view of the Urban centre video*

Figure 5.5. *Representative view of the Urban street video*

Analytic strategies. Statistical analyses were conducted using Jamovi (version 2.5.6). Descriptive statistics were utilized to present all variables. For data with a normal distribution, the mean and standard deviation were reported. Binary and categorical variables, such as participant demographics (e.g., age and gender), were summarized with frequencies and percentages.

For the present study, initial analyses were conducted to check the effectiveness of the experimental videos and the mood induction procedure. Repeated measures ANOVAs were used for manipulation checks and to examine control variables related to the experimental videos. This analysis aimed to determine whether the environments depicted in the videos—natural, urban, and historical-cultural—were perceived as intended. It also assessed control variables such as the familiarity and safety of the place, as well as the quality of video and audio. Also, repeated measures ANOVAs evaluated the overall impact of the mood induction procedure on increasing negative emotions by comparing the results of the first and third PANAS assessments, administered before and after the two MIP procedures. The effectiveness of each individual task within the procedure was also assessed, along with any variations in emotional effects based on the order of task administration. Additionally, content analyses were performed on the negative memories described by participants to identify key themes and recurring patterns (**Appendix C.7**).

To test the research hypotheses H_1, H_2 and H_3, a two-way repeated measures ANOVA was conducted to compare the experimental conditions regarding changes in participants' emotional states. Post hoc comparisons were carried out using the Tukey method to identify significant differences across conditions, between different time points, comparing emotions pre- and post- intervention (PANAS 3 *vs.* PANAS 4), as well as post-intervention emotions with pre-MIP levels to assess a return to baseline (PANAS 4 *vs.* PANAS 1). It is important to emphasize that post-hoc comparisons were conducted to investigate specific group-level changes in emotional states across experimental conditions and time points, which was the central focus of the study. As highlighted in prior works (e.g., Hsu, 1996; Midway et al., 2020), while ANOVA tests for overall differences, it does not identify subtle group differences, and relying solely on the omnibus interaction effect may miss meaningful patterns in the data. Therefore, post-hoc tests were crucial for exploring these specific comparisons, providing a more nuanced understanding of emotional responses to different environmental stimuli, even in the absence of a significant interaction effect.

Moreover, repeated measures ANOVAs were conducted to explore potential differences across experimental groups in the use of emotion regulation strategies, in order to assess hypothesis H_4. Additionally, a repeated measures ANOVA was employed to compare emotion regulation strategies reported as traits with those reported after the intervention, in line with hypothesis H_5. This analysis examined the main effect of intervention to identify significant overall differences between trait-based and state-based emotion regulation strategies after the experimental conditions, as well as the interaction effect of intervention and experimental conditions to determine whether these variations differed significantly across the environmental videos used as intervention. Analyses to identify differences in emotion regulation strategies were conducted on both the adaptive and maladaptive mean scores, as well as on each strategy individually.

Finally, to test the conceptual model proposed in H_6, a Structural Equation Modeling (SEM) analysis was performed to examine the hypothesized relationships among the variables, including the mediating roles of the perceived restorativeness and emotion regulation strategies on negative emotions post-experimental condition. The analysis was conducted systematically, involving several key steps. The model incorporated variables representing place perceived restorativeness, both adaptive and maladaptive emotion regulation strategies, and negative emotions post-experiment, with the experimental conditions serving as independent variables.

Direct and indirect paths were specified to explore the relationships among these constructs. The model was estimated using *Maximum Likelihood Estimation* (MLE) and the overall model fit was evaluated using various goodness-of-fit indices, and the significance of individual path coefficients was examined to test the hypothesized relationships. To assess the mediating effects of PRS and emotion regulation strategies, both direct and indirect effects were analysed. The significance of the indirect effects was tested using bootstrapping procedures, which provided confidence intervals for the mediation effects, enabling more precise inference.

Four alternative models were then tested to further explore these associations and evaluate the model fit. Model fits were assessed through several goodness-of-fit indices, each with their own acceptance criteria. The chi-square test (Chi-Square, χ^2)

should ideally be non-significant (p > .050), indicating no significant deviation between the model and the data (Wheaton et al., 1977; Bollen, 1989). The Root Mean Square Error of Approximation (RMSEA) value should be below 0.080, with a range of acceptance from 0.050 to 1.00 (Browne & Cudeck, 1992; MacCallum et al., 1996). The Standardized Root Mean Square Residual (SRMR) should be less than 0.080, with values between 0.080 and 1.00 considered to indicate a mediocre fit (Hu & Bentler, 1999). The Comparative Fit Index (CFI) value should exceed 0.090 for an excellent fit, with values above 0.80 indicating a satisfactory fit, and above 0.75 indicating a fair fit (Bentler, 1989). The Tucker-Lewis Index (TLI) values above 0.090 are also considered desirable (Bentler & Bonett, 1980; Hu & Bentler, 1999). The Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) are used to compare the relative quality of models, with lower values indicating better fit. The AIC penalizes model complexity, while the BIC imposes a greater penalty for complexity (Akaike, 1974; Schwarz, 1978). These indices provide a comprehensive assessment of the model's goodness-of-fit and guide the interpretation of the hypothesized relationships in the context of this study.

5.2.2. Results – Study 5

Manipulation check and control variables – Experimental videos.

Table 5.1 provides the descriptive analyses of the manipulation check and control variables associated with the environmental videos across the three experimental conditions.

Repeated measures ANOVA analyses were conducted for each of the manipulation check variables to assess potential differences in the perception of natural, urban and cultural value elements across the different experimental conditions. It was hypothesized that participants would perceive a higher level of natural elements in the experimental condition with the video representing the natural environment compared to the urban environment videos. Conversely, it was expected that the perceived level of urban elements would be lower in the video representing the natural environment than in the urban environment video, particularly for the urban street condition. Finally, it was expected that the urban centre condition would have higher rating for the historical-cultural value elements, compared to the videos with natural and urban street environments.

Table 5.1. *Descriptive statistics for manipulation check and control variables across experimental conditions: means and standard deviations in parentheses (Study 5)*

Variables	**Experimental conditions**		
	Nature	***Urban centre***	***Urban street***
Natural elements	5.48 (0.43)	0.55 (0.69)	0.47 (0.80)
Urban elements	0.49 (0.71)	4.20 (1.03)	5.11 (0.96)
Cultural value	1.11 (1.20)	3.80 (1.30)	2.33 (1.39)
Familiarity	1.18 (1.83)	1.13 (2.58)	0.63 (1.97)
Safety	2.13 (1.24)	0.79 (1.75)	-0.11 (1.65)
Video quality	5.12 (1.21)	5.02 (1.02)	4.96 (1.18)

The analysis revealed a statistically significant difference in the perception of natural elements between the experimental scenarios, $F(2, 55) = 1335$, $\eta^2 = 0.928$, $p < .001$. Post hoc Tukey comparisons showed that the nature video was perceived as having significantly more natural elements compared to both the urban centre and urban street videos. Specifically, the nature video ($M = 5.48$, $SD = 0.43$) was perceived to have significantly more natural elements than the urban centre video ($M = 0.55$, $SD = 0.69$), $t(55) = 46.42$, *mean difference* = 4.93, $p_{tukey} < .001$; and the urban street video ($M = 0.47$, $SD = 0.80$), $t(55) = 41.40$, *mean difference* = 5.01, $p_{tukey} < .001$. There was no significant difference in the perception of natural elements between the urban centre and urban street videos, $t(55) = 0.81$, $p_{tukey} = 0.701$. These findings indicate that the nature video was effectively perceived as having significantly more natural elements compared to both urban videos.

In terms of urban elements, the results also revealed a statistically significant difference between the experimental conditions, $F(2, 55) = 417$, $\eta^2 = 0.830$, $p < .001$. Post hoc Tukey comparisons revealed that the nature video ($M = 0.49$, $SD = 0.71$) was perceived to have significantly less urban elements compared to the urban centre video ($M = 4.20$, $SD = 1.03$), $t(55) = -21.41$, *mean difference* = -3.71, $p_{tukey} < .001$; and the urban street video ($M = 5.11$, $SD = 0.96$), $t(55) = -29.63$, *mean difference* = -4.62, $p_{tukey} < .001$. There was also a significant difference in the perception of urban elements between the urban centre and urban street, with urban centre perceived to have less urban elements than the urban street, $t(55) = -5.11$, *mean difference* = -0.91, $p_{tukey} < .001$. These results confirm that both urban environment videos were perceived as having significantly more urban elements compared to the nature video, and that the urban street video had a higher rating of urban elements than the urban centre video.

Finally, analysis revealed a statistically significant difference in the perception of historical-cultural value among the experimental conditions, $F(2, 55) = 71.9$, $\eta^2 = 0.422$, $p < .001$. Post hoc Tukey comparisons showed that the nature video ($M = 1.11$, SD = 1.20) was perceived as having significantly less cultural value compared to both the urban centre video (M = 3.80, SD = 1.30), $t(55) = -10.87$, *mean difference* = -2.69, $p_{tukey} < .001$, and the urban street video ($M = 2.33$, $SD = 1.39$), $t(55) = -5.27$, *mean difference* = -1.22, $p_{tukey} < .001$. Additionally, the urban centre video was rated as having significantly more cultural value than the urban street video, $t(55) = 7.68$, *mean difference* = 1.47, $p_{tukey} < .001$. These results confirm that the urban centre video was perceived to have the highest level of cultural value, followed by the urban street video, with the nature video rated the lowest in terms of cultural value.

Overall, the analyses confirm that the experimental videos effectively represented their intended environments: the nature video was perceived as having significantly more natural elements and fewer urban and cultural elements compared to both urban videos, while the urban centre and urban street videos were accurately rated with higher urban and cultural value elements, with the urban centre video being perceived as having the greatest historical-cultural value.

Differences in control variables were examined using repeated measures ANOVAs to ensure consistency across experimental conditions for potentially relevant factors such as familiarity with the environments, perceived safety, and video/audio quality. It was generally expected that these variables would remain consistent across the different conditions. However, based on pilot studies conducted on the experimental videos, a difference in perceived safety between the nature and urban street scenarios was anticipated. The urban centre condition was included specifically to provide an urban environment that was not perceived as dangerous.

No significant differences were found in familiarity between the experimental conditions, $F(2, 55) = 1.43$, $\eta^2 = 0.013$, $p = .243$.

Regarding safety, the analysis revealed a statistically significant difference in safety perceptions across the environments, $F(2, 55) = 39.5$, $\eta^2 = 0.263$, $p < .001$. Post hoc comparisons showed that the nature video ($M = 2.13$, $SD = 1.24$) was perceived as significantly safer than both the urban centre video ($M = 0.79$, $SD = 1.75$), $t(55) = 5.47$, *mean difference* = 1.43, $p_{tukey} < .001$, and the urban street video ($M = -0.11$, $SD = 1.65$), $t(55) = 8.94$, *mean difference* = 2.23, $p_{tukey} < .001$. Additionally, the urban centre video was perceived as significantly safer than the urban street video, $t(55) = 3.18$, *mean difference* = 0.80, $p_{tukey} = .007$. These findings suggest that the nature environment was perceived as the safest, the urban centre was perceived as an intermediate environment in terms of safety, and the urban street was perceived as the least safe.

Finally, results found there were no significant differences in terms of video and audio quality between the experimental conditions, $F(2, 55) = 0.48$, $\eta^2 = 0.004$, $p = .620$.

Overall, the analysis confirmed that the experimental conditions were consistent in terms of familiarity with the environments and video and audio quality, while highlighting significant differences in perceived safety, that were in line with the pilot studies results.

Manipulation check – Mood Induction Procedure.

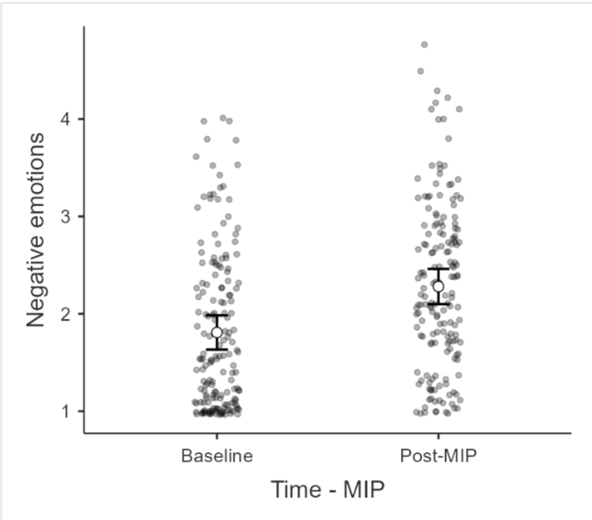
To verify the effectiveness of the Mood Induction Procedure (MIP), a manipulation check was conducted by comparing participants' levels of negative emotions before and after the entire MIP process across different experimental conditions. **Table 5.2** reports the descriptive statistics of the negative emotions for the different time points (baseline, post-MIP 1, post-MIP 2) across the experimental conditions.

Table 5.2. *Descriptive statistics for negative emotion levels across different time-points and experimental conditions: means and standard deviations in parentheses (Study 5)*

Time points	Experimental conditions		
	Nature	*Urban centre*	*Urban street*
Baseline	1.74 (0.86)	1.89 (0.80)	1.80 (0.78)
Post-MIP 1	2.01 (0.88)	2.25 (0.97)	2.21 (0.88)
Post-MIP 2	2.23 (0.88)	2.39 (0.92)	2.22 (0.76)
Post-intervention	1.71 (0.83)	2.01 (0.89)	1.91 (0.85)

When considering the overall effect of MIP—comparing negative emotions before and after the procedure—the results of a repeated measures ANOVA revealed a significant increase in negative emotions, $F(1, 55) = 37.661$, $\eta^2 = 0.075$, $p < .001$. This confirms that the MIP was successful in inducing negative emotions, as participants reported higher levels of negative emotions following the procedure. These findings are visually represented in **Figure 5.6**. No significant main effect of the experimental conditions was found, $F(2, 55) = 1.507$, $\eta^2 = 0.006$, $p = 0.226$. Also, the interaction between the experimental condition and MIP was not statistically significant, $F(2, 55) = 0.256$, $\eta^2 = 0.000$, $p = 0.774$. This suggests that the increase in negative emotions after the MIP was consistent across all three environments. Post hoc comparisons provided more detailed insights. In the nature condition, participants experienced a significant increase in negative emotions from baseline ($M = 1.74$, $SD = 0.86$) to the final measurement after the MIP (*M* = 2.23, *SD* = 0.88), with a statistical significance between the two time-points of measurement, $t(55) = -5.24$, *mean difference* = -0.49, p_{tukey} < .001. Similarly, the urban centre condition saw a significant rise in negative emotions from baseline (*M* = 1.89, *SD* = 0.80) to post-MIP (*M* = 2.39, *SD* = 0.92), demonstrating a strong effect of the MIP in this environment as well, $t(55) = -4.63$, *mean difference* = -0.50, p_{tukey} < .001. The urban street condition followed this pattern, with a significant increase in negative emotions from baseline (*M* = 1.80, *SD* = 0.78) to the final post-MIP measurement (*M* = 2.22, *SD* = 0.76), $t(55) = -3.49$, *mean difference* = -0.42, p_{tukey} = .012.

Figure 5.6. *Overall changes in negative emotions pre- and post-MIP (Study 5)*



An additional analysis was conducted to explore the differences related to the order of presentation of the two tasks (video viewing/memory recall) within the Mood Induction Procedure across all experimental conditions. The results indicated no significant effect of the order of presentation on the induced negative emotions. Specifically, for the nature condition, there was no significant main effect of the MIP order, $F(1, 54) = 0.244$, $\eta^2 = 0.003$, $p = .623$. Additionally, no significant interaction effect between time and the MIP order was found, $F(1, 54) = 0.819$, $\eta^2 = 0.002$, $p = .370$.

For the Urban Centre condition, no significant main effect of the MIP order was observed, $F(1, 54) = 0.803$, $\eta^2 = 0.011$, $p = .374$. Similarly, there was no significant interaction effect, $F(1, 54) = 2.34$, $\eta^2 = 0.008$, $p = .132$. For the Urban Street condition, no significant main effect of the MIP order was found, $F(1, 54) = 0.227$, $\eta^2 = 0.003$, $p = .636$. Furthermore, no significant interaction effect between time and MIP order was present, $F(1, 54) = 0.001$, $\eta^2 = 0.000$, $p = .979$. These findings confirm that the procedures were effective in inducing negative emotions across all conditions, regardless of the order of task presentation. This suggests that the order of presentation did not influence the effectiveness of the mood induction procedure.

Hypotheses testing.

In the following section, the confirmatory analyses related to the hypotheses formulated for this study are presented.

$H_{1\text{-}3}$) *Changes in negative emotions across time-points and experimental conditions*

First, to evaluate the impact of viewing videos featuring different environmental scenarios on negative emotions, a two-way repeated measures ANOVA was conducted. This analysis addressed three hypotheses: (H_1) that negative emotions would significantly decrease from post-MIP to post-intervention across all conditions, indicating an overall effect of the intervention; (H_2) that the reduction in negative emotions would differ by experimental condition, reflecting an interaction between the intervention and environment type; and (H_3) that negative emotions might return to baseline levels after the intervention, with differences across experimental conditions.

Descriptive statistics for negative emotions post-intervention across experimental conditions are reported in **Table 5.2**. Results revealed a significant main effect of the intervention on negative emotions, $F(3, 55) = 24.65$, $\eta^2 = 0.049$, $p < .001$. Post-hoc comparison indicated a significant general decrease in negative emotions from pre-intervention (M = 2.28) to post-intervention (M = 1.88), $t(55) = 7.06$, *mean difference* = 0.404, $p_{tukey} < .001$. This finding supports H_1, demonstrating that after viewing the videos negative emotions scores are reduced.

Furthermore, results showed that the post-intervention levels of negative emotions were not significantly different from the baseline level (M = 1.81), $t(55) = -0.984$, *mean difference* = -0.069, $p_{tukey} = .759$. This suggests that, overall, the video intervention effectively returned participants' negative emotions to levels comparable to those reported before the negative mood induction procedure (H_3).

The main effect of condition did not reach the significance level, $F(2, 55) = 2.82$, $\eta^2 = 0.010$, $p = .064$. This suggests that the type of environmental scenario did not have a significant overall effect on the level of negative emotions. The interaction between time and condition was also non-significant, $F(6, 55) = 0.821$, $\eta^2 = 0.002$, $p = .554$. This result implies that the changes in negative emotions over time were similar across the different experimental conditions, and no specific condition led to a markedly different pattern of emotional change. To gain deeper insights about these findings, post hoc Tukey tests were conducted to compare negative emotions changes between pre-intervention (post-MIP) and post-intervention, and between post-intervention and baseline levels across all conditions, as well as to explore differences in negative emotions across experimental conditions post-intervention. However, post hoc Tukey tests were conducted to provide additional insights into specific comparisons across time points and conditions. While the omnibus interaction effect did not reach statistical significance, post hoc tests allow for a more nuanced exploration of the data, particularly when the focus is on identifying specific group-level differences that are not captured by the main interaction effect alone (Hsu, 1996; Midway et al., 2020). This approach ensures that potential changes and differences in negative emotions across experimental conditions are thoroughly examined, even in the absence of a significant interaction. **Figure 5.7** illustrates the changes in negative emotions across the various time points for the three experimental conditions.

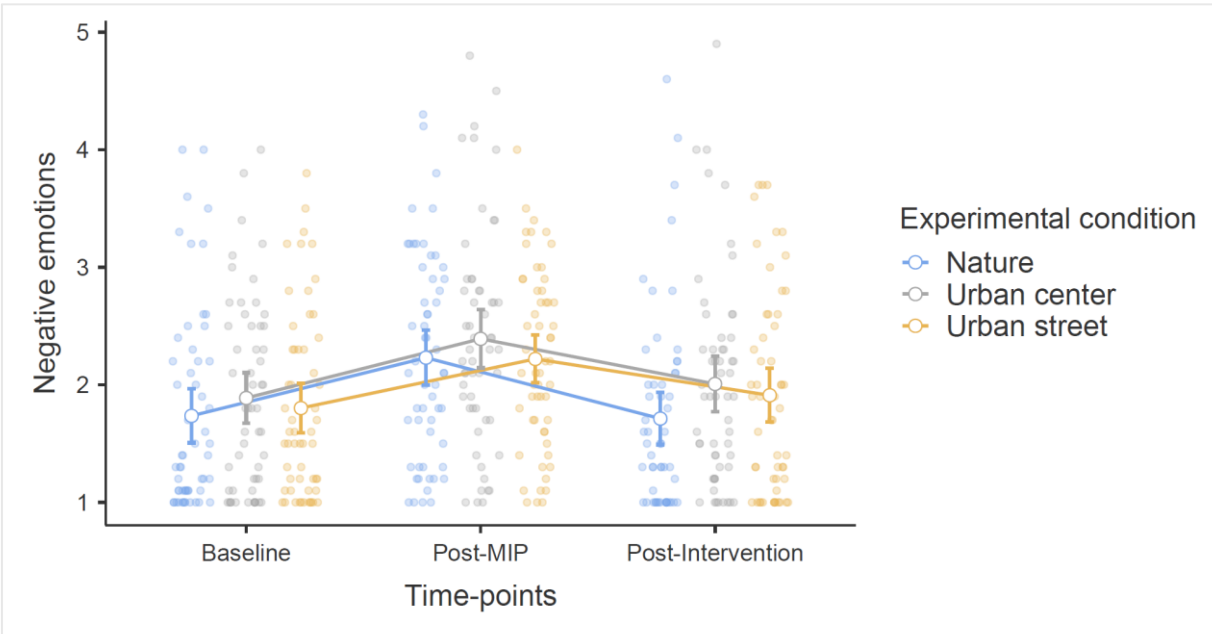
Interesting results emerged from the comparisons between pre- and post-intervention negative emotions across the experimental conditions. Specifically, findings showed that negative emotions significantly decreased from pre- to post-intervention in the nature experimental condition, $t(55) = 6.01$, *mean difference* = 0.518, $p_{tukey} < .001$. Similarly, there was a significant decrease in negative emotions from pre- to post-intervention in the urban centre condition, $t(55) = 4.85$, *mean difference* = 0.384, $p_{tukey} < .001$. Conversely, no significant difference was found between pre- and post-intervention in the urban street condition, $t(55) = 3.05$, *mean difference* = 0.309, $p_{tukey} = .123$. These results suggest that the video intervention was effective in reducing negative emotions in both the nature and urban centre conditions. In contrast, the urban street condition did not show a significant decrease, indicating that the video intervention was comparatively less effective in this context in reducing negative emotions post-MIP, supporting H_2.

The comparison of baseline and post-intervention negative emotions revealed that, for the nature condition, there was no significant difference between the scores, $t(55) = 0.26$, *mean difference* = 0.023, $p_{tukey} = 1.000$. This result supports the hypothesis H_3 that negative emotions in the nature condition returned to baseline levels (before MIP) after the intervention. However, no significant differences between baseline and post-intervention negative emotions were found for both the urban centre, $t(55) = -1.26$, *mean difference* = -0.120, $p_{tukey} = .981$, and the urban street condition, $t(55) = -1.08$, *mean difference* = -0.109, $p_{tukey} = .994$. These findings suggest that the urban conditions were similarly effective in returning negative emotions to baseline levels, which was contrary to the initial hypothesis (H_3) that these urban conditions would not achieve the same level of emotional recovery as the nature condition.

Results revealed no significant differences in negative emotions post-intervention between the nature and urban street conditions, $t(55) = -2.06$, *mean difference* = -0.198, $p_{tukey} = .323$; or between urban centre and urban street conditions, $t(55) = 1.06$, *mean difference* = 0.096, $p_{tukey} = .894$. However, a significant difference was found for the comparison between nature and urban centre conditions, with participants reporting lower negative emotions post-intervention in the nature condition than in the urban centre condition, $t(55) = -3.36$, *mean difference* = -0.295, $p_{tukey} = .017$.

Therefore, while no significant differences in negative emotions were observed between the nature and urban street conditions, the nature condition led to significantly lower negative emotions compared to the urban centre condition. This significant result, along with the overall trend in the means—where negative emotions were lowest in the nature condition ($M = 1.71$), followed by the urban street ($M = 1.91$) and urban centre conditions ($M = 2.01$)—provide further supports to the hypothesis (H_2) that exposure to natural environment may reduce negative emotions more effectively than urban environments.

Figure 5.7. *Changes in negative emotions across time points for the different experimental conditions (Study 5)*



In summary, these findings provided nuanced insights into the hypotheses. Regarding H_1, the intervention significantly reduced negative emotions from pre- to post-intervention, confirming the hypothesis that the videos overall led to a decrease in negative emotions.

For H_2, contrary to the hypothesis that the reduction in negative emotions would vary by video environment, the results showed no significant differences in negative emotions post-intervention across the different conditions. However, partial support for the hypothesis was observed: significant reductions in negative emotions from pre- and post-intervention were evident in the nature and urban centre conditions, whereas the urban street condition did not exhibit a significant change. This suggests that while the nature and urban centre videos effectively reduced negative emotions, the urban street video was less effective, aligning with H_2.

Regarding H_3, the analysis showed that negative emotions in the nature condition returned to baseline levels after the intervention, as expected. However, contrary to the hypothesis, the post-intervention negative emotions in the urban centre and urban street conditions also did not differ significantly from baseline levels. This suggests that the video intervention was effective in restoring negative emotions to baseline levels across all video conditions, not just in the nature video condition.

H_4) *Effect of the experimental condition on emotion regulation strategies*

It was expected that participants would report greater use of adaptive emotion regulation strategies (H_{4a}) and less use of maladaptive strategies (H_{4b}) in the nature video condition compared to the urban environment video conditions.

Descriptive statistics for adaptive and maladaptive emotion regulation post-intervention across experimental conditions are reported in **Table 5.3**. The average use of adaptive strategies was highest in the nature condition, followed by the urban street condition, and was lowest in the urban centre condition. However, maladaptive strategies were also most frequently used in the nature condition, with slightly lower usage in the urban centre and urban street conditions.

Table 5.3. *Descriptive statistics of emotion regulation strategies across the experimental conditions: means and standard deviations in parentheses (Study 5)*

ER strategies	**Experimental conditions**			**Trait level**
	Nature	***Urban centre***	***Urban street***	
Adaptive	51.8 (22.1)	47.9 (24.7)	51.1 (25.9)	62.1 (19.4)
Maladaptive	43.7 (23.6)	39.8 (18.1)	39.6 (22.4)	47.0 (17.8)

A repeated measures ANOVA was conducted to examine the effect of the experimental condition on the use of emotion regulation strategies.
The results indicated no significant effect of the experimental condition on adaptive emotion regulation strategies, $F(2, 55) = 1.22$, $\eta^2 = 0.005$, $p = .299$. This suggests that the type of environmental video did not significantly influence participants' use of adaptive emotion regulation strategies to manage their negative emotions during the intervention. Similarly, results showed no significant effect of the experimental condition on the use of maladaptive strategies, $F(2, 55) = 1.59$, $\eta^2 = 0.008$, $p = .209$, indicating that the type of environmental video did not significantly impact participants' reliance on maladaptive emotion regulation strategies to cope with their negative emotions during the intervention.

Analyses were also performed for each emotion regulation strategy individually. Descriptive statistics for all the separate strategies are reported in **Table 5.4**. The findings revealed no significant effects of the experimental conditions on these strategies, consistent with the results observed in the mean scores of adaptive and maladaptive emotion regulation strategies.

In conclusion, contrary to the hypothesis, the findings suggest that the type of environmental scenario depicted in the videos used as intervention did not significantly affect the use of adaptive (H_{4a}) or maladaptive (H_{4b}) emotion regulation strategies. Despite the expectation that the nature video would promote more adaptive and less maladaptive strategies, the results indicate similar levels of strategy use across all experimental conditions.

Table 5.4. *Descriptive statistics for all the emotion regulation strategies at state and trait level: means and standard deviations in parentheses (Study 5)*

ER strategies	*Nature*	*Urban centre*	*Urban street*	*Trait*
Adaptive				
Problem solving	54.4 (31.9)	49.3 (34.5)	52.9 (35.4)	69.4 (24.2)
Positive reminiscence	52.3 (32.1)	48.0 (33.3)	51.6 (37.0)	63.3 (30.9)
Positive thinking	57.4 (32.6)	49.4 (35.4)	54.4 (35.9)	62.2 (31.7)
Reappraisal	51.3 (31.9)	43.8 (30.6)	48.4 (35.1)	56.0 (26.8)
Emotional expression	43.7 (32.4)	47.1 (34.2)	44.1 (31.4)	65.9 (30.2)
Control	51.5 (30.7)	49.9 (31.7)	55.1 (32.9)	55.8 (28.6)
Maladaptive				
Denial	42.7 (32.5)	31.6 (31.5)	37.4 (33.3)	28.2 (29.0)
Cognitive avoidance	52.5 (34.1)	45.6 (33.0)	46.0 (32.0)	50.8 (31.4)
Expressive suppression	40.6 (32.6)	39.0 (30.1)	37.6 (32.6)	41.0 (31.3)
Rumination	39.1 (29.1)	43.0 (32.7)	37.5 (32.0)	67.9 (27.9)

H_5) *Differences between trait and state emotion regulation strategies*

Repeated measures ANOVAs were conducted to compare the use of both adaptive and maladaptive strategies at the state level across three experimental conditions against the trait level. **Table 5.3** presents means and standard deviations for both adaptive and maladaptive emotion regulation strategies at trait-level.

The analysis of adaptive emotion regulation strategies revealed a significant main effect of the emotion regulation level, with differences between the trait level and the state levels across all experimental conditions, $F(2, 55) = 9.60$, $\eta^2 = 0.051$, $p < .001$. Specifically, participants reported a significantly higher use of adaptive strategies at the trait level compared to each of the state conditions. When comparing the nature condition to the trait level, participants showed a significant decline in the use of adaptive strategies during the state-level intervention, $t(55) = -3.87$, *mean difference* = -10.345, $p_{tukey} = .002$. A similar pattern was observed in the urban centre condition, where participants also reported significantly less use of adaptive strategies at the state level compared to the trait level, $t(55) = -4.18$, *mean difference* = -14.190, $p_{tukey} < .001$. In the urban street condition, the reduction in adaptive strategies from the trait to the state level was also significant, $t(55) = -3.90$, *mean difference* = -11.015, $p_{tukey} < .001$. These findings suggest that participants generally relied more on adaptive emotion regulation strategies in their habitual (trait) context compared to when they were in the situational (state) context of the intervention, regardless of the specific environment they were exposed to.

In terms of maladaptive strategies, the results also showed a significant main effect of the emotion regulation level, with differences between the trait and state levels, $F(2, 55) = 3.81$, $\eta^2 = 0.022$, $p = .011$. However, these differences were more pronounced in the urban environments. Specifically, in the urban centre condition, participants reported a significant less use of maladaptive strategies compared to the trait level, $t(55) = -2.99$, *mean difference* = -7.205, $p_{tukey} = .021$.

Similarly, in the urban street condition, participants used significantly fewer maladaptive strategies than at the trait level, $t(55) = -2.83$, *mean difference* = -7.357, $p_{tukey} = .032$. However, in the nature condition, there was no significant difference between the trait and state levels in the use of maladaptive strategies, $t(55) = -1.31$, *mean difference* = -3.268, $p_{tukey} = .562$. These findings indicate that, in contrast to adaptive strategies, the situational context influenced the use of maladaptive strategies differently depending on the environment. Specifically, participants were less likely to rely on maladaptive strategies in urban settings during the state-level intervention than they were habitually (at the trait level). This pattern was not observed in the nature experimental condition, where participants' use of maladaptive strategies remained relatively consistent between trait and state levels.

Analyses were also conducted on each emotion regulation strategy separately. Descriptive statistics are shown in **Table 5.4**. The findings revealed significant differences between trait and state levels for several strategies. Specifically, participants reported lower use of problem-solving, $F(3, 55) = 8.29$, $\eta^2 = 0.056$, $p <.001$;

emotional expression, $F(3, 55) = 9.74$, $\eta^2 = 0.077$, $p < .001$ and rumination, $F(3, 55) = 17.3$, $\eta^2 = 0.142$, $p < .001$, across all experimental conditions compared to the trait level.

Additionally, there were notable differences in the use of positive reminiscence, $F(3, 55) = 3.73$, $\eta^2 = 0.029$, $p = .013$, and positive thinking strategies, $F(3, 55) = 2.68$, $\eta^2 = 0.019$, $p = .049$. Participants reported lower use of both strategies in the urban centre condition compared to the trait level, with $t(55) = -2.97$, *mean difference* = -15.27, $p_{tukey} = .022$, and $t(55) = -2.71$, *mean difference* = -12.82, $p_{tukey} = .042$, respectively. Finally, a significant difference was found on the use of the denial strategy, $F(3, 55) = 3.96$, $\eta^2 = 0.030$, $p = .009$, with an unexpected higher use in the natural environment condition compared to the trait level, $t(55) = 3.26$, *mean difference* = 14.50, $p_{tukey} = .010$.

In summary, the results provide evidence of differences in emotion regulation strategies between trait and state levels. Participants generally used more adaptive strategies in their habitual context (trait level) across all environments compared to situational contexts (state levels). For maladaptive strategies, both the urban conditions elicited a significant reduction in the use of these strategies at the state level compared to the trait level, while unexpectedly the nature environment did not show such a difference. Further differences can be observed in the specific strategies examined.

H_6) *Serial-parallel mediation model with PRS and ER strategies*

The study sought to explore the pathways through which nature stimuli used as intervention for emotion regulation may influence consequent negative emotions by employing a serial-parallel mediation model. Specifically, it investigated how different environmental conditions affect negative emotions post-intervention, with place perceived restorativeness (PRS) and emotion regulation strategies (adaptive and maladaptive) serving as mediators in the process. The experimental conditions were represented as dummy-coded variables, with the urban centre condition serving as the reference group. To control for initial emotional states induced through the negative mood induction procedure, negative emotions pre-intervention (PANAS 3) was included as a covariate variable in the model.

The overall model fit was assessed using several indices. The chi-square test for model fit was significant ($\chi^2 = 18.5$, $df = 4$, $p < .001$), indicating a possible deviation from the model to the data, but this is not uncommon in large sample sizes or complex models. The comparative fit index (*CFI* = 0.949), standardized root mean square residual (*SRMR* = 0.071), goodness-of-fit index (*GFI* = 0.996), the root mean square error of approximation (*RMSEA* = 0.147, 95% *CI* = 0.084 – 0.218, $p = .008$) all indicated a satisfactory fit. The model accounted for substantial portions of the variance in several key variables: 53% in PRS, 6% in adaptive emotion regulation strategies, 0.9% in maladaptive emotion regulation strategies, and 52.4% in post-intervention negative emotions.

Table 5.5 presents the parameter estimates for the direct effects, while the estimates for the indirect effects are shown in **Table 5.6**.

The analysis evaluated the serial-parallel mediation model through a series of steps.

1. Experimental conditions on PRS: The first step involved regressing the independent variables representing the experimental conditions on PRS. The results showed that the environmental conditions had significant effects on PRS ($R^2 = 0.53$, $p < .001$). Specifically, the nature condition led to significantly higher PRS scores ($\beta = 0.61$, $p < .001$) compared to the urban centre (reference group), whereas the urban street condition had a significantly negative effect on PRS ($\beta = -0.21$, $p < .001$) in comparison to the urban centre.
2. PRS on emotion regulation strategies: Next, PRS, along with experimental conditions, was regressed on both adaptive ($R^2 = 0.06$, $p = .007$) and maladaptive ($R^2 = 0.01$, $p = .673$) emotion regulation strategies. The model revealed that PRS significantly predicted the use of adaptive emotion regulation strategies ($\beta = 0.35$, $p = .002$) but did not significantly predict maladaptive strategies ($p = .632$). The direct effects of the nature and urban street conditions on these strategies were also non-significant.

3. Emotion regulation strategies on post-intervention negative emotions: Finally, the effects of PRS, adaptive and maladaptive emotion regulation strategies, and experimental conditions on negative emotions post-intervention ($R^2 = 0.52$, $p < .001$) were examined. The analysis found that adaptive strategies had a significant direct negative effect on these emotions ($\beta = -0.20$, $p < .001$). In contrast, maladaptive emotion regulation strategies were positively associated with higher post-intervention negative emotions ($\beta = 0.14$, $p = .007$). Further, results showed that PRS negatively predicted post-experimental negative emotions ($\beta = -0.16$, $p = .043$). However, direct effects of the nature and urban street conditions on post-intervention negative emotions were not significant.

The study further explored the indirect effects of the experimental conditions on post-experimental negative emotions, mediated by PRS and emotion regulation strategies. The indirect effect of the nature condition on negative emotions post-intervention through PRS and adaptive strategies was significant ($\beta = -0.04$, $p = .020$). This indicates that the nature environment reduced negative emotions post-intervention by increasing PRS, which in turn enhanced the use of adaptive strategies. However, the pathway through maladaptive strategies was not significant ($p = .637$), suggesting that the nature condition did not significantly affect negative emotions through changes in maladaptive strategies. The urban street condition's indirect effect on negative emotions post-intervention through PRS and adaptive strategies approached significance ($\beta = 0.01$, $p = .050$), implying a potential, albeit weaker, mediation effect. This suggests that exposure to the urban street condition may lead to an increase in negative emotions post-intervention by diminishing perceptions of restorativeness, which might subsequently hinder the effective use of adaptive emotion regulation strategies. Also in this case, the indirect pathway through maladaptive strategies was non-significant ($p = .640$), indicating that maladaptive strategies did not play a meaningful role in mediating the effect of environmental conditions on negative emotions.

The indirect paths also revealed PRS significantly mediated the effect of the nature condition on post-intervention negative emotions (β = -0.10, p = .048), and adaptive emotion regulation strategies also significantly mediated the relationship between PRS and post-intervention negative emotions (β = -0.07, p = .016).

The total effect of the nature condition on post-intervention negative emotions was not statistically significant (β = -0.10, p = 0.116), indicating that while the indirect pathways through PRS and adaptive emotions were significant, the overall impact of nature on negative emotions did not reach significance when considering all direct and indirect effects combined. Similarly, the total effect of the urban street on post-intervention negative emotions was not statistically significant (β = 0.013, p = 0.844).

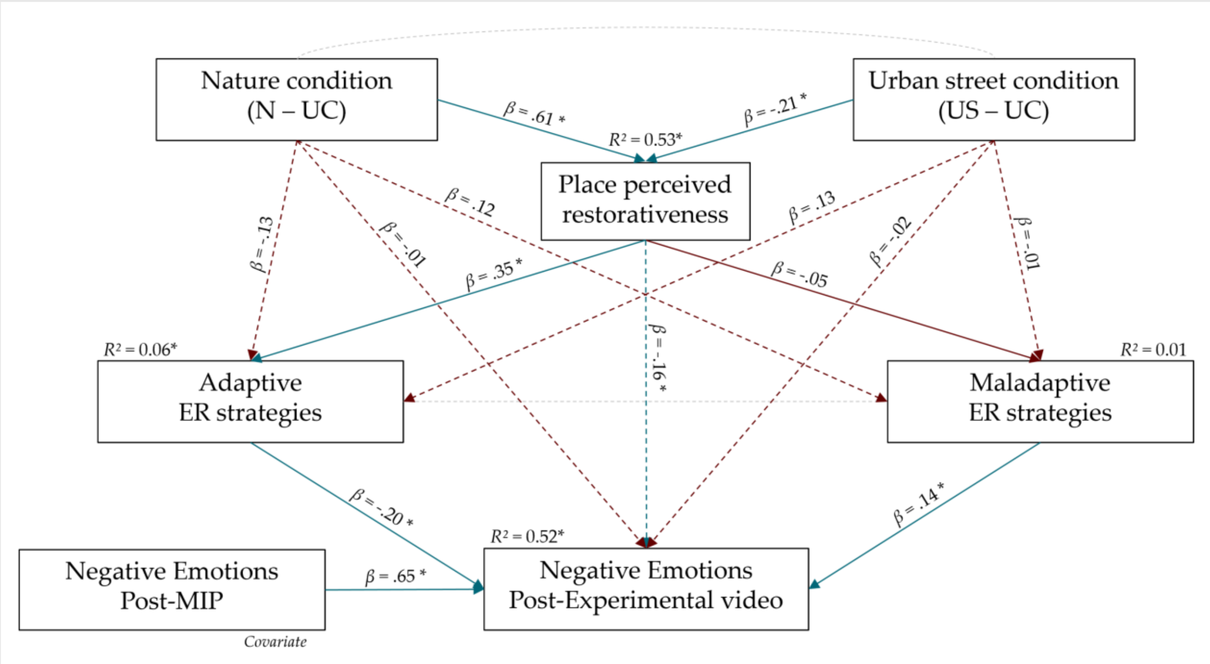
This pattern of results can be attributed to the interaction between significant indirect effects and direct effects that have opposite signs. Specifically, when indirect and direct effects oppose each other, they can result in a total effect that is not significantly different from zero, but the mediation can still be meaningful (MacKinnon et al., 2002).

Overall, the results provided partial support for the hypothesized model (**Figure 5.8**). The analyses revealed significant complete mediation of the effects of the experimental conditions on negative emotions post-intervention through PRS and adaptive emotion regulation strategies, as the direct effects of experimental conditions on negative emotions were not significant.

Specifically, exposure to natural environments led to a reduction in negative emotions post-intervention by enhancing perceptions of restorativeness, which subsequently facilitated the use of adaptive emotion regulation strategies. Similarly, a significant complete mediation was observed for the urban street condition, which increased negative emotions post-intervention by diminishing perceived restorativeness, thereby reducing the effectiveness of adaptive emotion regulation strategies. Notably, these mediation pathways were not significant for maladaptive emotion regulation strategies, suggesting that the influence of environmental conditions on negative emotions was primarily channelled through their impact on perceptions of restorativeness and adaptive strategies, rather than through maladaptive strategies.

The findings from the model suggest that the hypothesized pathway, where perceived restorativeness influences post-intervention negative emotions through adaptive emotion regulation strategies, provides a meaningful explanation of the data. Significant mediation effects were observed for both the nature and urban street conditions. However, given the correlational nature of the variables, it is not possible to definitively infer causal relationships, particularly regarding the position of the serial mediators considered in the model. While the overall fit indices for the original model were satisfactory, the RMSEA value indicates potential for refinement. This uncertainty in causal directionality motivated the exploration of alternative models to better understand the relationships among the variables and identify the most accurate representation of the data.

Figure 5.8. *Conceptual serial-parallel model (H_6) with standardized coefficients tested in Study 5, linking experimental conditions to negative emotions post-intervention with mediation through PRS and ER strategies.*



Note. Solid line: direct effects; dashed line: indirect effects; green lines: statistically significant effects; red lines: non-significant effects; *: significant effects ($p < .050$).

Table 5.5. *Parameter estimates for the direct effects of the serial-parallel mediation model (H_6) tested in Study 5*

Dependent	Predictor	*Estimate*	*SE*	*95 % Confidence Intervals*		*β*	*z*	*p*
				Lower	*Upper*			
PANAS 4 – NA	ER Adaptive	-0.007	0.002	-0.011	-0.003	-0.203	-3.691	<.001
PANAS 4 – NA	ER Maladaptive	0.006	0.002	0.002	0.010	0.143	2.676	0.007
PANAS 4 – NA	PRS	-0.045	0.022	-0.088	-0.001	-0.162	-2.019	0.043
PANAS 4 – NA	Nature	-0.021	0.135	-0.286	0.244	-0.012	-0.155	0.877
PANAS 4 – NA	Urban street	-0.025	0.111	-0.242	0.192	-0.015	-0.228	0.820
PANAS 4 – NA	PANAS 3 – NA	0.620	0.051	0.520	0.720	0.648	12.113	<.001
ER Adaptive	PRS	2.814	0.889	1.072	4.557	0.346	3.165	0.002
ER Adaptive	Nature	-6.869	5.564	-17.775	4.036	-0.134	-1.235	0.217
ER Adaptive	Urban street	6.825	4.564	-2.120	15.770	0.133	1.495	0.135
ER Maladaptive	PRS	-0.388	0.809	-1.974	1.198	-0.054	-0.479	0.632
ER Maladaptive	Nature	5.415	5.065	-4.512	15.341	0.120	1.069	0.285
ER Maladaptive	Urban street	-0.655	4.154	-8.796	7.487	-0.014	-0.158	0.875
PRS	Nature	3.807	0.383	3.056	4.558	0.605	9.937	<.001
PRS	Urban street	-1.296	0.383	-2.047	-0.546	-0.206	-3.384	<.001

Table 5.6. *Parameter estimates for the indirect effects of the serial-parallel mediation model (H_6) tested in Study 5*

Indirect paths	***Estimate***	***SE***	***95 % Confidence Intervals***		β	z	p
			Lower	***Upper***			
Nature ⇒ PRS ⇒ ER Adaptive ⇒ PANAS 4 – NA	-0.073	0.031	-0.135	-0.012	-0.042	-2.335	0.020
Nature ⇒ PRS ⇒ ER Maladaptive ⇒ PANAS 4 – NA	-0.008	0.017	-0.042	0.025	-0.005	-0.471	0.637
Nature ⇒ PRS ⇒ PANAS 4 – NA	-0.169	0.086	-0.337	-0.002	-0.098	1.979	0.048
Nature ⇒ ER Adaptive ⇒ PANAS 4 – NA	0.047	0.040	-0.032	0.126	0.027	1.171	0.242
Nature ⇒ ER Maladaptive ⇒ PANAS 4 – NA	0.030	0.030	-0.029	0.088	0.017	0.993	0.321
Urban street ⇒ PRS ⇒ ER Adaptive ⇒ PANAS 4 – NA	0.025	0.013	-0.000	0.050	0.014	1.959	0.050
Urban street ⇒ PRS ⇒ ER Maladaptive ⇒ PANAS 4 – NA	0.003	0.006	-0.009	0.014	0.002	0.467	0.640
Urban street ⇒ PRS ⇒ PANAS 4 – NA	0.058	0.033	-0.008	0.123	0.033	1.734	0.083
Urban street ⇒ ER Adaptive ⇒ PANAS 4 – NA	-0.047	0.034	-0.113	0.019	-0.027	-1.386	0.166
Urban street ⇒ ER Maladaptive ⇒ PANAS 4 – NA	-0.004	0.023	-0.048	0.041	-0.002	-0.157	0.875
PRS ⇒ ER Adaptive ⇒ PANAS 4 – NA	-0.019	0.008	-0.035	-0.004	-0.070	-2.403	0.016
PRS ⇒ ER Maladaptive ⇒ PANAS 4 – NA	-0.002	0.004	-0.011	0.007	-0.008	-0.472	0.637

Alternative Models Testing. The testing of alternative models is an essential aspect of structural equation modeling, particularly when exploring complex relationships between variables and the theoretical relationships between variables could be specified differently.

Given the moderate fit of the original model, with some indications of potential improvement (specifically in the RMSEA), it was important to investigate other plausible configurations that might better explain the relationships among place perceived restorativeness, emotion regulation strategies, and negative emotions post-intervention. Testing alternative models allows for the assessment of different causal paths, mediation effects, and moderating influences, offering a more comprehensive understanding of how environmental conditions impact emotion regulation processes.

By comparing several alternative models, this analysis aims to determine whether the original model provides the most accurate representation of the data or if another configuration offers a better explanation. The following section presents the results of the alternative models tested and their fit indices.

To evaluate the robustness of the original model and explore alternative pathways that may better explain the relationships among the variables, four alternative models were tested. Each model was developed to test different theoretical assumptions regarding the interrelationships between the experimental conditions (Nature vs. Urban Centre; Urban Street vs. Urban Centre, place perceived restorativeness (PRS), adaptive and maladaptive emotion regulation (ER) strategies, and negative emotions post-intervention (PANAS NA). Specifically, the following alternative models were tested:

1. ***Alternative Model 1***: Reversed mediation (IV: Experimental Conditions → M1 in parallel: ER Adaptive/Maladaptive strategies → M2: PRS → DV: PANAS NA post-intervention). This model reverses the mediation pathway proposed

in the original model. Instead of testing how place perceived restorativeness influences the subsequent use of emotion regulation strategies, it investigates whether ER strategies (both adaptive and maladaptive) mediate the relationship between experimental conditions and PRS, with PRS subsequently influencing negative emotions post-intervention. This model was tested to explore whether the position of the mediator could be reversed, suggesting that ER strategies might influence perceptions of restorativeness, thereby altering the effects on negative emotions. This approach challenges the assumption that PRS precedes ER strategies, offering a bidirectional perspective on these variables.

2. ***Alternative Model 2***: Parallel mediation (IV: Experimental Conditions → M1 in parallel: PRS and ER Adaptive/Maladaptive strategies in parallel → DV: PANAS NA post-intervention). In this model, it is assumed that PRS and ER strategies act as parallel mediators rather than as part of a sequential mediation chain. The model tests the possibility that both PRS and ER strategies independently mediate the effects of experimental conditions on negative emotions post-intervention. This configuration explores whether these two factors (PRS and ER strategies) have distinct but simultaneous roles in shaping emotional outcomes, suggesting that they may independently contribute to the regulation of negative emotions post-intervention rather than one influencing the other in a serial manner.

3. ***Alternative Model 3***: Moderation mediation by ER strategies (IV: Experimental Conditions → M1: PRS → DV: PANAS NA post-intervention, W: ER strategies on the effect of PRS on PANAS NA post-intervention). This model evaluates whether the relationship between PRS and negative emotion post-intervention is moderated by the type of emotion regulation strategies employed. It is hypothesized that the effectiveness of place perceived restorativeness in reducing negative emotions may depend on whether

adaptive or maladaptive emotion regulation strategies are used. Adaptive strategies are expected to strengthen the positive effects of PRS, while maladaptive strategies may attenuate or reverse these effects. This model tests the hypothesis that ER strategies influence the strength or direction of the relationship between PRS and negative emotions, offering insights into how different types of regulation may interact with environmental factors.

4. ***Alternative Model 4***: Moderated mediation by PRS (IV: Experimental Conditions → M1 in parallel: ER Adaptive/Maladaptive strategies → PANAS NA post-intervention, W: PRS on the effect of Experimental Conditions on ER strategies). This model explores whether the impact of experimental conditions on ER strategies (both adaptive and maladaptive) is moderated by place perceived restorativeness. Specifically, it tests the hypothesis that PRS influences how environmental conditions affect the use of emotion regulation strategies. In other words, the relationship between the experimental conditions (e.g., nature vs. urban settings) and the choice of adaptive or maladaptive emotion regulation strategies may vary depending on how restorative the environment is perceived to be. This model examines whether PRS strengthens or weakens the effects of the environmental conditions on emotion regulation processes, and their subsequent effects on negative emotions post-intervention.

Each model was evaluated based on several indices, including chi-square (χ^2), RMSEA, SRMR, CFI, TLI, AIC, and BIC, to assess how well they represent the data. **Table 5.7** summarizes the fit indices for the original model and all alternative models.

Table 5.7. *Model fit indices for the original (H_6) and alternative models tested in Study 5*

Model	χ^2 (df)	RMSEA (90% CI)	SRMR	CFI	TLI	AIC	BIC
Original Model	18.54 * (4)	.147 * (.084, .218)	.071	.949	.769	4081	4149
Alternative Model 1	18.76 * (1)	.148 * (.085, .219)	.072	.948	.765	4081	4149
Alternative Model 2	28.50 * (6)	.149 * (.097, .207)	.080	.920	.761	4086	4149
Alternative Model 3	309.39 * (5)	.602 * (.546, .660)	.620	.465	-.606	1021	1065
Alternative Model 4	21.29 * (7)	.110 * (.059, .165)	.056	.906	.719	3365	3427

Note. * = $p < .050$; χ^2 = chi-square; df = degree of freedom; RMSEA = Root Mean Square Error of Approximation; CI = confidence interval; SRMR = Standardized Root Mean Square Residual; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion.

The results for Alternative Model 1, which tested the reversed pathway wherein ER strategies influence perceptions of PRS and, in turn, negative emotions post-intervention, provide some support for theoretical assumptions but also highlight limitations in this pathway.

This model demonstrated a fit comparable to the original hypothesized model, indicating an acceptable but not superior fit compared to the original model. The R-squared values revealed that the model explained a substantial proportion of variance in PRS (55.9%) and NA (52.3%), while variance explained for ER adaptive and maladaptive strategies was minimal (0.5% and 0.8%, respectively).

Results highlighted some significant relationships (refer to **Appendix C.8 – Figure C.1**, **Table C.4** and **C.5** for the full parameter estimates). The direct effect of adaptive ER strategies on PRS was significant, suggesting that individuals who employ adaptive emotion regulation strategies perceive their environments as more restorative. However, the direct effect of maladaptive ER strategies on PRS was not significant, indicating that such strategies do not appear to influence perceptions of restorativeness. The direct effects of ER strategies and PRS on NA were consistent with those observed in the original model.

Despite the significant direct path from adaptive ER strategies to PRS, no significant indirect effects emerged linking ER strategies to negative emotions post-intervention through PRS.

In conclusion, Alternative Model 1 highlights that adaptive emotion regulation strategies have a significant direct effect on perceptions of restorativeness, whereas maladaptive strategies show no such influence. However, the absence of significant indirect effects through PRS suggests that this model does not robustly explain how emotion regulation strategies impact negative emotions. Overall, this reversed pathway offers limited insight into the interplay between ER, PRS, and negative emotions compared to the original hypothesized model, aligning less with prior literature where such correlations were never strongly proposed.

Alternative Model 2 which proposed a parallel mediation framework, in which PRS and ER strategies adaptive and maladaptive acted as independent mediators of the effects of experimental conditions on post-intervention negative emotions, demonstrated acceptable but not superior fit indices compared to the original model.

While the fit was comparable to the hypothesized and reversed pathway models, the slightly elevated RMSEA suggests a limitation in capturing the complexity of the relationships among the variables.

The R-squared values indicated that the model explained a substantial proportion of variance in PRS (53.3%) and negative affect (51.8%) post-intervention. However, the variance explained for adaptive and maladaptive ER strategies remained minimal (0.5% and 0.8%, respectively), suggesting that these mediators had less predictive power in this configuration.

The path analyses (**Appendix C.8** – **Figure C.2**, **Tables C.6** and **C.7**) highlighted several significant relationships. Notably, the direct effects of nature and urban street environments on the variables of interest were observed, as in the original model.

However, the direct effect of PRS on post-intervention negative emotions did not reach statistical significance ($p = .055$), which contrasts with the original model, where a significant direct effect of PRS on negative emotions was found.

In terms of emotion regulation strategies, adaptive ER strategies showed a small but significant positive effect on negative emotions post-intervention, whereas maladaptive ER strategies exerted a larger negative influence, in line with the original model.

Interestingly, the indirect pathways revealed no significant mediation effects for PRS or ER strategies. This suggests that, unlike in the original model, neither PRS nor ER strategies mediate the relationship between environmental conditions and negative emotions post-intervention in this parallel configuration.

In conclusion, Alternative Model 2 underscores the independent contributions of PRS and ER strategies to negative affect regulation. However, the absence of significant indirect effects suggests that this model provides limited insight into the mechanisms linking environmental conditions to post-intervention negative emotions, supporting the view that the hypothesized sequential mediation model better captures these dynamics.

The results from Alternative Model 3, which tested the moderation of the relationship between PRS and post-intervention negative emotions by ER strategies, showed a poor fit across all indices. In comparison to the original model, Alternative Model 3 exhibited a substantially worse fit, as reflected by the low values for CFI, TLI, and the high RMSEA. The model explained 52.7% of the variance in negative affect following the intervention and 53.3% of the variance in PRS.

Findings, detailed in **Appendix C.8** (**Figure C.3**, **Tables C.8**) showed that neither exposure to natural environments ($\beta = -0.029$, $p = 0.670$) nor urban streets ($\beta = 0.004$, $p = 0.952$) directly predicted changes in negative emotions, in line with the original proposed model. Contrary to the original model, alternative model 3 found that PRS did not exert a significant direct effect on post-intervention negative emotions (β = -

0.184, p = 0.113). The interaction terms for ER strategies did not reach statistical significance, suggesting that adaptive ER strategies did not moderate the relationship between PRS and negative emotions (β = -0.163, p = 0.063), as well as maladaptive strategies with a trend in the opposite direction (β = 0.157, p = 0.057). Finally, in line with the original model, conditions significantly influenced PRS, with Nature condition positively associated with higher PRS scores (β = 0.605, p < .001) and Urban Street negatively associated with PRS (β = -0.206, p = 0.002).

Conditional mediation analyses, presented in **Table C.9**, revealed further nuances in the indirect effects. When both adaptive and maladaptive ER strategies were lower, Nature condition had a significant negative indirect effect on affect via PRS (β = -0.229, p < .001), while Urban Street condition had a positive indirect effect (β = 0.083, p = 0.007). As adaptive ER strategies increased to mean levels, the indirect effect of the Nature condition weakened (β = -0.164, p = 0.008), as well as the indirect effect of the Urban Street condition (β = 0.060, p = 0.028). For higher levels of adaptive ER strategies, neither the Nature condition (β = -0.095, p = 0.120) nor the Urban Street condition (β = 0.035, p = 0.148) showed significant indirect effects. These patterns suggest that the restorative benefits of natural environments are most pronounced when individuals rely less on adaptive ER strategies, while urban settings exert weaker but opposite effects under similar conditions.

In conclusion, Alternative Model 3 did not provide overall support for the hypothesized moderation of the relationship between PRS and negative emotions by ER strategies, as the interaction terms for adaptive and maladaptive ER strategies failed to reach statistical significance. Furthermore, the model fit indices indicated a substantially poorer fit compared to the original proposed model, suggesting that the inclusion of ER strategies' moderation added complexity without enhancing explanatory power.

The results of Alternative Model 4, which tested the moderated mediation of perceived restorativeness on the relationship between experimental conditions and emotion regulation strategies (both adaptive and maladaptive), showed acceptable fit indices overall. Compared to the Original Model, Alternative Model 4 demonstrated a lower RMSEA and SRMR, indicating better absolute fit, as well as lower AIC and BIC values supporting its greater parsimony. However, the Original Model had higher CFI and TLI values, suggesting better relative fit. These mixed results suggest that while Alternative Model 4 introduces valuable nuance through the inclusion of PRS, its overall explanatory power relative to the original proposed model remains context-dependent.

In terms of explained variance, Alternative Model 4 accounted for 51.9% of the variance in post-intervention negative affect, slightly higher than the original model. However, the explained variance for ER strategies remained relatively low, with adaptive strategies accounting for 5.1% and maladaptive strategies for only 0.8%. This indicates that the moderating role of PRS, while potentially influential, does not substantially increase the explanatory power for ER strategies' selection.

The parameter estimates further clarify the relationships among variables (details in **Appendix C.8**: **Figure C.4** and **Tables C.10**). The direct effects of ER strategies on post-intervention negative emotions revealed that adaptive strategies had a significant negative association with this variable (β = -0.226, p < .001), while maladaptive strategies exhibited a smaller but significant positive association (β = 0.141, p = .016). Compared to the Original Model, these effects remained consistent, reinforcing the importance of ER strategies as mediators in both models. However, the interaction effects involving PRS (e.g., PRS × Nature condition) significantly influenced the selection of adaptive strategies (β = -0.579, p = .006), suggesting that perceived restorativeness moderates the extent to which the intervention with the natural environment promotes adaptive ER strategies. Such moderating effects were not present for maladaptive strategies, as PRS interactions did not reach significance for this pathway.

The indirect effects (**Tables C.11**) of experimental conditions through ER strategies on negative emotions outcomes were nuanced. While the indirect pathway from Nature condition to post-intervention negative emotions via adaptive ER strategies was significant (β = 0.131, p = .043) when moderated by PRS, other indirect effects remained non-significant. For example, the indirect effects of the Urban Street condition on negative emotions through ER strategies were not moderated by PRS, suggesting that the moderating role of PRS may be more critical in the context of natural environments.

Conditional mediation analyses (**Tables C.12**) provided additional insights into the role of PRS. At high levels of PRS (Mean +1 SD), the indirect effect of the Nature condition on post-intervention negative emotions via adaptive ER strategies became marginally stronger, although it did not reach statistical significance. This pattern aligns with the theoretical premise that highly restorative environments enhance the use of adaptive strategies, thereby reducing negative affect. In contrast, the indirect effects of maladaptive strategies remained not significant across PRS levels, indicating that PRS primarily influences adaptive processes.

In summary, Alternative Model 4 introduces a nuanced perspective by incorporating PRS as a moderator, highlighting its influence on the relationship between environmental conditions and adaptive ER strategies. While the fit indices and explained variance suggest incremental improvements over the original proposed model in capturing the complexity of these processes, the effects of PRS appear to be context-specific, primarily affecting pathways involving natural environments and adaptive strategies, whereas the hypothesized model also explained the effects of the Urban Street condition. The findings underscore the importance of perceived restorativeness in shaping emotion regulation processes and their subsequent effects on emotions, offering valuable insights for future research. However, the limited impact of PRS on maladaptive strategies and the modest improvement in overall model fit suggest that the Original Model retains its strength as a robust framework for understanding ER dynamics.

In conclusion, the testing of alternative models provided critical insights into the relationships among perceived restorativeness, emotion regulation strategies, and negative emotions post-intervention. While the original model offered a robust framework, the alternative configurations allowed for the exploration of different theoretical pathways, including reversed mediation, parallel mediation, and moderated mediation effects.

Overall, while some alternative models demonstrated incremental improvements in specific pathways, the original model remained the most comprehensive and theoretically consistent representation of the data, effectively capturing the dynamic interplay between environmental conditions, emotion regulation strategies, and emotional outcomes. These findings emphasize the central role of perceived restorativeness and adaptive strategies in explaining the emotional benefits of natural environments.

5.2.3. Discussion – Study 5

This experimental study employed a within-subject design to explore the impact of different environmental settings, depicted in 2D videos, on emotional states following a negative mood induction procedure. The research aimed to examine how exposure to nature, urban street, and urban centre environments, used as a form of intervention, influenced participants' emotional states and regulatory processes.

The study primarily aimed to explore four key aspects: the effectiveness of the video interventions in alleviating negative mood after a negative mood induction procedure, the capacity of specific environmental settings to facilitate emotional recovery and return participants to their baseline emotional states, the differences in the impact of nature versus urban environments on emotional responses and regulation, and the exploration of potential underlying mechanisms—such as perceived restorativeness and emotion regulation strategies—that might explain the differential impact of these environments on negative emotions.

Specifically, it was hypothesized that participants would experience a decrease in negative emotions after viewing the videos (H_1), and that this reduction would be most pronounced in the nature condition (H_2).

The results confirmed that the intervention led to a significant overall reduction in negative emotions from pre-test to post-test across all conditions, indicating that the video intervention was generally effective. However, when examining the specific conditions, significant decreases in negative emotions were observed in both the nature and urban centre conditions, while the urban street condition did not show a significant reduction. This finding aligns with the hypothesis, which anticipated a lower effectiveness of the intervention in the urban street condition.

Additionally, it was found that the nature condition resulted in significantly lower levels of negative emotions post-intervention compared to the urban centre condition, despite no significant differences emerged between the nature and urban street conditions. This suggests that the nature environment may be more effective in reducing negative emotions than urban environments. Moreover, the overall trend in the means further supports this interpretation, with the lowest levels of negative emotions post-intervention observed in the nature condition, followed by the urban street and urban centre conditions.

These findings, therefore, provide support for the hypothesis that exposure to natural environments may have a greater emotional benefit in reducing negative emotions than exposure to urban environments. This is consistent with prior research indicating that natural landscapes have a more pronounced beneficial effect on emotions compared to urban settings, being associated with reduced negative emotions and enhanced positive affect (e.g., McMahan & Estes, 2015; Yao et al., 2021).

Further, it was anticipated that negative emotions would return to baseline levels following the intervention, particularly in the nature condition (H_3).

The results overall supported this hypothesis, showing that negative emotions generally returned to baseline levels after the intervention. However, this effect was observed across all conditions, not solely in the nature condition as initially predicted, indicating that the effectiveness of the video intervention in restoring negative emotions to baseline levels was consistent regardless of the type of environment depicted.

The study also investigated hypotheses related to emotion regulation strategies. It was expected that participants would use more adaptive strategies (H_{4a}) and fewer maladaptive strategies (H_{4b}) in the nature condition compared to the urban conditions. Additionally, it was predicted that there would be differences between habitual (trait) and situational (state) emotion regulation strategies across the experimental conditions (H_5).

The findings did not reveal significant differences in the use of adaptive or maladaptive emotion regulation strategies across the different conditions. This suggests that the type of environment depicted in the videos did not significantly influence how participants managed their emotions.

Regarding the differences between trait and situational strategies, the results indicated that overall participants reported a lesser use of both adaptive and maladaptive strategies during the intervention (situational level) than at the trait level. Specifically, participants generally relied more on adaptive strategies in their everyday life, i.e., at the trait level, than during the intervention, i.e., at the state level, across all the conditions. Interestingly, for maladaptive strategies, participants reported lower usage in the urban conditions compared to their trait levels, whereas, unexpectedly, the nature condition did not result in significant changes in the use of maladaptive strategies.

Finally, the study explored a potential explanatory mechanism on how different environmental conditions—nature, urban centre, and urban street—affect negative emotions, focusing on the roles of place perceived restorativeness and emotion regulation strategies as serial mediators.

The results partially supported the hypotheses. Exposure to nature significantly increased perceived restorativeness, which in turn promoted the use of adaptive emotion regulation strategies, leading to reduced negative emotions. This finding aligns with previous research highlighting nature's restorative effects (e.g., Berto et al., 2014) and its role in facilitating adaptive emotion regulation (e.g., Fido et al., 2020; Bakir-Demire et al., 2021; Swami et al.., 2020; Stewart & Haaga, 2018; Sahni & Kumar, 2021). In contrast, the urban street condition was associated with decreased perceived restorativeness and less use of adaptive emotion regulation strategies, leading to higher negative emotions. This finding is consistent with prior studies suggesting that less restorative urban environments can hinder adaptive emotion regulation and increase negative emotions (e.g., Bratman et al., 2015[a]; 2015[b]; Lopes et al., 2020). Notably, the mediation effects of maladaptive strategies were not significant, suggesting that the primary pathway for environmental effects on negative emotions was through adaptive strategies rather than maladaptive ones, contrary to prior literature that suggest the impact of nature exposure on maladaptive emotion regulation strategies as well.

However, given the modest model fit of the original model and the nature of the data that does not allow for inferring causal effects between variables, four alternative models were tested to better understand the relationships between experimental conditions, perceived restorativeness, emotion regulation strategies, and negative emotions post-intervention.

Alternative Model 1 reversed the mediation pathway, with ER strategies influencing PRS and subsequently negative emotions. This model provided some support for adaptive ER strategies impacting PRS, but lacked significant indirect effects, making it less robust than the original model. Alternative Model 2 proposed parallel mediation, with both PRS and ER strategies acting independently on negative emotions, but found minimal explanatory power, especially for ER strategies. Alternative Model 3 examined the moderation of PRS by ER strategies, but showed poor fit and failed to identify significant moderating effects, indicating limited support for this interaction. Finally, Alternative Model 4 tested moderated mediation by PRS on the relationship between experimental conditions and ER strategies, showing a better fit than the original model and highlighting PRS's role in enhancing adaptive strategies in natural environments. Despite its nuanced perspective, Alternative Model 4 did not substantially outperform the original model in explaining the effects of both natural and urban conditions.

In conclusion, while the alternative models provided varying insights into the data, none offered a significantly better fit or stronger explanatory power than the original model, reinforcing its adequacy in describing the relationships among the variables.

In summary, in the study it was observed a reduction in negative emotions after participants view the videos in different experimental conditions, but any differences in the reported use of emotion regulation strategies (adaptive or maladaptive) across these conditions were found. These results can be interpreted in several ways. The absence of significant differences in emotion regulation strategies across different environmental conditions may suggest that short-term exposure to these environments was insufficient to induce meaningful changes in how participants manage their emotions. Additionally, the use of 2-D videos as the modality of exposure may not have fully captured the immersive qualities of natural or urban environments, limiting the potential impact on deeper cognitive processes like emotion regulation.

Moreover, the intervention itself may have acted as a form of distraction, reducing the need for active emotion regulation, and facilitating implicit form of emotion regulation (e.g., Braunstein et al., 2017; Gyurak et al., 2011). Watching videos, regardless of their environmental content, could have provided a disengagement strategy that temporarily alleviated emotional distress without requiring participants to consciously employ other emotion regulation strategies. For instance, the cognitive load associated with watching videos might have reduced the participants' capacity to actively engage in emotion regulation. This could explain the general lower use of both adaptive and maladaptive strategies reported at the state level compared to trait measures.

It is also possible that nature's well-documented calming effects acted as a buffer, reducing the need for active emotion regulation. Natural environments can reduce stress and promote emotional recovery without requiring conscious effort from individuals. Participants may have engaged in implicit forms of emotion regulation (e.g., Koole et al., 2015) that were not captured by self-reported measures, suggesting the presence of unconscious processes that contributed to the observed reduction in negative emotions.

It is important to note that although the study did not find significant differences in the use of emotion regulation strategies across environmental contexts, the overall reduction in negative emotions suggests that some form of emotion regulation was effective, even if it wasn't consciously recognized or reported by the participants. This reduction in negative emotions likely reflects an outcome of emotion regulation, but the processes involved may not be directly tied to the specific strategies measured in the study. Participants may have engaged in implicit or unconscious forms of emotion regulation that were not captured by the self-reported measures. These implicit processes, such as automatic shifts in attention, unconscious cognitive reappraisal, or changes in physiological arousal (e.g., lower heart rate, relaxed breathing), could reduce negative emotions without participants being fully aware of the strategies they were using or without requiring deliberate effort (Koole & Rothermund, 2011). Particularly with nature video, prior research suggests that exposure to natural environments can inherently reduce stress and negative emotions due to their restorative properties. This effect may occur independently of conscious emotion regulation strategies. Another potential explanation might be that the environments depicted in the videos may have primed participants to experience certain emotions, leading to a reduction in negative emotions that is not necessarily dependent on specific emotion regulation strategies.

Overall, these findings enhance our understanding of how different environments influence emotional well-being, particularly highlighting nature's benefits in promoting effective emotion regulation and reducing negative emotions. The study emphasizes the critical role of environmental context in shaping emotional outcomes through perceived restorativeness and adaptive regulation, underscoring the importance of considering environmental factors in interventions to improve emotional health.

Limitations and future research directions. This study provides valuable insights into the impact of different environmental settings on emotional states and emotion regulation. However, several limitations should be noted, which offer avenues for future research.

First, the use of 2D videos to represent natural and urban environments may not have fully captured the immersive qualities of these settings. The lack of significant differences in emotion regulation strategies across conditions could be partly due to this limitation. Future studies should employ more immersive methods, such as virtual reality or actual field settings, to better simulate the environmental experiences and assess their impact on emotion regulation and emotional recovery. Also, the brief exposure to environmental stimuli might not have been sufficient to elicit significant changes in emotion regulation strategies. Extended exposure times could yield more pronounced effects, particularly in natural environments, where longer interaction might enhance the restorative benefits and influence deeper cognitive and emotional processes. Future research should explore the effects of prolonged or repeated exposure to natural and urban settings on emotion regulation processes.

Second, given the controlled experimental design, the findings may not fully generalize to real-world experiences. The artificial nature of the mood induction procedure and video interventions might differ from how individuals naturally encounter and interact with these environments. Future studies should consider conducting research in naturalistic settings, for example through Ecological Momentary Assessment methods, to enhance ecological validity and generalize the findings to everyday experiences.

Third, another limitation of this study is the absence of a control condition, which makes it challenging to determine whether the observed changes in emotional states and regulation were directly attributable to the environmental stimuli in the 2D videos or if they might have resulted from other factors, such as the natural passage of time or participant expectations. Without a control group, it is difficult to disentangle the specific effects of the presented environmental videos from potential confounding variables. Future studies should incorporate a control condition to better isolate the unique contribution of the stimuli to the observed emotional outcomes and ensure that the results are not influenced by external factors.

Fourth, the study relied on self-reported measures to assess emotion regulation strategies, which may not have captured implicit or unconscious forms of emotion regulation. The reduction in negative emotions, despite the lack of reported changes in emotion regulation strategies, suggests the presence of these implicit processes. Future research should incorporate physiological or neurobiological measures, such as heart rate variability, skin conductance, or neuroimaging techniques, to investigate these unconscious processes and their role in emotional recovery. Also, while the study focused on perceived restorativeness and self-reported emotion regulation strategies, it is possible that other mediating factors, such as attention restoration or specific cognitive appraisals, were also at play. Future studies should examine a broader range of mediators and moderators to gain a more comprehensive understanding of how environmental settings influence emotional well-being.

Further, the study's sample may not represent the broader population, as individual differences in personality, cultural background, and prior experiences with nature could influence responses to environmental stimuli. Future research should explore how these factors might moderate the effects of environmental settings on emotion regulation and emotional outcomes.

Moreover, it should be noted that the model fit of the proposed explanatory model was not optimal, and although alternative models were tested and did not prove to be better, future research should explore additional variables and more refined modeling techniques, as well as bigger samples, to better capture the complexities of the relationships between the examined variables.

In conclusion, while this study contributes to our understanding of how different environments influence emotional outcomes, it also highlights the need for further research to address these limitations. By exploring these directions, future studies can build on these findings and provide more robust evidence on the role of environmental settings in promoting effective emotion regulation.

5.3. Study 6 — A between-subject study using 360-degree virtual reality scenarios

Building on the findings from the first experimental study (Study 5), a second empirical research was designed to more deeply explore the effects of different environmental contexts—natural and urban—on emotions and emotion regulation processes. Unlike Study 5, which used a within-subject design, this second experiment adopted a between-subjects approach, retaining the mood induction procedure to compare the effects across different experimental groups. This design choice was made due to the logistical challenges of having participants return to the laboratory facility multiple times to complete all experimental conditions.

With growing interest in innovative methods for nature exposure, particularly virtual reality (VR), and the limited evidence available regarding the impact of VR environments on emotion regulation, this follow-up study employed VR technology as the medium for the intervention, to create a more immersive experience.

Recently, VR has emerged as a potentially powerful tool for enhancing emotion regulation, improving individuals' ability to regulate negative and positive emotions, also in clinical practice (for a review: Colombo et al., 2021). As highlighted in Review 2 (**Chapter 3**), current research indicates that VR simulations of natural environments generally yield beneficial effects on emotional outcomes, such as improving positive affect (e.g., Valtchanov et al., 2010; Schutte et al., 2017; Huang et al., 2020; Newman et al., 2022), reducing negative affect (e.g., Emamjomeh et al., 2020; O'Meara et al., 2020; Chan et al., 2021), and enhancing restoration and relaxation (e.g., Gerber et al., 2019; Yu et al., 2018, 2020; Schutte et al., 2017).

Additionally, studies have highlighted the benefits of VR nature for well-being (Schebella et al., 2020), stress reduction (e.g., Valtchanov et al., 2010; Hedblom et al., 2019), and even improvements in depression symptoms and creativity (Yu et al., 2018, 2020; Palanica et al., 2019). On the other hand, VR built environments have been found to negatively affect positive affect, restoration, stress, and fatigue (e.g., Schebella et al., 2020; Yu et al., 2020; Mostajeran et al., 2021), though some studies have reported mixed results, showing that VR urban settings can also yield positive effects on negative affect and restoration (Valtchanov et al., 2010; Li et al., 2021).

Despite these findings, as pointed out in Review 1 (**Chapter 2**), research on the specific effects of VR-based natural and urban environments on emotion regulation processes and strategies remains limited. A recent study by Browning and colleagues (2023) found that participants who engaged with VR nature scenarios over several weeks showed a significant decrease in worry post-intervention, although no changes in rumination were observed. Similarly, Theodorou and colleagues (2023) highlighted the moderating role of cognitive reappraisal in the relationship between natural environments and subjective vitality.

These initial findings suggest a promising path for understanding how immersive VR environments influence emotion regulation, yet much remains to be explored, particularly regarding the nuances of different emotion regulation strategies in natural versus urban virtual settings. While the potential of virtual environments—especially natural ones—in shaping emotional states and regulation processes is marked, there remains a need for further exploration into how specific environmental contexts shape these effects. The present study seeks to advance this understanding by investigating the impact of VR natural and urban environments on emotional recovery and emotion regulation strategies.

Aim and hypotheses. The general goal of the study was to evaluate the effects of exploring virtual reality scenarios representing different environmental settings (natural environments and an urban environment) on emotional states (with a focus on negative emotions) and the use of emotion regulation strategies, following the evocation of negative emotions in participants.

Additionally, the study aimed to explore potential differences between virtual reality scenarios in terms of location selection for emotion regulation and perceived restorativeness.

Concerning the first aim, building on prior research that highlights the emotional benefits of nature exposure, the following hypotheses were formulated similarly to the previous experimental study (Study 5):

H_1) *Effect of the intervention on negative emotions*: It was hypothesized a significant effect of the intervention which would result in a decrease in negative emotions across all conditions, with participants reporting lower levels of negative emotions in the post-test compared to the pre-test, attributed to the VR experience with the environmental scenarios.

H_2) *Interaction effect between intervention and experimental group on negative emotions*: It was expected an interaction effect between the intervention and the experimental group on negative emotions, such that the extent of the decrease in negative emotions from pre-test to post-test would vary depending on the specific experimental condition, with lower negative emotions in the post-test for participants in the experimental groups with VR natural scenarios and higher levels of negative emotions in the post-test for participants in the experimental group with the VR urban scenario.

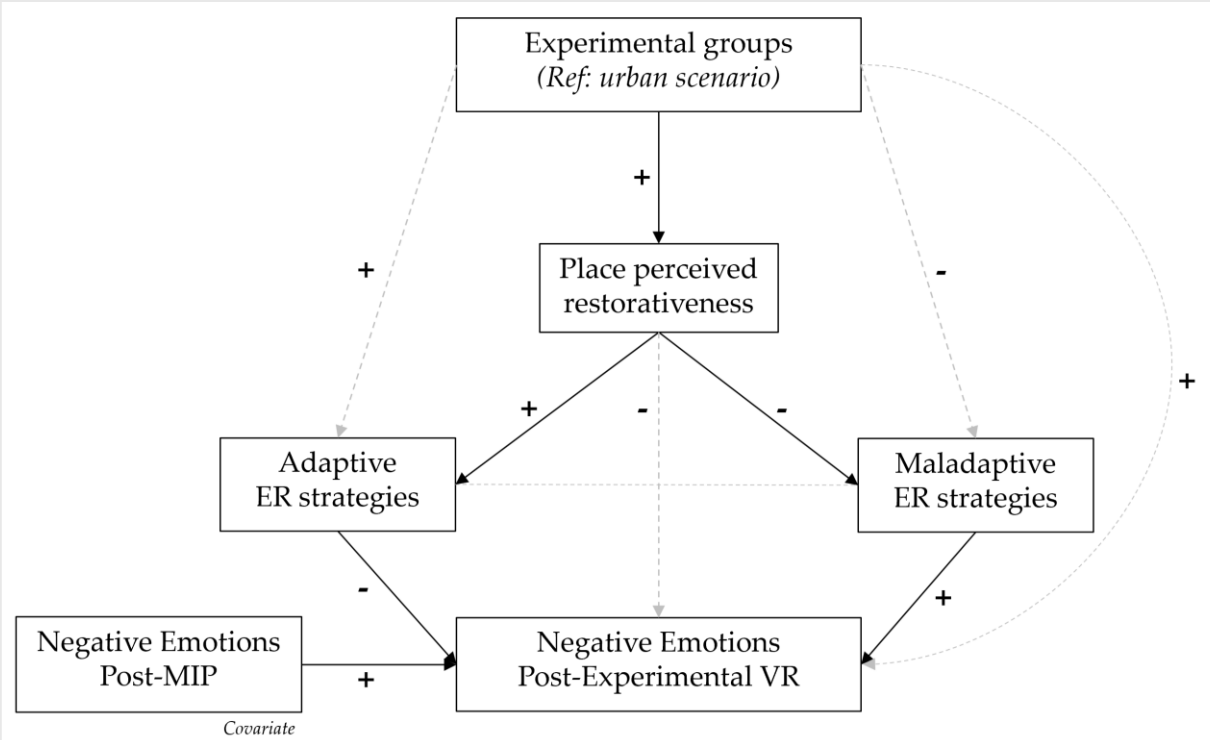
H_3) *Return to baseline of negative emotions:* It was posited that, following the intervention, negative emotions would return to baseline levels observed before the mood induction procedure (pre-MIP). Consequently, no significant differences are expected between negative emotions measured pre-MIP and those measured post-intervention. This effect was expected to be more pronounced for participants in the experimental groups with VR natural scenarios, where a return to baseline levels of negative emotions was anticipated. In contrast, for those in the experimental group with the VR urban scenario, negative emotions were predicted to remain elevated relative to baseline, indicating a lesser degree of emotional recovery.

H_4) *Effect of the experimental group on emotion regulation strategies*: It was hypothesized that participants in the experimental groups with VR natural scenarios would report greater use of adaptive emotion regulation strategies (H_{4a}) and less use of maladaptive strategies (H_{4b}) compared to those in the experimental group with the VR urban scenario.

H_5) *Differences between trait and state emotion regulation strategies*: It was expected that there would be observable differences in the use of emotion regulation strategies between trait (habitual) and state (situational) levels across the experimental conditions. Specifically, it was expected that participants might engage in different emotion regulation strategies during the experimental scenarios (state) compared to their general, everyday strategies (trait), with these differences potentially varying based on experimental groups.

H_6) *Serial-parallel mediation model with PRS and ER strategies*: Similarly to Study 5, it was hypothesized a serial-parallel mediation model to explain the effects of the experimental groups on negative emotions post-intervention. Specifically, the experimental groups (IV), with the urban environment scenario as the reference group, was expected to influence the perception of the place's restorativeness (M_1). This perception, in turn, was anticipated to impact the use of adaptive and maladaptive emotion regulation strategies (M_2) in parallel. These strategies were then expected to affect the level of negative emotions experienced post-intervention (DV). **Figure 5.9** shows a simplified representation of the expected serial-parallel mediation model. It was anticipated that participants in the experimental groups with VR natural scenarios would perceive the place as more restorative, leading to an increased use of adaptive ER strategies and a decreased use of maladaptive strategies. This process was expected to result in fewer negative emotions post-intervention. Conversely, participants in the experimental group with the VR urban scenario were expected to perceive the environment as less restorative, which would lead to a reduced use of adaptive ER strategies and an increased use of maladaptive strategies, ultimately resulting in higher levels of negative emotions.

Figure 5.9. *Simplified conceptual model with hypothesized serial-parallel mediation paths (H_6) tested in Study 6, linking experimental group to negative emotions post-intervention with mediation through PRS and ER strategies.*

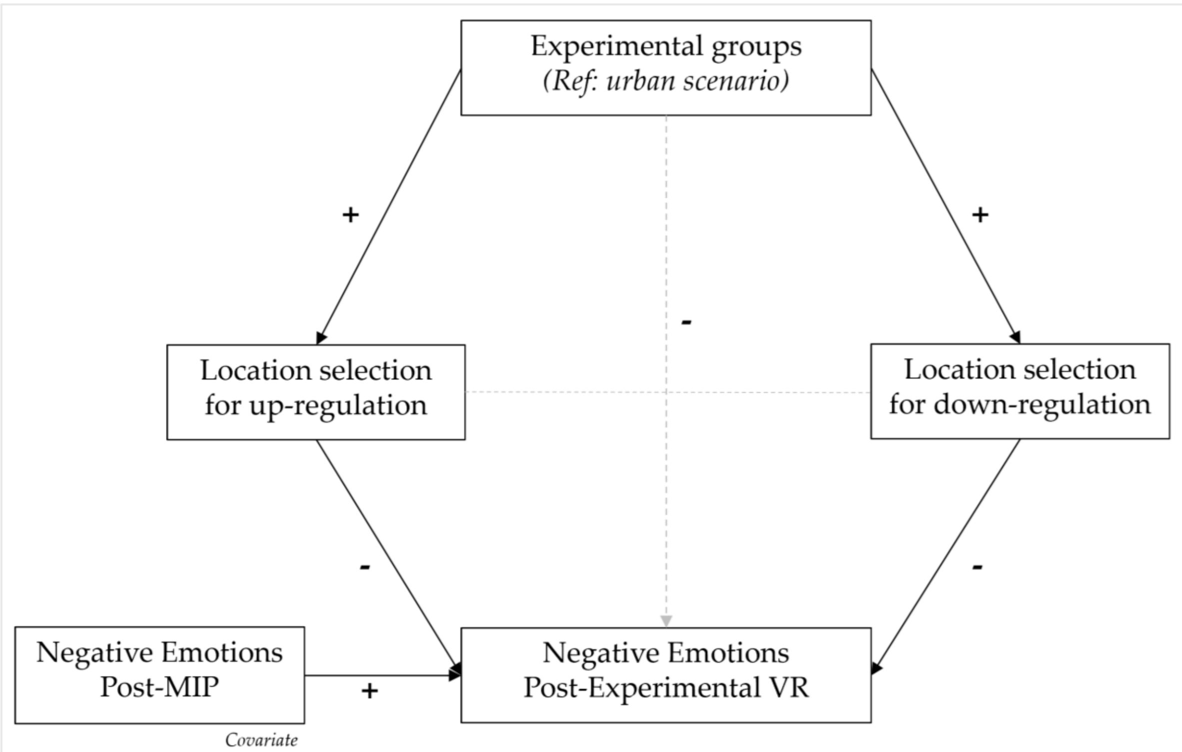


Note. Solid line: direct effects; dashed line: indirect effects;
+ : expected positive association; - : expected negative association.

H_7) *Differences between experimental groups in terms of Location Selection:* Based on the literature indicating that natural environments are generally more effective in promoting emotional well-being compared to urban settings, it was hypothesized that participants would prefer natural environments over urban environments for up-regulation and down-regulation. Specifically, it was expected that participants in the experimental groups with VR natural scenarios would rate these environments as more suitable location for up-regulation (H_{7a}) and down-regulation (H_{7b}) compared to participants in the experimental group with the VR urban environment. However, no specific hypotheses were made regarding differences in preference among the various experimental groups with VR natural scenarios.

H8) *Parallel mediation model with Location Selection variables:* Building on this premise, it was hypothesized that location selection for up-regulation and down-regulation would function as parallel mediators in the relationship between the experimental groups and negative emotions following the intervention (**Figure 5.10**). Similarly to the model tested in Study 4, it was anticipated that experimental groups exposed to VR natural scenarios would lead to higher scores for location selection aimed at both up-regulation and down-regulation, compared to the experimental group with the VR urban scenario. This, in turn, was expected to result in low negative emotions post-intervention in the experimental groups with VR natural scenarios, and higher levels in the experimental group with the VR urban scenario.

Figure 5.10. *Simplified conceptual model with hypothesized parallel mediation paths (H8) tested in Study 6, linking experimental groups to negative emotions post-intervention with mediation through LS variables.*



Note. Solid line: direct effects; dashed line: indirect effects;
+ : expected positive association; - : expected negative association.

For the second objective of the study, which explores potential differences between virtual scenarios in terms of preferences, location selection for emotion regulation and perceived restorativeness, the focus will be on the second phase of the experimental procedure. This involves comparing participants' evaluations of all VR scenarios, encompassing both natural and urban environments.

Based on this, the following hypotheses were formulated:

H_9) *Preferences among scenarios*: It was hypothesized that there would be a significant difference in the preferences for VR scenarios, with participants showing a lower selection frequency for the urban scenario compared to natural environments across their overall scenario choices (H_{9a}), preferences for managing negative emotions (H_{9b}), and restoring concentration (H_{9c}).

H_{10}) *Differences across experimental scenarios in terms of Location Selection:* The VR scenarios with natural environments were expected to be perceived as more suitable location for emotion regulation, both up-regulation (H_{10a}) and down-regulation (H_{10b}), compared to the VR scenario with the urban environment.

H_{11}) *Differences across experimental scenarios in terms of place perceived restorativeness:* The VR scenarios with natural environments were anticipated to be perceived as more restorative than the VR scenario with the urban environment.

5.3.1. Method – Study 6

This second research consisted of an experimental study designed in two main phases. The first phase employed a mixed design where participants were randomly assigned to one of five experimental groups (between-subject factor: arctic, island, forest, flowery field, urban) following a negative emotional induction procedure, as in the previous study. The study evaluated changes in emotional states before and after the experimental condition (i.e., the intervention). Additionally, an initial measurement of emotions was conducted before the emotional induction procedure to assess the effectiveness of the manipulation (i.e., manipulation check). This resulted in three time points for measuring emotional states in total (within-subject factor: pre-MIP vs. post-MIP/pre-condition vs. post-condition).

The second phase involved the exploration and evaluation of the four remaining VR scenarios not employed for the intervention in the first phase. To eliminate potential effects due to the order of stimuli in this phase, the order of scenario exploration was randomized (counterbalanced within-subjects design).

Sample. Data collection involved a sample of Italian young adults aged between 18 and 35. An *a priori* power analysis was performed using G*Power software (version 3.1.9.6) to determine the minimum total sample size required for the study to test the main hypotheses, related to the ANOVA test (repeated measures, within-between interaction). The results indicated that the required sample size to achieve 80% power to detect a medium effect (effect size, $f = 0.25$), with a significance level of $\alpha \leq 0.05$ and a test power of $1\text{-}\beta \geq 0.80$, was $N = 45$ (number of groups: 5; number of measurements: 3; correlations between repeated measures: 0.5). The effect size was determined using general guidelines (Cohen, 1988) to detect a medium effect, as the literature review on the topic did not reveal comparable studies with similar methodologies, and no pilot study of the entire procedure was conducted.

Regarding the recruitment methods, potential participants were invited to complete a recruitment questionnaire implemented and completed via the online platform *Qualtrics*. This questionnaire was distributed through the snowball sampling technique and within specific platforms to reach potential participants (e.g., *Classroom*, *LinkedIn*, *Facebook*) by sharing a flyer with the study's information.

To participate in the study, participants had to meet the following inclusion criteria: (1) consent to participate in the study; (2) provide consent for data processing; (3) be aged between 18 and 35; (4) be fluent in Italian; (5) express willingness to participate in the laboratory experiment; (6) not have significant issues that could hinder the use of the virtual reality device (e.g., problems encountered in previous experiences with virtual reality, physical or psychological health conditions, medications that could interact with the experience, uncorrected visual impairments).

Consequently, participants were excluded from the study if: (1) they did not consent to participate; (2) they did not agree to data processing; (3) they were younger than 18 or older than 35; (4) they were not fluent in Italian; (5) they were unwilling to participate in the laboratory experiment; (6) they indicated significant issues that could limit or complicate the use of the virtual reality device (e.g., problems encountered in previous experiences with virtual reality, physical or psychological health conditions, medications that could interact with the virtual reality experience or influence participation in the study, uncorrected visual impairments).

A total of 115 participants began filling out the recruitment survey. However, 26 participants did not complete the full survey and, as a result, did not provide contact information, which precluded scheduling them for an experimental session. An additional 10 participants were unavailable for scheduling during the established dates and times. Thus, a total of 79 participants effectively participated in the study, fully completing the recruitment survey and took part to the experimental session.

The research experiment was carried out with a final sample of 79 participants (54 women and 25 men), aged between 18 and 31 years, with a mean age of 25.2 years ($SD = 3.03$). Each experimental group consisted of 16 participants (5 male participants in each group), except for the arctic condition, which had 15 participants (4 male participants). **Table 5.8** shows the age descriptive statistics by experimental group.

The majority of participants were students (49.4%), 20.3% were student-workers, and 30.4% were workers. In terms of educational attainment at the time of the survey, 36.7% of participants held a Bachelor’s Degree, 30.4% had completed a Master’s Degree, 21.5% had finished High school, 8.9% had obtained other postgraduate qualifications, and a small proportion (2.5%) had a middle school diploma.

Table 5.8. *Age descriptive statistics by experimental group (Study 6)*

Experimental groups	*Mean*	*SD*	*Minimum*	*Maximum*
Arctic	25.2	3.19	18	30
Forest	25.1	2.95	20	29
Flowery field	25.4	2.80	19	30
Island	24.9	3.72	19	31
Urban	25.4	2.73	19	31

Procedure. The study was approved by the Ethics Committee for Transdisciplinary Research of Sapienza University of Rome (ID: 217/2024), and all participants provided informed consent before participation.

The study procedure involved several phases (**Figure 5.11**).

First, participants were asked to complete a recruitment questionnaire, which included questions related to personal socio-demographic information (i.e., age, gender, occupation, education), experience with nature (i.e., nature connectedness, frequency, and duration of visits to natural environments), and trait disposition in the use of 12 emotion regulation strategies, reflecting a general tendency to use certain strategies. They were also asked about potential issues that could interfere with the use of virtual reality (e.g., problems encountered in previous VR experiences, physical or psychological health conditions, medications that might interact with the VR experience or affect participation in the study, uncorrected vision problems).

At this stage, participants were asked to read and sign the informed consent form, which clarified the main objectives of the study and the subsequent phases of research in which they would be involved. Based on the contact information provided during the recruitment phase, participants were later contacted to schedule the day of their participation in the laboratory experiment. Data were collected between approximately May 6 and June 15, 2024.

The laboratory experiment consisted of two main phases: 1) intervention, and 2) exploration and evaluation of the other VR scenarios.

In the first phase, an emotion induction procedure was used to evaluate the emotion regulation strategies that participants would naturally adopt to cope with negative life situations, as implemented in the prior experimental study.

To assess the effectiveness of this procedure, a baseline questionnaire (PANAS 1) was administered to evaluate emotional states before the procedure. The emotion induction procedure then followed. Specifically, two tools were used:

- Viewing of a short video (a film excerpt of approximately 2 minutes),
- Recalling and describing a personal negative event (5 minutes).

The procedure order was consistent for all participants, as the results of the first experimental study indicated no significant effects related to the sequence of presentation. At the end of the mood induction procedure, participants were administered the emotional states questionnaire (PANAS 2) again to assess whether the procedure effectively increased the experience of negative emotional states (manipulation check).

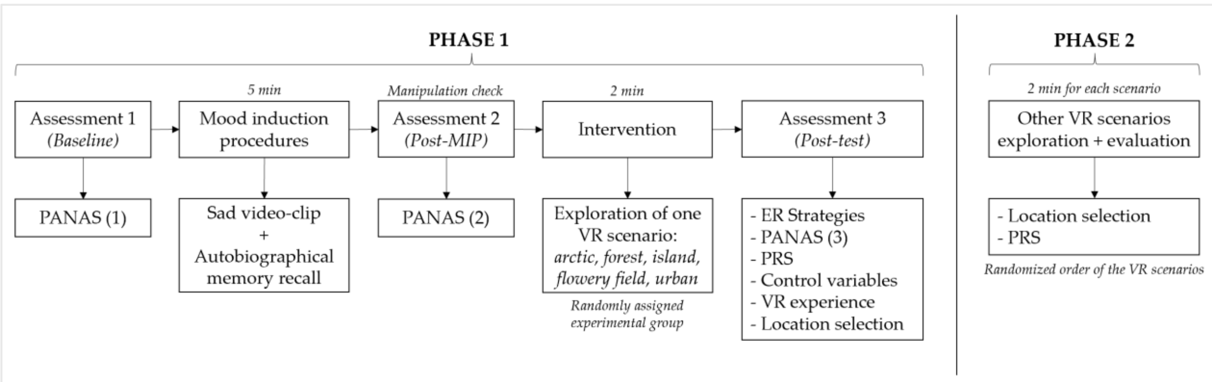
Next, the intervention was introduced, where participants explored the first virtual reality scenario according to the experimental group to which they were randomly assigned: 1) arctic, 2) island, 3) forest, 4) flowery field, 5) urban. The scenario exploration lasted 2 minutes, during which the participant sat on a swivel chair and was instructed to explore the 360° scenario by looking in all directions.

After the exploration, participants were asked to respond to items regarding their emotions (PANAS 3) and the extent to which they used various emotion regulation strategies. Additional questions were posed about the environment represented in the explored scenario, perceptions of the environment in terms of restorativeness and location selection for emotion regulation, the experience with the virtual reality device in terms of sense of presence and realism, and any symptoms of virtual sickness.

After completing the questionnaire, participants proceeded to the second phase of the study, where they explored the remaining four scenarios (i.e., those not explored in the experimental condition, presented in a random order). The exploration of each scenario lasted 2 minutes and was conducted in the same manner as the experimental condition (swivel chair). After each exploration, participants completed a brief questionnaire, evaluating the explored environment in terms of perceived restorativeness and location choice for emotion regulation. Following the exploration of all scenarios, participants were asked to indicate their preferred scenario and were then presented with a debriefing document that outlined the study's objectives and methodologies.

All questionnaires, along with the mood induction procedure, were administered on a laboratory computer.

Figure 5.11. *Diagram of the experimental procedure adopted in Study 6, with a factorial design 5 (experimental groups) x 3 (emotions assessment)*



Mood Induction Procedure (MIP). The mood induction procedure involved the same two tasks as in the first experimental study: watching a sad video and recalling a negative autobiographical memory. In this study, since there was only one experimental session, a single video was used—the one most strongly associated with the emotion of sadness (*Million Dollar Baby*, 2004). Additionally, the order of tasks was consistent for all participants: the film excerpt was shown first, followed by the recall of a personal memory. This sequence ensured that the participants' last thoughts before exploring the experimental scenarios were focused on their personal memories, allowing them to reflect on these while engaging with the scenarios.

Measures. For the present study, the same measurement instruments were employed as in the first experimental study, along with additional ones concerning emotion regulation strategies and the VR experience.

The following measurement tools were used, consistent with Study 5:

- *Positive and Negative Affect Schedule* (PANAS, Watson et al., 1988; Italian validated version: Terraciano et al., 2003): including 10 items about negative emotions (α = .851 to .907 across experimental groups and time points) and 10 measuring positive emotions (α = .871 to .914 across experimental groups and time points). Only the negative affect component was considered in the study.

- *Emotion Regulation Strategies*: including 4 maladaptive strategies (i.e., rumination, expressive suppression, cognitive avoidance, denial; α = .760) and 6 adaptive strategies (i.e., reappraisal, control problem-solving, emotional expression, positive reminiscence, positive thinking; α = .767).

- *Perceived Restorativeness Scale* (PRS, Hartig et al., 1997; Italian validated version: Pasini et al., 2009; α = .759 to .888 across experimental scenarios).

- *Environmental Characteristics* (items adapted from Aletta et al., 2019): In this study, due to the absence of scenarios involving historical environments, only the items related to natural (α = .791) and urban (α = .853) elements were considered as manipulation check of the VR scenarios.

- *Emotional reactions* (items adapted from the Self-Assessment Manikin Scale, Bradley & Lang, 1994) in terms of pleasantness (α = .840) and relaxation (α = .907).

Additionally, the following measurement tools were added:

- *State Emotion Regulation Inventory* (SERI; Katz et al., 2017): This inventory consists of 16 items (see **Appendix C.9**) that assess four different emotion regulation strategies, two of which are adaptive (i.e., acceptance, reappraisal) and two are maladaptive (i.e., distraction, brooding rumination). Each item was rated using a 7-point scale (1 = strongly disagree; 7 = strongly agree). The mean score for each factor was then calculated (acceptance, α = .860; reappraisal, α = .845; distraction, α = .898; brooding, α = .814). This measure was employed as a trait strategy in the recruitment questionnaire and as a state strategy during the experimental phase, with adjustments made to suit the specific context of each application.

- *Difficulties in Emotion Regulation Scale* (DERS; Gratz & Roemer, 2004; Italian validated version: Sighinolfi et al., 2010): The scale measures an individual's difficulties in emotion regulation (see **Appendix C.10**). It evaluates various aspects of emotional dysregulation across several dimensions. The short version of the scale includes four dimensions: lack of emotional awareness (i.e., limited awareness or inattention to emotional responses), lack of emotional clarity (i.e., reflects the extent to which an individual knows and is clear about his or her emotions), limited access to emotion regulation strategies (i.e., the ability to use flexible emotional regulation strategies to modulate emotional responses), nonacceptance of emotional responses (i.e., tendency to have a negative secondary or non-accepting reaction to one's own distress). Three items were selected for each of the four factors of the scale and the mean score for each factor was then calculated (awareness, α = .784; clarity, α = .788; modulate, α = .768; non-acceptance, α = .894). The items were rated on a 5-point scale (1 = almost never; 5 = almost always). Scores are calculated for each of the subscales, with higher scores suggest greater problems with emotion regulation. This measure was utilized at the trait level in the recruitment questionnaire and as state level during the experimental phase, with modifications tailored to the applied context.

- *Location Selection Scale* (Italian applied version of the scale presented in **Chapter 4**): Participants were asked to reflect on the possibility of visiting a place like the one explored in virtual reality to manage their emotions and to rate their level of agreement or disagreement with 8 statements on a 7-point scale (1 = completely disagree; 7 = completely agree). Scores were calculated according to the two-factors of location selection for up- and down-regulation.

- *Video/Audio Quality of VR Scenarios* (*ad hoc* item): Participants were asked to evaluate their satisfaction with the graphical quality of the virtual reality experience, specifically in terms of video and audio, on a 7-point response scale (0 = not at all; 6 = very much). This item was used as a control variable for the VR experience.

- *VR-Related Symptoms* (Virtual Reality Sickness Questionnaire; VRSQ, Kim et al., 2018; Italian version used by Latini et al., 2021): Participants were asked to assess the presence of symptoms related to the virtual reality experience (see **Appendix C.11**, in terms of oculomotor (α = .629) and disorientation symptoms (α = .732), on a 5-point scale (0 = not at all; 4 = very much). This measure was used as a control variable for the VR experience.

- *Perception of Immersiveness and Sense of Presence in VR* (Ingroup Presence Questionnaire; IPQ, Schubert et al., 2001): The virtual reality experience was evaluated by participants in terms of perception of realism (α = .742) and sense of presence (α = .666), expressing their level of agreement with 12 statements (see **Appendix C.12**) on a 7-point scale (0 = completely disagree; 6 = completely agree). This measure was used as a control variable for the VR experience, considering the mean scores of the two factors.

Reliability analyses were conducted for the measurement tools employed, particularly for scales where the average score of items was considered. *Cronbach's α* coefficient was utilized to ensure that the scales demonstrated adequate internal consistency and reliability. For the complete list of the scales' reliability analyses, refer to the **Appendix C.13**.

Virtual Scenarios. For the experimental stimuli adopted for the intervention, virtual scenarios previously developed by IDEGO Digital Psychology were used. This company has promoted several projects in the fields of e-Health and virtual reality to support the practice of psychologists, psychotherapists, and other professionals working in the field of mental health, psychotherapeutic practice, and psychological and neurological rehabilitation.

Specifically, the four natural scenarios (arctic, **Figure 5.12**; forest, **Figure 5.13**; island, **Figure 5.14**; flowery field, **Figure 5.15**) were created considering the ten components of the Biophilic Quality Index (sunlight, colour, gravity, fractals, curves, detail, water, life, nature representation, and organized complexity), elements associated with relaxation and recovery from activation as a consequence of the restorative environment. For the urban environment, a scenario representing a metropolitan setting with skyscrapers and cars was used (**Figure 5.16**).

The virtual scenarios were enriched with a relevant sound component, reproducing the characteristic sounds of the natural and urban environments represented. This sound integration was designed to further enhance the immersion and realism of the virtual experiences, allowing participants to perceive the distinctive acoustic features of each environment more fully.

Figure 5.12. *Representative view of the VR Arctic scenario*

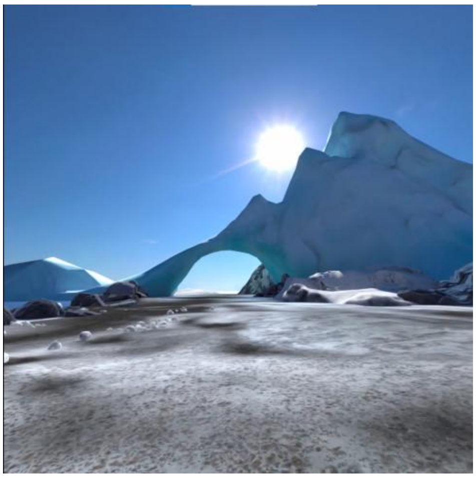


Figure 5.13. *Representative view of the VR Forest scenario*

Figure 5.14. *Representative view of the VR Island scenario*

Figure 5.15. *Representative view of the VR Flowery field scenario*

Figure 5.16. *Representative view of the VR Urban scenario*

Analytic strategies. Analyses were conducted following a methodology similar to that of the previous experimental study. Statistical analyses were performed using Jamovi (version 2.5.6).

Descriptive statistics were used to present all variables. For data with a normal distribution, the mean and standard deviation (*SD*) were reported. Binary and categorical variables, such as participant information (e.g., age and gender), were summarized using frequencies and percentages.

One-way ANOVA was applied to perform manipulation checks and to examine control variables in relation to the experimental virtual scenarios. This analysis aimed to evaluate potential differences between scenarios in terms of natural *versus* urban elements, sense of presence and realism, virtual sickness, and the quality of video and audio. Repeated measures ANOVA was used to check the manipulation of the mood induction procedures. The objective was to determine whether the mood induction procedure effectively increased participants' negative emotions by comparing PANAS scores from two different times (PANAS 1 and PANAS 2). Further, content and thematic analyses were conducted on the descriptions of memories related to the negative event reported by participants, to identify and summarize the main recurring themes related to the negative event described by participants (**Appendix C.14**).

A repeated measures ANOVA was performed to analyse changes in emotional states following the experimental condition. This analysis compared the five experimental groups (Arctic, Island, Forest, Countryside, Urban) regarding changes in participants' emotional states from before (post-MIP) to after the experimental condition. The analysis addressed hypotheses H_1 and H_2 and aimed to assess the main effect of the intervention (i.e., to identify significant changes in negative emotions from pre- to post-test), and the interaction effect of the intervention and the experimental group, to examine whether the reduction in negative emotions from pre- to post-test varied significantly across the experimental groups.

Moreover, a repeated measures ANOVA was conducted to test whether negative emotions in the post-intervention would return to baseline levels observed before the mood induction procedure (H_3), by comparing PANAS scores at two different times (PANAS 1 and PANAS 3).

Further, one-way ANOVAs were conducted to explore potential differences across experimental groups in the use of emotion regulation strategies, in order to assess hypothesis H_4. Also, a repeated measures ANOVA was used to compare emotion regulation strategies reported as traits versus those reported after the experimental condition, aiming to test hypothesis H_5. This analysis assessed the main effect of time, to identify overall significant differences between emotion regulation strategies reported as traits and those as states after the experimental condition, as well as the interaction effect of time and group, to determine if variations in emotion regulation strategies as trait and as state differed significantly between the experimental groups.

Since the primary focus of the above analyses is on specific group comparisons, post-hoc comparisons are necessary to provide more detailed insights. As noted by Hsu (1996) and Midway et al. (2020), an ANOVA only tests for overall differences among group levels, without specifying where those differences lie. Therefore, post-hoc comparisons allow for a deeper exploration of group-level differences and the interaction with changes in negative emotions across the time-points that may not be captured by the omnibus test, ensuring a more comprehensive understanding of the data. This approach is especially important when the interaction effect is non-significant, as it can still reveal meaningful patterns that are not detectable through the overall effect.

To test the conceptual model of H_6, a Structural Equation Modeling (SEM) analysis was conducted to test the hypothesized relationships among the variables, including the mediating role of place perceived restorativeness and emotion regulation strategies on negative emotions post-experimental condition. To explore the mediating effects of PRS and emotion regulation strategies, both direct and indirect effects were examined. The specified model was estimated using *Maximum Likelihood Estimation* (MLE) and the significance of the indirect effects was tested using bootstrapping procedures. As in Study 5, four alternative models were then tested to further explore these associations and evaluate the model fit through several goodness-of-fit indices, using the same cut-off guidelines described in **Section 5.2.1**.

Finally, a one-way ANOVA was conducted to examine potential differences in location selection for emotion regulation across the virtual environments. This analysis aimed to test the hypothesis (H_7) that natural environments would be rated as more suitable for emotion regulation compared to the urban environment. Finally, a SEM analysis was performed to verify the potential mediating roles of location selection for both up-regulation and down-regulation in the effects of experimental conditions on negative emotions following the intervention (H_8).

Chi-square tests were conducted to analyse the differences in selection frequencies among the VR scenarios, in terms of participants' overall preference, managing negative emotions, and restoring concentration, focusing on the lower preference for the urban scenario compared to natural environments (H_9).

Additionally, repeated measures ANOVAs were conducted on the data collected in Phase 2, in order to deeper understanding potential similarities and differences between the experimental scenarios, in terms of location selection for up- and down-regulation (H_{10}) and place perceived restorativeness (H_{11}).

5.3.2. Results – Study 6

Manipulation check and control variables – VR Scenarios.

Table 5.9 provides the descriptive analyses (mean and standard deviation) of the manipulation check and control variables associated with the virtual scenarios across the five experimental groups.

Table 5.9. *Descriptive statistics for manipulation check and control variables across experimental groups: means and standard deviations in parentheses (Study 6)*

Variables	Experimental groups				
	Arctic	*Forest*	*Island*	*Flowery field*	*Urban*
Natural elements	3.63 (1.09)	5.13 (1.04)	5.16 (0.80)	3.89 (0.91)	0.92 (1.09)
Urban elements	0.00 (0.00)	0.20 (0.68)	0.25 (0.30)	0.34 (0.68)	4.98 (0.56)
IPQ – presence	4.55 (1.09)	3.86 (1.34)	3.81 (1.25)	3.67 (1.45)	3.48 (1.48)
IPQ – realism	3.98 (1.03)	3.71 (1.64)	2.63 (1.45)	2.85 (1.61)	3.13 (1.24)
Virtual sickness	0.19 (0.23)	0.16 (0.16)	0.22 (0.36)	0.23 (0.30)	0.23 (0.32)
VR quality	5.00 (1.07)	4.94 (1.00)	4.44 (1.26)	4.19 (1.83)	4.50 (1.03)

One-way ANOVA analyses were conducted for each of the manipulation check variables to assess potential differences in the perception of urban and natural elements across the different VR experimental scenarios. It was hypothesized that participants would perceive a higher level of natural elements in the VR scenarios representing natural environments (arctic, island, forest, flowery field) compared to the urban environment scenario. Conversely, it was expected that the perceived level of urban elements would be lower in the VR scenarios representing natural environments than in the VR urban scenario.

The analysis revealed a statistically significant difference between the experimental scenarios in terms of natural elements, $F(4, 74) = 48.5$, $p < .001$. Specifically, Tukey post-hoc comparisons showed that the forest scenario was perceived to have significantly more natural elements compared to the urban scenario, $t(74) = 12.00$, *mean difference* = 4.20, $p_{tukey} < .001$. Similarly, the arctic scenario was perceived as having significantly more natural elements than the urban scenario, $t(74) = 7.61$, *mean difference* = 2.71, $p_{tukey} < .001$. The island and flowery field scenarios were also perceived to have significantly more natural elements than the urban scenario, with *mean differences* of 4.23, $t(74) = 12.09$, $p_{tukey} < .001$, and 2.97, $t(74) = 8.47$, $p_{tukey} < .001$, respectively. Furthermore, analyses showed that the forest scenario was perceived as having significantly more natural elements compared to the flowery field scenario, $t(74) = 3.52$, *mean difference* = 1.23, $p_{tukey} = .006$; and the arctic scenario, $t(74) = 4.19$, *mean difference* = 1.49, $p_{tukey} < .001$. Similarly, the flowery field scenario was rated lower in natural elements than the island scenario, $t(74) = - 3.61$, *mean difference* = -1.27, $p_{tukey} = .005$. Further, the island scenario was perceived as having significantly more natural elements compared to the arctic scenario, $t(74) = 4.28$, *mean difference* = 1.52, $p_{tukey} < .001$.

In terms of urban elements, the one-way ANOVA also revealed a statistically significant difference between the scenarios, $F(4, 74) = 292$, $p < .001$. Tukey post-hoc tests highlighted that the VR urban scenario was perceived as having significantly more urban elements compared to all other VR natural scenarios. The forest scenario, in particular, had a significantly lower rating for urban elements than the urban scenario, $t(74) = -27$, *mean difference* = - 4.78, $p_{tukey} < .001$. Similarly, the flowery field scenario showed significantly fewer urban elements compared to the urban scenario, $t(74) = -26.20$, *mean difference* = - 4.64, $p_{tukey} < .001$. The island scenario also had a significantly lower perception of urban elements than the urban scenario, $t(74) = -26.70$, *mean difference* = - 4.73, $p_{tukey} < .001$. Furthermore, the arctic scenario was rated with significantly fewer urban elements compared to the urban scenario, $t(74) = -27.70$, *mean difference* = - 4.98, $p_{tukey} < .001$.

Overall, no significant differences in the perception of urban elements were observed among the four natural scenarios, but there were significant differences in the perception of natural elements among these same scenarios. This indicates that while participants clearly distinguished between urban and natural environments, the specific type of natural environment did significantly affect the perceived presence of natural elements. In particular, the arctic and flowery field scenarios were perceived as having lower naturalness compared to the forest and island scenarios. This perception may be attributed to factors such as a reduced variety of natural elements and biodiversity in these environments or other distinguishing characteristics.

The control variables were analysed to ensure that the observed differences in the main variables of interest were not influenced by variations in factors such as sense of presence, realism, virtual sickness or video and audio quality across the different experimental scenarios. It was expected that these control variables would remain consistent and therefore would not exhibit significant differences across scenarios, given the balanced design of the virtual scenarios.

For the sense of presence, the one-way ANOVA revealed no significant differences between the scenarios, $F(4, 74) = 1.41$, $p = 0.240$. This indicates that the level of presence experienced by participants did not vary significantly across the different virtual environments, ensuring that perceived presence was consistent among the experimental groups. On the 0-6 scale, the average sense of presence ratings across scenarios were moderate to high, indicating an overall satisfactory level in each, with slightly higher presence in the Arctic scenario.

Regarding perception of realism, the one-way ANOVA approached significance with $F(4, 74) = 2.52$, $p = 0.048$. However, post-hoc Tukey tests indicated no significant pairwise differences between scenarios, with p-values ranging from 0.071 to 0.991. This suggests that while there was a tendency for realism to vary, the differences were not substantial enough to affect the outcomes. Overall, the perception of realism ratings across scenarios ranged from moderate to moderately high, on the 0-6 scale, with the arctic and forest scenarios rated as somewhat more realistic than the others.

Further, for virtual sickness, the one-way ANOVA showed no significant differences among the scenarios, $F(4, 74) = 0.20$, $p = 0.937$. This result confirms that virtual sickness levels were consistent across all experimental conditions, ensuring that this factor did not contribute to any observed differences in the primary outcomes. Overall, on the 0-4 response scale, virtual sickness ratings were uniformly low across all scenarios, suggesting minimal discomfort experienced by participants.

Finally, for video and audio quality, the one-way ANOVA showed no significant differences among the experimental groups, $F(4, 74) = 1.15$, $p = 0.341$, thus indicating that virtual scenarios' quality was consistent across all groups. Overall, video and audio quality ratings were generally high across all scenarios, on a 0-6 scale, reflecting participants' satisfaction with the multimedia experience in each virtual environment.

In summary, these findings support the robustness of the experimental manipulation by demonstrating that variations in control variables were not driving the observed differences in natural and urban elements between the scenarios.

Manipulation check – Mood Induction Procedure.

To assess the effectiveness of the Mood Induction Procedure, a manipulation check was performed by comparing the PANAS scores collected before and after the procedure. The primary aim was to detect a significant change in emotional states, specifically an increase in negative emotions following the negative mood induction. **Table 5.10** provides the descriptive analyses (mean and standard deviation) of the negative emotions pre- and post-MIP across the five experimental groups.

A repeated measures ANOVA was conducted with the two time points as a within-subjects factor and the experimental groups as between-subject factors, in order to evaluate the effectiveness of the Mood Induction Procedure by examining changes in negative emotions and ensuring the uniformity of mood induction effects across the various experimental groups.

Table 5.10. *Descriptive statistics for negative emotions pre- and post-MIP across experimental groups: means and standard deviations in parentheses (Study 6)*

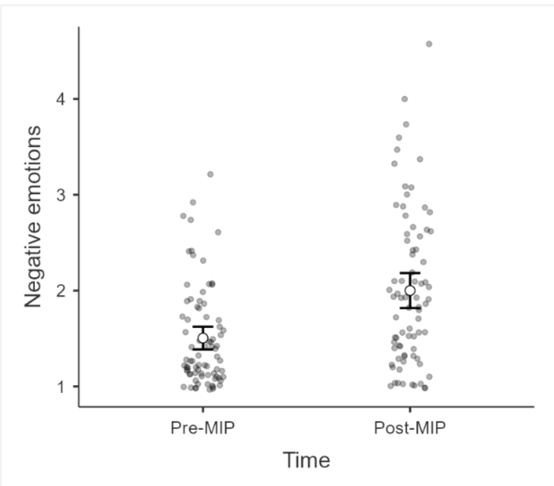
Time-points	Experimental group				
	Arctic	*Forest*	*Island*	*Flowery field*	*Urban*
Pre-MIP	1.49 (0.52)	1.56 (0.56)	1.52 (0.49)	1.59 (0.59)	1.37 (0.47)
Post-MIP	2.25 (1.11)	1.78 (0.52)	2.08 (0.83)	1.90 (0.72)	1.99 (0.81)

The analysis revealed a significant main effect of time on negative emotions, $F(1, 74) = 43.03$, $\eta^2 = 0.118$, $p < .001$. Post hoc comparisons between the pre-MIP ($M = 1.51$, $SD = 0.52$) and post-MIP ($M = 2.00$, $SD = 0.81$) measures showed a rise in negative emotions, $t(74) = -6.56$, *mean difference* = -0.496, $p_{tukey} < .001$. These findings are visually represented in **Figure 5.17**.

In contrast, there was no significant effect of the experimental groups on negative emotions, $F(4, 74) = 0.30$, $\eta^2 = 0.011$, $p = 0.874$. Furthermore, the interaction between time and experimental group was not statistically significant, $F(4, 74) = 1.76$, $\eta^2 = 0.019$, $p = 0.146$. This indicates that the mood induction procedure was consistently effective across all experimental groups.

Overall, these results confirm that the MIP successfully induced a general increase in negative emotions, validating its effectiveness in manipulating mood as intended.

Figure 5.17. *Graph illustrating the overall changes in negative emotions pre/post-MIP (Study 6)*



Hypotheses testing – Phase 1

This section presents the confirmatory analyses related to the hypotheses formulated for the first phase of the study.

First, a repeated measures ANOVA was conducted to investigate the effects of the intervention (i.e., exploring the virtual scenarios), and potential differences between experimental groups, on negative emotions. Descriptive analyses (mean and standard deviation) of the negative emotions post-intervention across the five experimental groups are provided in **Table 5.11**.

Table 5.11. *Descriptive statistics for negative emotions post-intervention across experimental groups (Study 6)*

Experimental group	*Mean*	*SD*
Arctic	1.45	0.43
Forest	1.30	0.50
Island	1.41	0.59
Flowery field	1.25	0.28
Urban	1.56	0.54

H_1) *Changes in negative emotions after the intervention*

The analysis revealed a significant main effect of the intervention on negative emotions, $F(1, 74) = 84.20$, $\eta^2 = 0.175$, $p < .001$. Specifically, post-hoc comparisons showed a significant decrease in negative emotions from pre- ($M = 2.00$, $SD = 0.81$) to post-test ($M = 1.39$, $SD = 0.48$), $t(74) = 9.18$, *mean difference* = 0.61, $p_{tukey} < .001$.

These results confirmed the first hypothesis, which proposed a general reduction in negative emotions following the exploration of the virtual scenarios.

H2) *Interaction effect between intervention and experimental group on negative emotions*

The analysis of negative emotions did not reveal a significant interaction effect between the intervention (pre- vs. post-test) and the experimental group (VR scenarios), $F(4, 74) = 1.04$, $\eta^2 = 0.009$, $p = 0.391$.

As highlighted in the analytic strategies section, even if the overall interaction effect is not significant, it remains necessary to perform post-hoc comparisons. This is because ANOVA identifies whether differences exist among group levels but does not specify which groups differ from each other. Therefore, post-hoc comparisons were performed to further explore specific group-level differences across time, ensuring a more thorough understanding of how each experimental group affects negative emotions.

Results from the post-hoc comparisons indicated significant differences in negative emotions between pre- and post-test, for the experimental groups with VR nature scenarios. **Table 5.12** presents the main results from the post-hoc comparisons related to the interaction between intervention and experimental group on negative emotions.

Specifically, for the experimental group with the VR arctic scenario, a statistically significant difference between pre- ($M = 2.25$, $SD = 1.11$) and post-intervention ($M = 1.45$, $SD = 0.43$) was found; *mean difference* = 0.81, $t(74) = 5.30$, $p_{tukey} < .001$. Similarly, for the experimental group with the VR forest scenario, negative emotions were significantly higher in the pre- ($M = 1.78$, $SD = 0.52$) compared to the post-intervention ($M = 1.30$, $SD = 0.50$); *mean difference* = 0.48, $t(74) = 3.27$, $p_{tukey} = 0.050$. Further, a statistically significant difference between pre- (M = 2.08, SD = 0.829) and post-intervention ($M = 1.41$, $SD = 0.59$) was found for the experimental group with the VR island scenario; *mean difference* = 0.68, $t(74) = 4.58$, $p_{tukey} = < .001$. Also, for the experimental group with the VR flowery field scenario, results showed that participants reported significantly greater negative emotions in the pre- ($M = 1.90$, $SD = 0.72$) than in the post-intervention ($M = 1.25$, $SD = 0.28$); *mean difference* = 0.65, $t(74) = 4.41$, $p_{tukey} = 0.001$. In contrast, for the experimental group with the VR urban scenario no significant difference in negative emotions was found between pre- (M = 1.99, SD = 0.81) and post-intervention (M = 1.56, SD = 0.54); *mean difference* = 0.43, $t(74)$ = 2.93, p_{tukey} = 0.117, indicating that participants' emotional levels remained stable in this condition.

Finally, findings revealed no statistically significant differences between the experimental groups with respect to negative emotions post-intervention.

These results partially confirm the study's hypothesis that exploring VR scenarios representing natural environments would lead to a greater reduction in negative emotions compared to the exploration of the urban environment scenario.

Table 5.12. *Post-hoc comparisons related to the interaction between intervention and experimental group on negative emotions (Study 6)*

Time 1	Time 2	Experimental group	*Mean difference*	*SE*	*t* (74)	p_{tukey}
	Post-intervention	Arctic	0.807	0.152	5.300	< .001
	Post-intervention	Forest	0.481	0.147	3.265	.050
Pre-intervention	***Post-intervention***	Flowery field	0.650	0.147	4.410	.001
	Post-intervention	Island	0.675	0.147	4.580	< .001
	Post-intervention	Urban	0.431	0.147	2.93	.117

H_3) *Return to baseline of negative emotions*

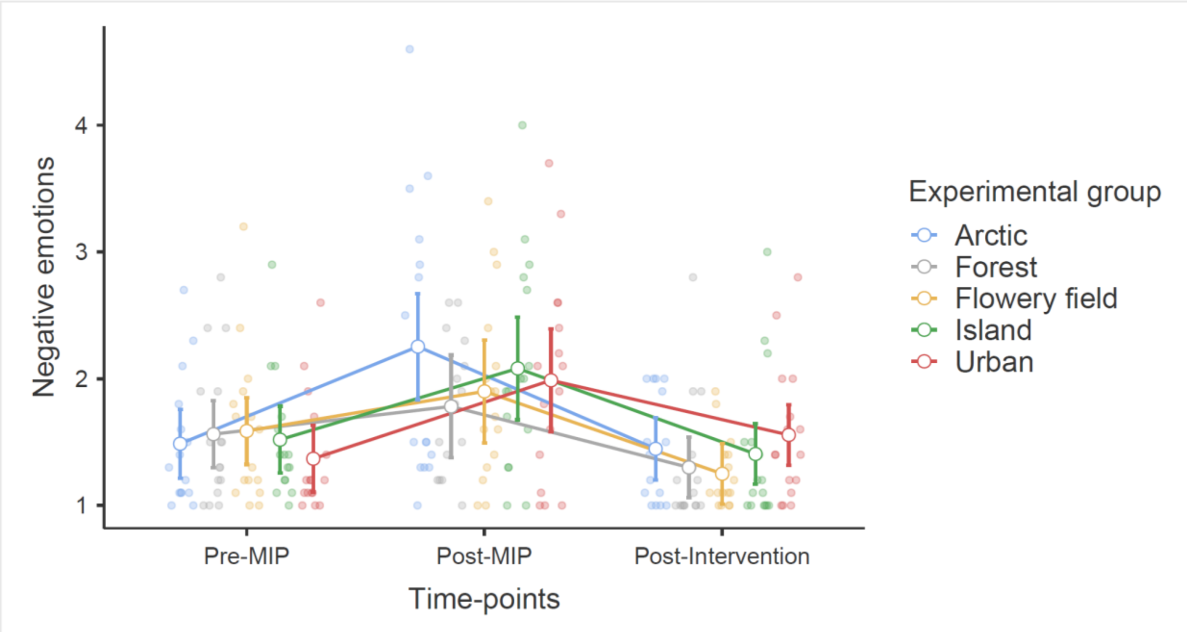
A repeated measures ANOVA was conducted to examine whether negative emotions in the post-intervention returned to the baseline levels observed before the mood induction procedure. **Figure 5.18** displays the changes of negative emotions levels measured at the three time-points (i.e., pre-MIP, pre-intervention, and post-intervention) across the experimental groups.

The results indicated that overall, there was no significant difference between negative emotions measured pre-MIP (M = 1.51, SD = 0.52) and those measured post-intervention (M = 1.39, SD = 0.48). Specifically, the effect of the intervention approached but did not reach statistical significance, $F(1, 74) = 3.78$, $p = 0.056$, with $\eta^2 = 0.013$, suggesting a small effect size. Moreover, results showed that the interaction effect between intervention and experimental group was significant, $F(4, 74) = 2.52$, $\eta^2 = 0.034$, $p = 0.048$, indicating that the change in negative emotions over time varied across the VR scenarios adopted for the intervention. However, post hoc comparisons revealed that none of the specific experimental group showed a significant deviation from the baseline, confirming that the negative emotions measured pre-MIP did not significantly differ from those measured post-intervention across all experimental groups.

Looking at the means (**Tables 5.10** and **5.11**), it is possible to note that for all the experimental group with the VR scenarios representing natural environments, negative emotions were lower in the post-intervention compared to the pre-MIP/baseline levels, even though these differences did not reach statistical significance. In contrast, for the experimental group with the VR urban scenario, negative emotions in post-intervention (M = 1.56, SD = 0.54) remained higher than the pre-MIP levels (M = 1.37, SD = 0.47). Thus, there appears to be a trend suggesting that while natural environments facilitated a greater return to baseline emotional states, the urban environment did not fully support this emotional recovery, resulting in persistently higher negative emotions.

In summary, the analysis supports the hypothesis that negative emotions returned to baseline levels following the intervention. The lack of significant differences between negative emotions pre-MIP and those measured after the intervention, suggests that the exploration of VR scenarios was effective in allowing participants to regulate their emotions and restore their initial emotional state.

Figure 5.18. *Changes in negative emotions across time points for the different experimental groups (Study 6)*



H$_4$) *Effect of the experimental group on emotion regulation strategies*

To investigate whether participants in experimental groups involving VR natural scenarios would utilize more adaptive emotion regulation strategies (H$_{4a}$) and fewer maladaptive strategies (H$_{4b}$) compared to those in the experimental group with the VR urban scenario, a series of one-way ANOVAs were conducted. The strategies were assessed through various measures, including ad-hoc items on adaptive and maladaptive strategies, as well as scales from the SERI and DERS instruments. **Table 5.13** provides descriptive statistics for all the emotion regulation strategies assessed across the experimental groups.

Table 5.13. *Descriptive statistics of emotion regulation strategies' scores by experimental groups: means and standard deviations in parentheses (Study 6)*

ER strategies	**Experimental groups**				
	Arctic	***Forest***	***Island***	***Flowery field***	***Urban***
ER Adaptive	40.23 (20.29)	47.75 (23.61)	36.89 (18.05)	40.82 (22.72)	34.44 (25.79)
ER Maladaptive	32.07 (26.84)	39.09 (21.29)	31.58 (26.27)	29.25 (18.96)	32.52 (28.10)
SERI – Distraction	4.17 (1.97)	5.00 (1.16)	4.42 (1.99)	3.69 (1.94)	3.42 (2.09)
SERI – Reappraisal	3.43 (1.64)	3.58 (1.51)	3.17 (1.75)	2.98 (1.58)	2.77 (1.68)
SERI – Brooding	2.67 (1.16)	3.09 (1.30)	2.86 (1.87)	2.94 (1.71)	2.47 (1.14)
SERI – Acceptance	4.58 (1.72)	3.52 (1.48)	3.98 (1.69)	4.22 (1.80)	4.13 (1.62)
DERS – Awareness	3.31 (1.09)	3.46 (1.17)	3.56 (0.99)	3.56 (0.99)	3.10 (1.20)
DERS – Clarity	2.13 (0.97)	2.04 (1.10)	1.73 (1.10)	1.90 (0.82)	1.98 (1.02)
DERS – Modulate	1.91 (1.11)	1.63 (0.60)	1.77 (1.02)	1.83 (1.03)	1.65 (0.85)
DERS – Non acceptance	1.71 (1.18)	1.25 (0.43)	1.83 (1.13)	1.52 (0.79)	1.63 (1.17)

Note. ER: emotion regulation strategies; SERI: State Emotion Regulation Inventory; DERS: Difficulties in Emotion Regulation Scale.

Overall, the analysis revealed that there were no significant differences across the experimental groups in terms of the use of adaptive or maladaptive emotion regulation strategies.

Specifically, measures of adaptive strategies (ad-hoc items) and maladaptive strategies (ad-hoc items) showed no significant variation between experimental groups; respectively: $F(4, 74) = 0.817$, $p = 0.518$; and $F(4, 74) = 0.361$, $p = 0.836$.

Similarly, there were no significant differences in the use of distraction, $F(4, 74) = 1.782$, $p = 0.141$; cognitive reappraisal, $F(4, 74) = 0.641$, $p = 0.635$; brooding, $F(4, 74) = 0.434$, $p = 0.784$; or acceptance, $F(4, 74) = 0.848$, $p = 0.500$, as measured by the SERI.

Furthermore, DERS scores also did not differ significantly across the experimental groups: emotional awareness, $F(4, 74) = 0.539$, $p = 0.708$; clarity, $F(4, 74) = 0.362$, $p = 0.835$; modulation, $F(4, 74) = 0.265$, $p = 0.899$; and non-acceptance, $F(4, 74) = 0.807$, $p = 0.525$.

In summary, the results suggest that the experimental groups, whether natural or urban, did not significantly influence participants' emotion regulation strategies adopted during the intervention. Thus, the anticipated effect of natural environments leading to a greater use of adaptive strategies and a reduction in maladaptive strategies compared to urban environments was not observed.

H_5) *Differences between trait and state emotion regulation strategies*

A series of repeated measures ANOVAs were conducted in order to investigate potential differences in the use of emotion regulation strategies between trait (habitual) and state (situational) levels across the experimental groups. **Table 5.14** provides descriptive statistics for all the emotion regulation strategies as trait by experimental group.

The analysis for the adaptive strategies (measured through the ad-hoc items) revealed a significant main effect of the emotion regulation level (trait vs. state), $F(1, 74) = 79.16$, $\eta^2 = 0.278$, $p < .001$. This finding indicates that overall participants' use of adaptive strategies differed significantly between trait and state conditions. However, no significant main effect of experimental group was observed, $F(4, 74) = 1.03$, $\eta^2 = 0.024$, $p = .396$, suggesting that the type of virtual environment did not independently influence the use of adaptive strategies. Additionally, the interaction between emotion regulation level and experimental group was not significant, $F(4, 74) = 0.935$, $\eta^2 = 0.013$, $p = .448$, implying that the difference between trait and state strategies did not vary significantly across the different experimental conditions.

Post-hoc analyses provided further insights. In particular, it was found that adaptive strategies were significantly higher in the trait level ($M = 62.63$) compared to the state level ($M = 40.0$), $t(74) = 8.90$, *mean difference* = 22.6, $p_{tukey} < .001$. When examining specific scenarios, the arctic condition showed significantly higher adaptive strategies in the trait level ($M = 62.48$, $SD = 12.50$) compared to the state level ($M = 40.23$, $SD = 20.29$), $t(74) = 3.82$, *mean difference* = 22.24, $p_{tukey} = .010$. The flowery field scenario showed significant differences in adaptive strategies between the trait (*M* = 64.14, *SD* = 12.16) and state level (*M* = 40.82, *SD* = 22.72), $t(74) = 4.13$, *mean difference* = 23.31, $p_{tukey} = .004$. The island scenario, also, did reveal a significant difference, with scores at the trait level (*M* = 55.73, *SD* = 11.85) being higher than the state level (*M* = 36.89, *SD* = 18.05), $t(74) = 3.34$, *mean difference* = 18.84, $p_{tukey} = .041$. In the urban scenario, trait-based strategies (M = 65.77, SD = 16.11) were significantly higher than state-based strategies (*M* = 34.33, *SD* = 25.79), $t(74) = 5.55$, *mean difference* = 31.33, $p_{tukey} < .001$. No significant differences were found between trait and state level of adaptive emotion regulation strategies for the forest scenario.

Regarding maladaptive strategies (ad-hoc items), a significant main effect of the emotion regulation level was also observed, $F(1, 74) = 33.66$, $\eta^2 = 0.132$, $p < .001$. This suggests that participants' use of maladaptive strategies differed between the trait and state levels. Similar to adaptive strategies, there was no significant main effect of the experimental group on maladaptive strategies, $F(4, 74) = 0.550$, $\eta^2 = 0.009$, $p = .700$, and the interaction between strategy level and environment was not significant, $F(4, 74) = 0.473$, $\eta^2 = 0.014$, $p = .755$. Post-hoc tests revealed that overall maladaptive strategies were significantly higher in the trait condition (*M* = 49.5) compared to the state condition (*M* = 32.9), $t(74) = 5.80$, *mean difference* = 16.6, $p_{tukey} < .001$. Moreover, post-hoc analyses showed that for the island scenario, maladaptive strategies in the trait level (M = 55.38, SD = 20.41) were significantly higher than in the state condition (*M* = 31.58, *SD* = 26.27), $t(74) = 3.75$, *mean difference* = 23.80, $p_{tukey} = .012$. No significant differences were found in the other scenarios.

Table 5.14. *Descriptive statistics of trait emotion regulation strategies' scores by experimental groups: means and standard deviations in parentheses (Study 6)*

ER strategies	Experimental groups				
	Arctic	*Forest*	*Island*	*Flowery field*	*Urban*
ER Adaptive	62.48 (12.50)	65.04 (12.99)	55.73 (11.85)	64.14 (12.16)	65.77 (16.11)
ER Maladaptive	49.72 (17.36)	50.44 (14.99)	55.38 (20.41)	45.41 (17.70)	46.34 (19.97)
SERI – Distraction	4.18 (1.31)	4.45 (1.01)	3.84 (1.06)	4.11 (0.95)	4.11 (1.04)
SERI – Reappraisal	5.03 (1.00)	4.80 (1.09)	3.80 (1.16)	4.41 (1.35)	4.41 (1.19)
SERI – Brooding	5.10 (0.92)	4.75 (0.83)	4.77 (0.99)	4.63 (0.82)	4.84 (1.25)
SERI – Acceptance	3.82 (0.92)	3.80 (1.19)	3.97 (0.86)	3.41 (0.89)	3.52 (0.86)
DERS – Awareness	4.07 (0.96)	3.90 (0.70)	4.00 (0.74)	4.17 (0.68)	3.96 (0.82)
DERS – Clarity	2.47 (1.27)	2.38 (0.99)	2.17 (1.10)	1.92 (0.75)	1.98 (0.80)
DERS – Modulate	2.44 (1.05)	2.35 (1.09)	2.31 (0.92)	2.38 (1.09)	2.40 (1.06)
DERS – Non acceptance	2.47 (1.28)	2.13 (1.11)	2.23 (1.02)	2.19 (1.22)	2.58 (1.46)

Note. ER: emotion regulation strategies; SERI: State Emotion Regulation Inventory; DERS: Difficulties in Emotion Regulation Scale.

For distraction (SERI), no significant main and interaction effects were found.

For the reappraisal strategy (SERI), results revealed a significant main effect of the emotion regulation level (trait vs. state), $F(1, 74) = 44.68$, $\eta^2 = 0.173$, $p < .001$. However, no significant main effect of experimental group was observed, $F(4, 74) = 0.906$, $\eta^2 = 0.014$, $p = .465$. Additionally, the interaction between emotion regulation level (trait vs. state) and experimental group was not significant, $F(4, 74) = 1.51$, $\eta^2 = 0.040$, $p = .209$, implying that the difference between trait and state strategies did not vary significantly across the different experimental groups. Post-hoc analyses showed that reappraisal strategy was significantly higher in the trait level ($M = 4.49$) compared to the state level ($M = 3.19$), $t(74) = 6.68$, *mean difference* = 1.30, $p_{tukey} < .001$. When examining specific scenarios, the arctic condition showed significantly higher ratings for the reappraisal strategy in the trait level ($M = 5.03$, $SD = 0.99$) compared to the state condition ($M = 3.43$, $SD = 1.64$), $t(74) = 3.58$, *mean difference* = 1.60, $p_{tukey} = .020$. Similarly, for the flowery field scenario, results did reveal a significant difference, with reappraisal trait strategy (*M* = 4.41, *SD* = 1.35) being higher than at the state level (*M* = 2.98, *SD* = 1.58), $t(74) = 3.29$, *mean difference* = 1.42, $p_{tukey} = .047$. Also, for the experimental group with the VR urban scenario, reappraisal was rated higher for the trait-level (*M* = 4.41, *SD* = 1.19), compared to the state-level (*M* = 2.77, *SD* = 1.68), $t(74) = 3.79$, *mean difference* = 1.64, $p_{tukey} = .011$. No further significant differences were found for the other experimental groups.

Regarding the brooding strategy (SERI), a significant main effect of the strategy level was also observed, $F(1, 74) = 120.18$, $\eta^2 = 0.404$, $p < .001$. There was no significant main effect of the experimental group on the strategy, $F(4, 74) = 0188$, $p = .944$, $\eta^2 = 0.003$, and the interaction between strategy level and experimental group was not significant, $F(4, 74) = 0.814$, $\eta^2 = 0.011$, $p = .520$. Post-hoc tests revealed that the use of the brooding strategy was significantly higher in the trait level (*M* = 4.82) compared to the state level (*M* = 2.81), $t(74) = 11$, *mean difference* = 2.01, $p_{tukey} < .001$. Moreover, post-hoc analyses showed that for the arctic scenario, the brooding strategy in the trait level (*M* = 5.10, *SD* = 0.92) was significantly higher than in the state level (*M* = 2.67, *SD* = 1.16), $t(74) = 5.78$, *mean difference* = 2.43, $p_{tukey} < .001$. Similarly, for the forest experimental condition, the brooding strategy was rated higher for the trait level (*M* = 4.75, *SD* = 0.83) compared to the state level (*M* = 3.09, *SD* = 1.30), $t(74) = 4.06$, *mean difference* = 1.66, $p_{tukey} = .004$. Also, for the flowery field scenario, analysis showed higher scores of the brooding strategy in the trait level (*M* = 4.63, *SD* = 0.82) than at the state level (*M* = 2.94, *SD* = 1.71), $t(74) = 4.14$, *mean difference* = 1.69, $p_{tukey} = .003$. Further, for the island experimental condition, brooding was rated higher at the trait level (*M* = 4.77, *SD* = 0.99) compared to the state level (*M* = 2.87, *SD* = 0.47), $t(74) = 4.68$, *mean difference* = 1.91, $p_{tukey} < .001$. Finally, similar results were obtained for the urban scenario, with higher reported use of the brooding strategy at the trait level (*M* = 4.84, *SD* = 1.25) than at the state level (*M* = 2.47, *SD* = 1.14), $t(74) = 5.83$, *mean difference* = 2.38, $p_{tukey} < .001$.

For the acceptance strategy (SERI), results revealed a significant main effect of the emotion regulation level, $F(1, 74) = 5.08$, $\eta^2 = 0.020$, $p = .020$. Post-hoc analyses showed that the acceptance strategy was significantly lower in the trait level ($M = 3.70$) compared to the state level ($M = 4.09$), $t(74) = -2.25$, *mean difference* = -3.85, $p_{tukey} = .027$. However, no significant main effect of experimental group was observed, $F(4, 74) = 0.516$, $\eta^2 = 0.018$, $p = .724$. Additionally, the interaction between emotion regulation level and experimental group was not significant, $F(4, 74) = 1.65$, $\eta^2 = 0.026$, $p = .170$, implying that the difference between trait and state strategies did not vary significantly across the different experimental groups.

Regarding awareness (DERS), a significant main effect of the strategy level was also observed, $F(1, 74) = 26.68$, $\eta^2 = 0.103$, $p < .001$. Post-hoc tests revealed that awareness was significantly higher in the trait level ($M = 49.5$) compared to the state condition ($M = 32.9$), $t(74) = 5.17$, *mean difference* = 0.62, $p_{tukey} < .001$. However, there was no significant main effect of the experimental group, $F(4, 74) = 0.426$, $\eta^2 = 0.014$, $p = .789$, and the interaction between strategy level and experimental group was not significant, $F(4, 74) = 0.492$, $\eta^2 = 0.008$, $p = .742$.

About clarity (DERS), no significant main and interaction effects were found.

For modulate (DERS), results revealed a significant main effect of the emotion regulation level, $F(1, 74) = 24.33$, $\eta^2 = 0.094$, $p < .001$. Post-hoc analyses showed that the modulate was significantly higher in the trait level ($M = 2.38$) compared to the state level ($M = 1.76$), $t(74) = 4.93$, *mean difference* = 0.619, $p_{tukey} < .001$. However, no significant main effect of experimental group was observed, $F(4, 74) = 0.130$, $\eta^2 = 0.004$, $p = .971$. Additionally, the interaction between emotion regulation level and experimental group was not significant, $F(4, 74) = 0.155$, $\eta^2 = 0.002$, $p = .960$, implying that the difference between trait and state strategies did not vary significantly across the different experimental conditions.

Similar results were obtained for non-acceptance (DERS), where a significant main effect of the emotion regulation level was found, $F(1, 74) = 26.23$, $\eta^2 = 0.101$, $p < .001$, with higher scores at the trait level ($M = 2.32$) compared to the state level ($M = 1.59$), $t(74) = 5.12$, *mean difference* = 0.730, $p_{tukey} < .001$. However, results revealed no significant main effect of experimental group, $F(4, 74) = 0.610$, $\eta^2 = 0.019$, $p = .657$, as well as no significant interaction effect between emotion regulation level and experimental group, $F(4, 74) = 0.472$, $\eta^2 = 0.007$, $p = .756$.

In summary, the results of this study reveal notable distinctions between trait and state emotion regulation strategies across different experimental conditions, but the impact of the virtual environments themselves appears limited. **Table 5.15** presents an overview of the results.

Table 5.15. *Summary of trait-state comparisons for emotion regulation strategies (Study 6)*

ER strategy	Main effect of strategy level	Main effect of exp. group	Interaction effect (level*exp. group)	Significant post-hoc differences
Adaptive strategies	Significant (Trait > State)	Not significant	Not significant	Arctic, Flowery field, Island, Urban (Trait > State)
Maladaptive strategies	Significant (Trait > State)	Not significant	Not significant	Island (Trait > State)
Distraction (SERI)	Not significant	Not significant	Not significant	None
Reappraisal (SERI)	Significant (Trait > State)	Not significant	Not significant	Arctic, Flowery field, Urban (Trait > State)
Brooding (SERI)	Significant (Trait > State)	Not significant	Not significant	Arctic, Forest, Flowery field, Island, Urban (Trait > State)
Acceptance (SERI)	Significant (Trait < State)	Not significant	Not significant	None
Awareness (DERS)	Significant (Trait > State)	Not significant	Not significant	None
Clarity (DERS)	Not significant	Not significant	Not significant	None
Modulate (DERS)	Significant (Trait > State)	Not significant	Not significant	None
Non acceptance (DERS)	Significant (Trait > State)	Not significant	Not significant	None

H$_6$) *Serial-parallel mediation model with PRS and ER strategies*

Structural Equation Modelling (SEM) was employed to test the pathways defined in the conceptual model. The model evaluated the influence of the different experimental groups (dummy coded variables, with the experimental group with the VR urban scenario as the reference category) on negative emotions post-intervention (PANAS 3). The model also included place perceived restorativeness (PRS), and adaptive and maladaptive emotion regulation strategies, in parallel, as serial mediators, and negative emotions pre-intervention (PANAS 2) as a control variable.

The overall model fit was assessed using various indices. In particular, the chi-square test of model fit was not significant ($\chi^2 = 7.36$, $df = 4$, $p = 0.118$), indicating a good fit. Fit indices such as *CFI* (0.967), *GFI* (0.998), and *SRMR* (0.043) also suggested a good fit, although the *RMSEA* was somewhat higher at 0.103, with a 95% CI ranging from 0.000 to 0.219 ($p = 0.188$). The model accounted for 41%, 0.2% and 0.8% of the variance in place perceived restorativeness, adaptive and maladaptive emotion regulation strategies, respectively, as well as 59% of the variation in negative emotions post-intervention.

The parameter estimates for the direct effects are detailed in **Table 5.16**, while the indirect effects are outlined in **Table 5.17**. The analysis was conducted in a serial-parallel mediation model, as follows:

1. The experimental groups variables were first regressed on PRS. These paths were significant, with the experimental groups showing strong associations with PRS ($R^2 = 0.41$, $p < .001$). Specifically, exposure to arctic, forest, flowery field, and island scenarios significantly increased PRS scores compared to the urban condition.
2. Subsequently, PRS and experimental groups were regressed onto both adaptive ($R^2 = 0.08$, $p = .212$) and maladaptive ($R^2 = 0.02$, $p = .879$) emotion regulation strategies. However, the direct paths of experimental groups and PRS showed non-significant effects on both adaptive and maladaptive strategies.

3. Finally, the effects of experimental groups, PRS, and emotion regulation strategies on post-intervention negative emotions were assessed. The model explained a substantial portion of the variance in negative emotions post-intervention (R^2 = 0.59, p < .001). While maladaptive strategies positively influenced negative emotions post-intervention (β = 0.16, p = .025), adaptive strategies did not show a significant effect (p = .724). PRS had a negative and significant direct effect on post-intervention negative emotions' scores (β = -0.27, p = .004). No significant direct effects of the experimental groups on post-intervention negative emotions were observed.

The indirect paths examined the mediating roles of PRS and emotion regulation strategies. Results showed that PRS significantly mediated the effects of all the experimental groups on negative emotions post-intervention. In contrast, the indirect effects involving emotion regulation strategies were non-significant, with no meaningful mediation observed for either adaptive or maladaptive strategies.

In summary, the SEM analysis demonstrated that PRS plays a crucial mediating role in reducing negative emotions post-intervention, particularly under non-urban conditions. However, contrary to the hypothesis, emotion regulation strategies were not found to be significant mediators in this context.

Table 5.16. *Parameter estimates for the direct effects of the serial-parallel mediation model (H_6) tested in Study 6*

Dependent	Predictor	*Estimate*	*SE*	*95 % Confidence Intervals*		β	*z*	*p*
				Lower	*Upper*			
PANAS 3 – NA	ER Adaptive	-0.001	0.002	-0.004	0.001	-0.027	-0.353	0.724
PANAS 3 – NA	ER Maladaptive	0.003	0.002	0.000	0.006	0.163	2.236	0.025
PANAS 3 – NA	PRS	-0.049	0.017	-0.083	-0.015	-0.273	-2.848	0.004
PANAS 3 – NA	Arctic	-0.020	0.129	-0.273	0.234	-0.016	-0.153	0.879
PANAS 3 – NA	Forest	0.034	0.133	-0.226	0.294	0.029	0.256	0.798
PANAS 3 – NA	Flowery field	-0.096	0.121	-0.334	0.141	-0.081	-0.795	0.427
PANAS 3 – NA	Island	0.041	0.134	-0.221	0.303	0.035	0.309	0.758
PANAS 3 – NA	PANAS 2 – NA	0.413	0.044	0.327	0.499	0.694	9.457	<.001
ER Adaptive	Arctic	-2.804	8.877	-20.202	14.594	-0.050	-0.316	0.752
ER Adaptive	Forest	3.661	9.081	-14.138	21.459	0.067	0.403	0.687
ER Adaptive	Flowery field	-0.649	8.361	-17.036	15.738	-0.012	-0.078	0.938
ER Adaptive	Island	-7.504	9.174	-25.484	10.476	-0.137	-0.818	0.413
ER Adaptive	PRS	2.181	1.170	-0.112	4.474	0.262	1.865	0.062
ER Maladaptive	Arctic	2.025	9.966	-17.508	21.557	0.033	0.203	0.839
ER Maladaptive	Forest	9.354	10.195	-10.628	29.337	0.157	0.918	0.359
ER Maladaptive	Flowery field	-1.242	9.387	-19.639	17.155	-0.021	-0.132	0.895
ER Maladaptive	Island	1.9251	10.299	-18.261	22.111	0.032	0.187	0.852
ER Maladaptive	PRS	-0.627	1.313	-3.202	1.947	-0.069	-0.478	0.633
PRS	Arctic	3.943	0.730	2.513	5.372	0.585	5.405	<.001
PRS	Forest	4.425	0.718	3.019	5.831	0.673	6.167	<.001
PRS	Flowery field	3.225	0.718	1.819	4.631	0.491	4.494	<.001
PRS	Island	4.563	0.718	3.156	5.969	0.694	6.358	<.001

Table 5.17. *Parameter estimates for the indirect effects of the serial-parallel mediation model (H_6) tested in Study 6*

Indirect paths	***Estimate***	***SE***	***95 % Confidence Intervals***		***β***	***z***	***p***
			Lower	***Upper***			
Arctic ⇒ PRS ⇒ ER Adaptive ⇒ PANAS 3 – NA	-0.005	0.014	-0.033	0.023	-0.004	-0.346	0.729
Arctic ⇒ PRS ⇒ ER Maladaptive ⇒ PANAS 3 – NA	-0.008	0.017	-0.042	0.026	-0.007	-0.465	0.642
Arctic ⇒ PRS ⇒ PANAS 3 – NA	-0.195	0.077	-0.346	-0.043	-0.160	-2.520	0.012
Arctic ⇒ ER Adaptive ⇒ PANAS 3 – NA	0.002	0.007	-0.012	0.015	0.001	0.235	0.814
Arctic ⇒ ER Maladaptive ⇒ PANAS 3 – NA	0.007	0.033	-0.057	0.070	0.005	0.202	0.840
Forest ⇒ PRS ⇒ ER Adaptive ⇒ PANAS 3 – NA	-0.006	0.016	-0.037	0.026	-0.005	-0.346	0.729
Forest ⇒ PRS ⇒ ER Maladaptive ⇒ PANAS 3 – NA	-0.009	0.019	-0.047	0.029	-0.008	-0.466	0.641
Forest ⇒ PRS ⇒ PANAS 3 – NA	-0.219	0.085	-0.384	-0.053	-0.184	-2.586	0.010
Forest ⇒ ER Adaptive ⇒ PANAS 3 – NA	-0.002	0.008	-0.018	0.013	-0.002	-0.266	0.791
Forest ⇒ ER Maladaptive ⇒ PANAS 3 – NA	0.030	0.036	-0.040	0.101	0.026	0.849	0.396
Flowery field ⇒ PRS ⇒ ER Adaptive ⇒ PANAS 3 – NA	-0.004	0.012	-0.027	0.019	-0.003	-0.346	0.729
Flowery field ⇒ PRS ⇒ ER Maladaptive ⇒ PANAS 3 – NA	-0.007	0.014	-0.034	0.021	-0.006	-0.465	0.642
Flowery field ⇒ PRS ⇒ PANAS 3 – NA	-0.159	0.066	-0.289	-0.030	-0.134	-2.406	0.016
Flowery field ⇒ ER Adaptive ⇒ PANAS 3 – NA	0.000	0.005	-0.009	0.010	0.000	0.076	0.940
Flowery field ⇒ ER Maladaptive ⇒ PANAS 3 – NA	-0.004	0.031	-0.064	0.056	-0.003	-0.132	0.895
Island ⇒ PRS ⇒ ER Adaptive ⇒ PANAS 3 – NA	-0.006	0.017	-0.038	0.027	-0.005	-0.346	0.729
Island ⇒ PRS ⇒ ER Maladaptive ⇒ PANAS 3 – NA	-0.009	0.020	-0.048	0.030	-0.008	-0.466	0.641
Island ⇒ PRS ⇒ PANAS 3 – NA	-0.225	0.087	-0.396	-0.055	-0.189	-2.599	0.009
Island ⇒ ER Adaptive ⇒ PANAS 3 – NA	0.004	0.013	-0.022	0.030	0.004	0.324	0.746
Island ⇒ ER Maladaptive ⇒ PANAS 3 – NA	0.006	0.034	-0.060	0.072	0.005	0.186	0.852
PRS ⇒ ER Adaptive ⇒ PANAS 3 – NA	-0.001	0.004	-0.008	0.006	-0.007	-0.347	0.729
PRS ⇒ ER Maladaptive ⇒ PANAS 3 – NA	-0.002	0.004	-0.011	0.007	-0.011	-0.467	0.640

Alternative Models Testing. Given the correlation nature of the data, to explore alternative pathways that may better explain the relationships among the examined variables, four alternative models were tested, as in Study 5. Each model was developed to test different theoretical assumptions regarding the interrelationships between the experimental groups, place perceived restorativeness, adaptive and maladaptive emotion regulation strategies, and negative emotions post-intervention. The models were compared to the original model (H_6) to assess their fit to the data. **Table 5.18** presents the model fit indices for the original and alternative models.

Table 5.18. *Model fit indices for the original (H_6) and alternative models tested in Study 6*

Model	χ^2 (df)	RMSEA (90% CI)	SRMR	CFI	TLI	AIC	BIC
Original Model	7.36 (4)	.103 (.000, .219)	.043	.967	.786	1863	1934
Alternative Model 1	10.99 (6)	.103 (.000, .197)	.046	.951	.788	1863	1929
Alternative Model 2	10.99 (6)	.103 (.000, .197)	.046	.951	.788	1863	1929
Alternative Model 3	33.62 * (3)	.359 * (.256, .473)	.067	.766	-.169	406	445
Alternative Model 4	17.08 * (7)	.135 * (.054, .218)	.036	.832	.280	1531	1600

Note. * = $p < .050$; χ^2 = chi-square; df = degree of freedom; RMSEA = Root Mean Square Error of Approximation; CI = confidence interval; SRMR = Standardized Root Mean Square Residual; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion.

Specifically, the following alternative models were tested:

1. ***Alternative Model 1***: This model tested a reversed mediation pathway, where the experimental groups influenced both ER strategies (adaptive and maladaptive), which then predicted PRS, that in turn impacted post-intervention negative emotions. The fit indices for Alternative Model 1 showed acceptable fit, although slightly lower than the original model. Notably, the RMSEA and SRMR were similar to the original model. However, compared to the original model, this alternative model demonstrated weaker

relationships between ER strategies and post-intervention negative emotions. Additionally, no significant direct effects of emotion regulation strategies on perceived restorativeness, nor the proposed indirect effects between ER strategies and PRS, were observed, indicating that the reversed pathway may not offer a more compelling explanation of the data.

2. ***Alternative Model 2***: In this model, both ER strategies and PRS were tested in parallel as mediators between the experimental groups and post-intervention negative emotions. The model fit was comparable to Alternative Model 1 and was again similar to the original model, indicating a reasonable fit. As in the original model, only the indirect effects of PRS were found to be significant. While this model provided slightly improved explanatory power for negative emotions compared to Alternative Model 1, it still did not outperform the original model in terms of explaining the full set of relationships among the variables.

3. ***Alternative Model 3***: This model tested a moderated mediation of the experimental groups on post-intervention negative emotions through PRS, examining whether ER adaptive and maladaptive strategies moderated the effect of PRS on negative emotions. The results indicated poor model fit, suggesting that the model does not adequately fit the data, especially when compared to the original model. Additionally, the non-significant moderation paths further supported that this model did not offer a better explanation of the relationships than the original.

4. ***Alternative Model 4***: The final model tested a moderate mediation of the experimental groups on post-intervention negative emotions through ER adaptive and maladaptive strategies, examining whether PRS moderated the effect of the experimental groups on ER strategies. This model showed a less favourable fit than the original. Although the fit indices were still acceptable

in some indices, the moderation effect was not significant, and the model did not outperform the original model in explaining the relationship between the variables.

Details regarding the analyses and parameter estimates for each model are provided in **Appendix C.15**.

Overall, although some alternative models showed reasonable fit indices, none surpassed the original model in explaining the relationships among the experimental groups, PRS, ER strategies, and post-intervention negative emotions. Therefore, the original model remains the best fit for the data.

H_7) *Differences between experimental groups in terms of Location Selection*

Based on the factor analyses of the Location Selection in Nature scale detailed in **Chapter 3**, the analyses for location selection variables were performed using the two identified factors from the scale: up-regulation (i.e., managing negative low arousal and enhancing positive high arousal) and down-regulation (i.e., managing negative high arousal and enhancing positive low arousal).

Descriptive statistics for these variables across the experimental groups are summarized in **Table 5.19**. Based on the hypothesis that natural environments are locations more effective than urban settings for emotion regulation, the analysis aimed to determine if participants in the experimental group with VR natural scenarios had higher scores for location selection variables compared to participants in the experimental group with the VR urban scenario.

To explore this, one-way ANOVAs were performed to explore potential differences across experimental groups on location selection for up- and down-regulation variables.

Table 5.19. *Descriptive statistics of emotion regulation strategies' scores by experimental groups: means and standard deviations in parentheses (Study 6)*

Variables	Experimental group				
	Arctic	*Forest*	*Island*	*Flowery field*	*Urban*
LS up-regulation	4.28 (1.01)	4.61 (1.70)	4.00 (1.37)	3.61 (1.44)	3.13 (1.21)
LS down-regulation	5.40 (1.29)	5.83 (1.04)	6.08 (1.26)	5.03 (1.85)	3.31 (1.68)

For up-regulation, the one-way ANOVA showed a significant effect of the experimental group, $F(4, 74) = 2.84$, $p = .030$. Post-hoc comparisons revealed that participants in the experimental group with the VR forest scenario had higher scores in location selection for up-regulation ($M = 4.61$, $SD = 1.70$) compared to the participants in the experimental group with the VR urban scenario ($M = 3.13$, $SD = 1.21$), $t(74) = 3.07$, *mean difference* = 4.48, $p_{tukey} = .025$. The differences between the other experimental groups' comparisons were not statistically significant.

For down-regulation, the one-way ANOVA revealed a significant effect of the experimental group, $F(4, 74) = 8.99$, $p < .001$. Post-hoc Tukey tests indicated that in all the experimental group with the VR natural scenarios, participants had significantly higher scores compared to the participants in the experimental group with the VR urban scenario. Specifically, participants in the experimental group with the arctic scenario ($M = 5.40$, $SD = 1.29$) reported significantly higher scores of location selection for down-regulation than participants in the urban experimental group ($M = 3.31$, $SD = 1.68$), $t(74) = 3.99$, *mean difference* = 2.09, $p_{tukey} = .001$. Additionally, participants in the forest experimental group ($M = 5.83$, $SD = 1.04$) reported it as a significantly better location for down-regulation compared to participants in the urban experimental group, $t(74) = 4.89$, *mean difference* = 2.52, $p_{tukey} < .001$. Finally, participants in the experimental groups with the flowery field ($M = 5.03$, $SD = 1.85$) and the island scenarios ($M = 6.08$, $SD = 1.26$) had significantly higher scores than participants in the experimental group with the VR urban scenario, respectively: $t(74) = 3.34$, *mean difference* = 1.72, $p_{tukey} = .011$, and $t(74) = 5.37$, *mean difference* = 2.77, $p_{tukey} < .001$. The other comparisons between the different experimental groups with VR natural scenarios did not reach statistical significance.

Overall, the results support the hypothesis that natural environments are preferred over urban settings for managing negative emotions, particularly in the context of down-regulation (H_{7b}), where the data indicate that participants in the experimental groups with VR natural scenarios perceived those settings as more effective for emotion regulation compared to participants in the experimental group with the VR urban scenario. For up-regulation (H_{7a}), only the forest scenario was preferred as more effective for emotion regulation in comparison to the VR urban scenario.

H_8) *Parallel mediation model with Location Selection variables*

Building on those findings, a SEM analysis was conducted to further investigate how the different environmental groups influenced negative emotions post-intervention. A parallel mediation model was employed to examine the role of location selection for up-regulation and down-regulation as parallel mediators in this process. The experimental groups, including the four experimental groups with the VR natural scenarios and the experimental group with the VR urban scenario as reference category, served as independent variables, while negative emotions post-intervention (PANAS 3) constituted the dependent variable. Negative emotions pre-intervention (PANAS 2) was controlled for as a covariate to account for initial emotional states post-mood induction procedure.

The model's fit was assessed through several statistical indices. The chi-square test was significant ($X^2 = 22.4, df = 3, p < .001$), which suggested some deviation between the model and the data. Also, the *RMSEA* was 0.286 (90% *CI* [0.183, 0.402], $p < .001$), which is generally considered to indicate a poor fit. However, such indexes may be biased due to sample size (Hooper et al., 2008). The *CFI* score was 0.830, indicating a moderate fit. The *SRMR* value of 0.060 fell within an acceptable range, suggesting reasonable model alignment. The model accounted for 58%, 33% and 13% of the variance in negative emotions post-intervention, location selection for down-regulation and location selection for up-regulation respectively.

The parameter estimates for the direct effects are presented in **Table 5.20**, while the indirect effects are outlined in **Table 5.21**.

The analysis revealed key insights into the direct relationships between the explored variables.

1. Direct effects of experimental groups on location selection for up- and down-regulation: The analysis found significant direct effects of the experimental groups on participants' scores of location selection for both up-regulation and down-regulation. Specifically, the arctic scenario significantly increased the likelihood of selecting that environment for both up-regulation ($\beta = .319$, $p = .015$) and down-regulation ($\beta = .476$, $p < .001$). Similarly, the forest scenario had a notable positive impact on location selection scores for both up-regulation ($\beta = .419$, $p = 0.002$) and down-regulation ($\beta = .588$, $p < .001$). For the flowery field scenario, while there was no significant effect on location selection for up-regulation ($\beta = .137$, $p = .301$), it did show a significant positive effect on down-regulation ($\beta = .402$, $p < .001$). Similarly, the island scenario did not significantly influence location selection score for up-regulation selection ($\beta = .247$, $p = .062$), but it did have a strong positive effect on location selection for down-regulation ($\beta = .647$, $p < .001$).

   Overall, the model explained a substantial amount of variance in location selection for both up-regulation ($R^2 = .327$, *95% CI* = .025 – .294, $p = .016$) and even more for down-regulation ($R^2 = .581$, *95% CI* = .161 – .496, $p < .001$). These findings underscore the significant impact of VR nature scenarios in shaping participants' perceptions of these settings as effective locations for managing their emotions.

2. Direct effects of experimental groups on negative emotions post-intervention: Results showed that none of the experimental groups had direct effects on negative emotions post-intervention. Specifically, the arctic scenario did not significantly reduce negative emotions (β = -.058, p = .573), nor did the forest scenario (β = .003, p = .977). Similarly, the flowery field and island scenarios also failed to show direct significant effects on negative emotions post-intervention, with β = -.110, p = .271 and β = .028, p = .802, respectively.
3. Direct effects of location selection for up- and down-regulation on negative emotions post-intervention: The results revealed that location selection for down-regulation had a significant direct effect in reducing negative emotions post-intervention (β = -.331, p = .001). This finding confirms that higher ratings of location selection for down-regulation in the experimental group predict fewer negative emotions after the intervention. Conversely, location selection for up-regulation did not exhibit a significant direct effect on negative emotions post-intervention (β = .112, p = .216).

Finally, the pre-intervention negative emotions (PANAS 2) significantly predicted negative emotions post-intervention (β = 0.690, p < .001), as expected.

The model explained a substantial portion of the variance in negative emotions post-intervention (R^2 = 0.58, *95% CI* = .423 – .708, p < .001).

Concerning the indirect effects, results revealed that location selection for down-regulation consistently mediated the relationship between experimental groups and post-intervention negative emotions. Specifically, for the arctic scenario, the indirect effect via down-regulation was significant (β = -.158, p = .011). The forest scenario also showed a significant indirect effect of the location selection for down-regulation variable (β = -.195, p = .006). Similarly, the flowery field (β = -.133, p = .018) and island (β = -.214, p = .005) scenarios exhibited significant indirect effects of location selection for down-regulation. Conversely, location selection for up-regulation did not show significant mediation effects across any of the experimental groups (p > .050).

When analysing the total effects of the experimental groups on post-intervention negative emotions, most of the VR natural scenarios did not yield significant results, except for the flowery field condition, which had a significant total effect (β = -.227, *SE* = .118, *95% CI* = -.502 – -.038, *p* = .023). This lack of significance can be attributed to the interplay between indirect effects and direct effects that exhibited opposing signs.

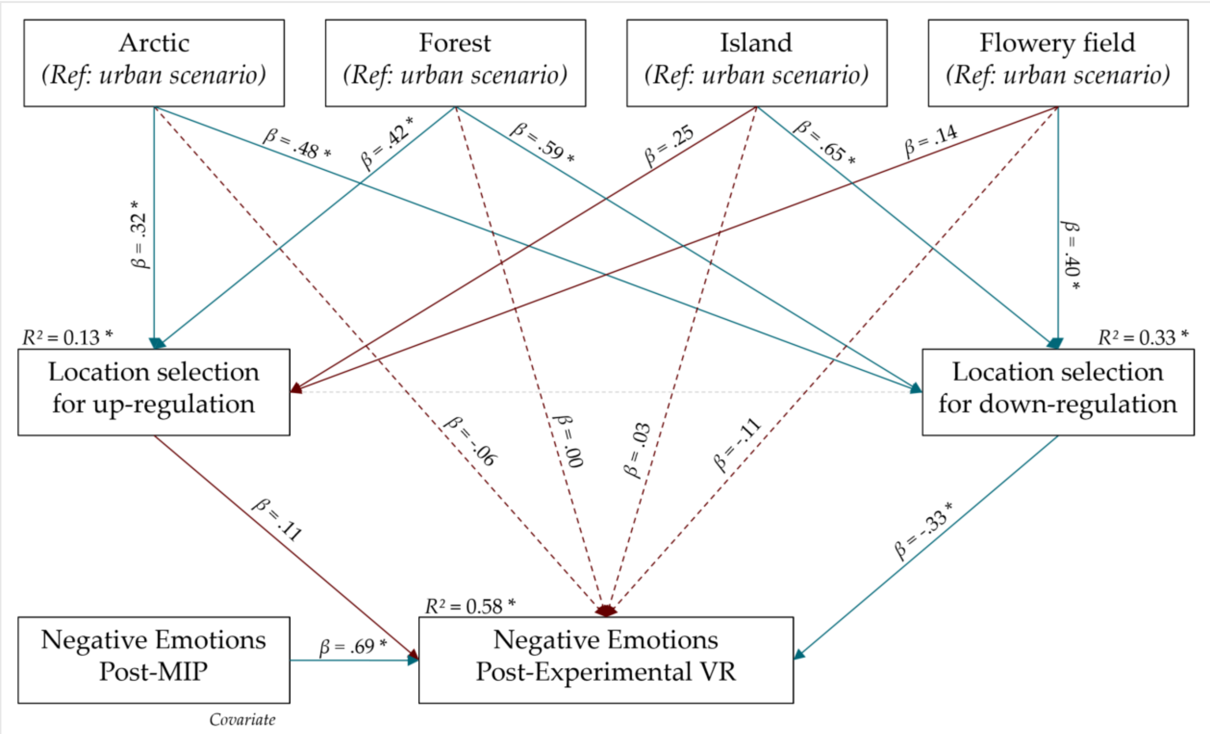
In summary, this analysis provided partial support for the hypothesized parallel mediation model (**Figure 5.19**), revealing the nuanced role of location selection in the relationship between environmental groups and post-intervention negative emotions.

Location selection for down-regulation emerged as a key factor in reducing negative emotions across the various experimental groups with VR natural scenarios. Specifically, nature scenarios significantly enhanced individuals' ratings of location selection for down-regulation compared to the experimental group with the VR urban scenario. Participants perceived the VR nature scenarios as ideal for seeking relaxation and alleviating stress, which played a crucial role in reducing subsequent negative emotions post-intervention.

In contrast, the analysis revealed that location selection for up-regulation did not serve as a significant mediator in the relationship between experimental group and post-intervention negative emotions.

These findings underscore the importance of down-regulation location selection in facilitating emotional recovery in VR nature environments, while highlighting that up-regulation location selection may play a lesser role in mitigating negative emotions in these contexts.

Figure 5.19. *Conceptual parallel mediation model (H_8) with standardized coefficients tested in Study 6, linking experimental groups to negative emotions post-intervention with mediation through LS variables.*



Note. Solid line: direct effects; dashed line: indirect effects; green lines: statistically significant effects; red lines: non-significant effects; *: significant effects ($p < .050$).

Table 5.20. *Parameter estimates for the direct effects of the parallel mediation model (H_8) tested in Study 6*

Dependent	Predictor	*Estimate*	*SE*	*95 % Confidence Intervals*		*β*	*z*	*p*
				Lower	*Upper*			
PANAS 3 – NA	LS up-regulation	0.037	0.030	-0.022	0.096	0.112	1.236	0.216
PANAS 3 – NA	LS down-regulation	-0.092	0.028	-0.147	-0.036	-0.331	-3.233	0.001
PANAS 3 – NA	Arctic	-0.070	0.124	-0.314	0.174	-0.058	-0.563	0.573
PANAS 3 – NA	Forest	0.004	0.128	-0.247	0.254	0.003	0.029	0.977
PANAS 3 – NA	Flowery field	-0.131	0.119	-0.364	0.102	-0.110	-1.100	0.271
PANAS 3 – NA	Island	0.033	0.131	-0.223	0.289	0.028	0.251	0.802
PANAS 3 – NA	PANAS 2 – NA	0.410	0.045	0.321	0.498	0.690	9.077	<.001
LS up-regulation	Arctic	1.158	0.476	0.224	2.092	0.319	2.431	0.015
LS up-regulation	Forest	1.484	0.469	0.566	2.403	0.419	3.167	0.002
LS up-regulation	Flowery field	0.484	0.469	-0.434	1.403	0.137	1.033	0.301
LS up-regulation	Island	0.875	0.469	-0.044	1.794	0.247	1.867	0.062
LS down-regulation	Arctic	2.088	0.507	1.095	3.080	0.476	4.121	< .001
LS down-regulation	Forest	2.516	0.498	1.539	3.492	0.588	5.048	< .001
LS down-regulation	Flowery field	1.719	0.498	0.742	2.695	0.402	3.449	< .001
LS down-regulation	Island	2.766	0.498	1.789	3.742	0.647	5.550	< .001

Table 5.21. *Parameter estimates for the indirect effects of the parallel mediation model (H_8) tested in Study 6*

Indirect paths	*Estimate*	*SE*	*95 % Confidence Intervals*		*β*	*z*	*p*
			Lower	*Upper*			
Arctic ⇒ LS up-regulation ⇒ PANAS 3 – NA	0.043	0.039	-0.034	0.120	0.036	1.102	0.271
Arctic ⇒ LS down-regulation ⇒ PANAS 3 – NA	-0.192	0.075	-0.339	-0.044	-0.158	-2.544	0.011
Forest ⇒ LS up-regulation ⇒ PANAS 3 – NA	0.055	0.048	-0.039	0.150	0.047	1.152	0.250
Forest ⇒ LS down-regulation ⇒ PANAS 3 – NA	-0.231	0.085	-0.397	-0.065	-0.195	-2.722	0.006
Flowery field ⇒ LS up-regulation ⇒ PANAS 3 – NA	0.018	0.023	-0.027	0.063	0.015	0.793	0.428
Flowery field ⇒ LS down-regulation ⇒ PANAS 3 – NA	-0.158	0.067	-0.289	-0.027	-0.133	-2.359	0.018
Island ⇒ LS up-regulation ⇒ PANAS 3 – NA	0.033	0.032	-0.029	0.095	0.028	1.031	0.303
Island ⇒ LS down-regulation ⇒ PANAS 3 – NA	-0.254	0.091	-0.432	-0.076	-0.214	-2.794	0.005

Hypotheses testing – Phase 2

This section presents confirmatory analyses for the hypotheses derived from data collected in Phase 2, where participants expressed their preferences for the VR scenarios and rated all non-assigned VR scenarios based on location selection and perceived restorativeness. Additionally, the ratings from Phase 1 for the scenarios participants experienced as experimental conditions were incorporated into these analyses, allowing comparisons with the ratings of the full sample.

H_9) *Preferences among scenarios*

Participants were asked to indicate their overall favorite scenario among the five they explored. The distribution of preferences is showed in **Table 5.22**.

A chi-square goodness-of-fit test was conducted to examine differences in the choice frequencies across the scenarios. The results were statistically significant, χ^2 (4) = 27.772; $p < .001$, suggesting that participants showed distinct preferences for the scenarios. Specifically, the urban scenario was chosen significantly less frequently (3.8%) than expected, while the island (31.6%) and forest (30.4%) scenarios were preferred more than expected.

These findings indicate a significant preference for the VR natural scenarios, supporting the hypothesis that the VR urban scenario is less favoured compared to the other environments (H_{9a}).

Table 5.22. *Frequencies of the overall preferred VR scenario in Study 6*

Experimental scenario	Counts	% of Total
Arctic	21	26.6 %
Forest	24	30.4 %
Flowery field	6	7.6 %
Island	25	31.6 %
Urban	3	3.8 %

Participants were also asked to select the VR scenario they would choose for managing negative emotions and improving their mood. The frequencies are indicated in **Table 5.23**.

A chi-square goodness-of-fit test was conducted to examine differences in the choice frequencies for emotion regulation scenarios. The results were statistically significant, χ^2 (4) = 57.519; p < .001, suggesting that participants exhibited distinct preferences for the scenarios. Specifically, the urban scenario was chosen significantly less frequently (1.3%) than expected, while the forest (43.0%) and island (38.0%) scenarios were preferred more than expected.

These results highlight a clear preference for VR natural scenarios in managing emotions, supporting the hypothesis that the VR urban scenario is less preferred than the other environments (H_{9b}).

Table 5.23. *Frequencies of the preferred VR scenario for emotion regulation in Study 6*

Experimental scenario	Counts	% of Total
Arctic	6	7.6 %
Forest	34	43.0 %
Flowery field	8	10.1 %
Island	30	38.0 %
Urban	1	1.3 %

Lastly, participants indicated which scenario they would choose to restore their ability to concentrate. The distribution of preferences is presented in **Table 5.24**.

A chi-square goodness-of-fit test was conducted to assess differences in choice frequencies across the scenarios. The results were statistically significant, χ^2 (4) = 54.734; p < .001, revealing that participants exhibited clear preferences. Specifically, the forest scenario was chosen by more than half of the participants (50.6%), while the urban scenario was selected significantly less frequently (2.5%).

These findings underscore a strong preference for VR natural scenarios in promoting concentration, reinforcing the hypothesis that the VR urban scenario is less favoured compared to the other environments (H_{9c}).

Table 5.24. *Frequencies of the preferred VR scenario for concentration recovery in Study 6*

Experimental scenario	Counts	% of Total
Arctic	11	13.9 %
Forest	40	50.6 %
Flowery field	8	10.1 %
Island	18	22.8 %
Urban	2	2.5 %

Overall, these findings consistently demonstrate a clear preference for natural environments, particularly the forest first of all and then for the island scenarios, for both emotion regulation and concentration, further emphasizing the restorative benefits of nature in general as compared to urban settings, and especially for certain natural landscapes over other ones.

H_{10}) *Differences across experimental scenarios in terms of Location Selection*

Repeated Measures ANOVAs were conducted on both up-regulation and down-regulation scores of location selection for emotion regulation. Descriptive statistics are presented in **Table 5.25**.

Table 5.25. *Descriptive statistics of location selection for emotion regulation scores by experimental scenarios: means and standard deviations in parentheses (Study 6)*

Variables	Experimental scenario				
	Arctic	*Forest*	*Island*	*Flowery field*	*Urban*
LS up-regulation	4.34 (1.69)	4.97 (1.59)	4.51 (1.65)	3.86 (1.64)	2.66 (1.49)
LS down-regulation	4.76 (1.69)	5.94 (1.11)	5.78 (1.53)	4.95 (1.62)	2.31 (1.43)

The results for up-regulation revealed a significant main effect of the experimental scenarios, $F(4, 78) = 35.8$, $\eta^2 = 0.195$, $p < .001$. Post-hoc analyses indicated that all VR natural scenarios were rated significantly higher for location selection for up-regulation compared to the VR urban scenario (H_{10a}).

Specifically, the arctic scenario ($M = 4.34$, $SD = 1.69$) was selected significantly more often than the urban scenario ($M = 2.66$, $SD = 1.49$) for up-regulation, $t(78) = 6.84$, *mean difference* = 1.69, $p_{tukey} < .001$. However, arctic scenario received significantly lower scores for up-regulation compared to the forest scenario ($M = 4.97$, $SD = 1.59$), $t(78) = -3.54$, *mean difference* = -0.63, $p_{tukey} = .006$. Additionally, the forest scenario was reported as significantly better location for up-regulation compared to the urban scenario, $t(78) = 9.58$, *mean difference* = 2.31, $p_{tukey} < .001$; as well as the island ($M = 4.51$, $SD = 1.65$), $t(78) = 3.03$, *mean difference* = 0.46, $p_{tukey} = .027$, and flowery field scenarios ($M = 3.86$, $SD = 1.64$), $t(78) = 6.70$, *mean difference* = 1.11, $p_{tukey} < .001$. Furthermore, both the flowery field and island scenarios were significantly preferred over the urban scenario, respectively: $t(78) = 4.76$, *mean difference* = 1.21, $p_{tukey} < .001$, and $t(78) = 8.34$, *mean difference* = 1.86, $p_{tukey} < .001$. Finally, the island scenario was rated higher than the flowery field, $t(78) = 3.46$, *mean difference* = 0.65, $p_{tukey} = .008$.

The other comparisons between the different natural conditions did not reach statistical significance.

Similarly, the analyses demonstrated a significant main effect of experimental scenarios on down-regulation, $F(4, 78) = 92.9$, $\eta^2 = 0.434$, $p < .001$. Post-hoc comparisons highlighted that all natural scenarios were considered more suitable for down-regulation compared to the urban scenario (H_{10b}).

In particular, arctic scenario ($M = 4.76$, $SD = 1.69$) was rated significantly higher than the urban scenario ($M = 2.32$, $SD = 1.43$), $t(78) = 9.15$, *mean difference* = 2.44, $p_{tukey} < .001$. However, the arctic scenario was selected significantly less often for down-regulation than the forest ($M = 5.94$, $SD = 1.11$) and island scenarios ($M = 5.78$, $SD = 1.53$), respectively: $t(78) = -6.20$, *mean difference* = -1.18, $p_{tukey} < .001$, and $t(78) = -4.34$, *mean difference* = -1.02, p_{tukey} < .001. Furthermore, results showed that the forest scenario was rated significantly higher than the urban one, *t*(78) = 18.12, *mean difference* = 3.62, p_{tukey} < .001, as well as the flowery field scenario (*M* = 4.95, *SD* = 1.62), *t*(78) = 6.15, *mean difference* = 0.98, p_{tukey} < .001. Moreover, the island scenario was reported with higher scores for down-regulation compared to the urban scenario, *t*(78) = 14.36, *mean difference* = 3.46, p_{tukey} < .001, and the flowery field scenario, *t*(78) = 4.31, *mean difference* = 0.83, p_{tukey} < .001. Finally, the flowery field scenario was rated higher for down-regulation than the urban scenario, *t*(78) = 10.32, *mean difference* = 2.63, p_{tukey} < .001.

Overall, these findings suggest a consistent preference for natural environments over urban settings for both up-regulation (H_{10a}) and down-regulation (H_{10b}), as hypothesized, with certain natural scenarios, such as the forest and island, being particularly favoured across both regulatory goals.

H_{11}) *Differences across experimental scenarios in terms of place perceived restorativeness*

A repeated measures ANOVA was conducted to examine differences in perceived restorativeness across the five experimental scenarios, aiming to determine whether the perceived restorativeness varied significantly depending on the environment. Descriptive statistics are reported in **Table 5.26.**

Table 5.26. *Descriptive statistics of place perceived restorativeness by experimental scenarios (Study 6)*

Experimental scenario	*Mean*	*SD*
Arctic	7.05	1.99
Forest	8.03	1.71
Island	7.80	2.13
Flowery field	6.53	2.24
Urban	2.83	1.96

The analysis revealed a significant main effect of the experimental scenario on place perceived restorativeness, $F(4, 308) = 108$, $\eta^2 = 0.470$, $p < .001$.

To explore specific differences between scenarios, post-hoc comparisons were performed using *Tukey*'s HSD test. Significant differences were observed between several scenario pairs. Specifically, the arctic scenario ($M = 7.05$, $SD = 1.99$) was perceived as much more restorative than the urban scenario ($M = 2.83$, $SD = 1.96$), $t(77) = 12.21$, *mean difference* = 4.21, $p_{tukey} < .001$. Moreover, the arctic scenario was perceived as significantly less restorative than the forest scenario ($M = 8.03$, $SD = 1.71$), $t(77) = -4.97$, *mean difference* = -0.99, $p_{tukey} < .001$. Similarly, the forest scenario was perceived as more restorative compared to the urban scenario, $t(77) = 17.22$, *mean difference* = 5.20, $p_{tukey} < .001$. Further, the forest scenario was rated significantly higher in restorativeness compared to the flowery field, ($M = 6.53$, $SD = 2.24$), $t(77) = 5.83$, *mean difference* = 1.46, $p_{tukey} < .001$. The island scenario ($M = 7.80$, $SD = 2.13$) was also perceived as significantly more restorative than the urban scenario, $t(77) = 15.06$, *mean difference* = 4.99, $p_{tukey} < .001$, as well as the flowery field scenario, $t(77) = 4.85$, *mean difference* = 1.26, $p_{tukey} < .001$. Finally, even the flowery field scenario, which was rated lower than other natural scenarios, was significantly more restorative than the urban scenario, $t(77) = 10.29$, *mean difference* = 3.73, $p_{tukey} < .001$ with a mean difference of 3.733, $p < .001$. The other post-hoc comparisons between natural environments are not significant.

These results confirm that the type of environment represented in the VR scenarios has a significant impact on perceived restorativeness, with natural settings, particularly the forest and island scenarios, perceived as far more restorative than the urban environment. These findings are consistent with the hypothesis and in line with theories suggesting that natural settings, and more specifically VR nature scenarios, offer psychological benefits, including greater perceived restorativeness, compared to urban environments and scenarios.

5.3.3. Discussion – Study 6

This study aimed to investigate the effects of different virtual environments—specifically natural and urban settings—on emotional recovery and the use of emotion regulation strategies following a negative mood induction. Building on the findings from Study 5, this research seeks to expand the knowledge of how immersive experiences can affect emotional responses. It draws on existing literature that highlights the psychological benefits of nature exposure to explore whether virtual representations of natural environments can elicit similar emotional recovery benefits as actual nature exposure.

By employing a between-subject design and utilizing 360-degree VR technology, the study aimed to provide an analysis of emotional recovery processes and assess the effectiveness of different virtual scenarios in promoting adaptive emotion regulation strategies while simultaneously reducing maladaptive ones. Specifically, the present study focuses on four key areas related to emotional experiences in virtual environments.

First, it investigates how exposure to various virtual settings affects emotional recovery following negative mood induction, to verify the efficacy of these environments in alleviating negative emotions and facilitating a return to baseline emotional states. Second, the study explores the emotion regulation strategies individuals employ in response to different environmental contexts. It aims to understand how various virtual environments influence the use of adaptive versus maladaptive strategies and examines the differences between habitual (trait) and situational (state) responses to negative emotions. Third, the research delves into exploratory models that investigate the underlying mechanisms contributing to emotional recovery, with a particular emphasis on perceived restorativeness and emotion regulation strategies, as discussed in Study 5. Additionally, it explores the potential mediating role of location selection for emotion regulation. This area seeks to uncover how these factors differ between natural and urban settings and their impact on emotional outcomes. Lastly, the study highlights the differences across virtual environments by examining potential variations in participants' preferences of scenarios, perceived restorativeness and location selection for emotion regulation.

Concerning the first focus on emotional recovery, it was hypothesized that participants would experience a decrease in negative emotions following exposure to the virtual environments (H_1), and that this reduction would be more pronounced in the experimental groups with the VR natural scenarios compared to the experimental group with the VR urban scenario (H_2). Additionally, it was posited that negative emotions would return to baseline levels after the intervention, in particular for the natural scenarios' experimental groups (H_3).

The results confirmed H_1, indicating a significant reduction in negative emotions after the exploration of the virtual scenarios across all experimental groups. Participants reported lower levels of negative emotions in the post-test compared to the pre-test, confirming the effectiveness of the intervention.

In contrast to the anticipated greater reduction for participants exposed to natural scenarios compared to those in urban environments outlined in H_2, the analysis did not reveal a significant interaction effect between the intervention and the type of environment, suggesting similar levels of negative emotion post-intervention across the experimental groups. However, post-hoc comparisons highlighted that the reduction of negative emotions from pre- to post-intervention was statistically significant for all the experimental groups with VR natural scenarios, but not for the urban experimental group. This suggests that while participants in natural environments experienced meaningful emotional recovery, those in urban settings did not benefit to the same extent.

Regarding H_3, the results indicated that the levels of negative emotions post-intervention were not statistically significant from baseline levels across all experimental groups, suggesting that participants returned to their baseline emotional states as hypothesized. Even though all experimental scenarios, including the urban one, seemed to allow participants to return to baseline levels of negative emotions, the means trend suggests that the urban environment may not have provided the same degree of emotional restoration as the natural environments. Specifically, negative emotions were lower in the post-intervention for all the experimental groups with the VR natural scenarios compared to baseline levels, indicating meaningful emotional recovery in these settings. In contrast, participants in the urban experimental group showed higher negative emotions in the post-intervention than at baseline, reflecting a less effective emotional restoration process. This trend suggests that while natural environments facilitated a return to baseline emotional states, the urban environment did not fully support emotional regulation, leading to persistently higher negative emotions after the intervention.

Overall, these findings are consistent with existing literature that highlights the superior emotional restorative effects of natural environments, reinforcing the idea that nature offers distinct psychological benefits compared to urban settings (e.g., Pearson & Craig, 2014; Hartig et al., 1991; Ulrich et al., 1991). As observed in previous research, the VR natural environments in this study significantly reduced negative affect, showing a notable decrease in negative emotions compared to urban environments, as supported by earlier findings (for a meta-analysis, see Bolouki, 2024). This result further underscores the potential of VR nature to mimic the restorative effects of real-world nature, offering promising implications for mental health interventions.

About the second objective of the present study, two main hypotheses were explored related to emotion regulation: it was hypothesized that participants in the experimental groups with VR natural scenarios would use more adaptive (H_{4a}) and fewer maladaptive (H_{4b}) emotion regulation strategies compared to those in the urban experimental groups, and differences between trait (habitual) and state (situational) emotion regulation strategies across conditions were expected (H_5).

Contrary to hypothesis H_4, the results showed no significant differences in the use of adaptive or maladaptive emotion regulation strategies between the natural and urban scenarios. Participants across all experimental groups, whether exposed to natural or urban settings, reported similar levels of both adaptive strategies (e.g., cognitive reappraisal) and maladaptive strategies (e.g., brooding or rumination), as in Study 5. These findings suggest that, in this study, the type of virtual scenario (natural vs. urban) did not substantially influence the emotion regulation strategies participants employed to manage their negative emotions during the intervention.

This contrasts with prior research suggesting that natural environments tend to promote more adaptive and less maladaptive emotion regulation, as highlighted in **Chapter 2**, potentially indicating that the immersive nature of the virtual experience itself, regardless of environmental type, may limit the differentiation in regulation strategies. It is also possible that the relatively short exposure time to the virtual scenarios was not sufficient to trigger significant changes in emotion regulation strategy use, which might require prolonged engagement or real-world context to have a more pronounced effect.

As in Study 5, it is important to highlight that while no significant differences in the use of emotion regulation strategies were found across experimental conditions, the overall reduction in negative emotions suggests that some form of emotion regulation was effective, even if it was not consciously recognized or reported by participants.

Concerning the differences between trait and state emotion regulation strategies (H_5), the results supported the hypothesis that there would be significant differences between these levels across all experimental groups. Across both natural and urban experimental groups, participants consistently reported higher use of adaptive emotion regulation strategies at the trait level (habitual use) than in the situational (state) context during the intervention. The differences between trait and state strategies, particularly for adaptive strategies and maladaptive strategies, were consistently observed across scenarios, indicating that participants were less effective at deploying adaptive strategies during the VR experience independently from their experimental group. Similar results were observed for maladaptive strategies, with higher use of these strategies reported at the trait level compared to the state level across all conditions.

These differences between emotion regulation strategies' use at trait and state level, aligns with recent emotion regulation theories that emphasize the importance of context in understanding the consequences of ER strategy use, suggesting that static trait ER measures may not fully capture the dynamic nature of regulation across different contexts (Aldao, 2013; Bonanno & Burton, 2013). Several studies examining ER in naturalistic settings have similarly found greater within-person variability in ER strategy use across time and situations (e.g., Brans et al., 2013; Brockman et al., 2017). It is important to note that trait measures often rely on retrospective recall, which can be prone to biases like intensity or recency effects (Schwarz, 2012), potentially explaining the discrepancy between trait and state use. Contrary to expectations, while the main effect of trait versus state differences was significant, the type of virtual environment (natural vs. urban) used for the intervention did not affect these differences. This implies that although participants exhibited clear distinctions between their habitual and situational use of emotion regulation strategies, the virtual environment itself did not substantially impact these patterns. Natural environments did not lead to the expected advantages in the use of adaptive emotion regulation strategies during the VR experience, as it has been hypothesized in the study and proposed by prior literature.

As observed in Study 5, this finding suggests that while nature may offer emotional benefits, the immersive nature of VR alone may not be enough to enhance emotion regulation in real-time. This highlights the possibility that the immersive virtual experience alone may not be sufficient to trigger differences in emotion regulation processes based solely on environmental context. The findings point to the need for future research to explore longer-term exposure to virtual environments or perhaps more deeply engaging experiences to better understand how VR can impact emotion regulation strategies.

The third objective of the study aimed to explore potential mechanisms underlying the impact of the different environmental contexts (natural vs. urban) on negative emotions post-intervention. Specifically, two explanatory model were proposed and tested.

First, a serial-parallel mediation model was examined, hypothesizing that the perception of place restorativeness (PRS) and emotion regulation strategies (adaptive and maladaptive, in parallel) would mediate the relationship between environmental conditions and negative emotions (H_6). The results provided partial support for the hypothesized pathways. The direct effects of the experimental groups on PRS were significant. Participants exposed to VR natural scenarios perceived these settings as more restorative compared to those in the urban scenario's experimental group, which aligns with prior research on the restorative qualities of nature (Kaplan & Kaplan, 1989; Hartig et al., 1991). Conversely, VR urban scenario had a negative impact on PRS, reaffirming the well-documented distinction between the restorative potential of natural versus urban environments (Menardo et al., 2021).

Regarding the direct effects of PRS on adaptive and maladaptive emotion regulation strategies, the results were not significant. Despite the expectation that higher perceived restorativeness in natural scenarios would promote the use of more adaptive strategies and reduce maladaptive strategies, this relationship did not hold in the current study. This lack of significance suggests that, while participants perceived natural scenarios as more restorative, this perception did not directly translate into greater use of adaptive strategies or a decrease in maladaptive strategies. This finding contrasts with results of Study 5, which suggested that environments perceived as restorative enhance the use of adaptive emotion regulation strategies. Moreover, the non-significant relationship between PRS and maladaptive strategies suggests that even in environments perceived as restorative, participants' tendency to engage in maladaptive strategies may not be directly influenced by their perceived restorativeness of the place. This result is consistent with the findings of Study 5, where no direct effects of perceived restorativeness were observed on the use of maladaptive emotion regulation strategies.

Further, the direct effect of adaptive emotion regulation strategies on negative emotions post-intervention was not significant. This result suggests that although participants may have engaged in adaptive strategies, these strategies did not directly lead to a significant reduction in negative emotions. This contradicts some previous research that positions adaptive strategies as key in managing negative emotions (Aldao & Nolen-Hoeksema, 2012; Gross, 2015; Gross & John, 2003). It is possible that the brief nature of the VR intervention did not allow participants enough time to fully implement adaptive strategies, or that these strategies were less effective in the context of short-term emotional recovery.

On the other hand, the direct effect of maladaptive strategies on negative emotions post-intervention was significant. Participants who engaged in maladaptive strategies experienced higher levels of negative emotions post-intervention. This finding is consistent with extensive research that links maladaptive strategies to poorer emotional outcomes (Aldao et al., 2010). The results emphasize that maladaptive strategies play a crucial role in sustaining or exacerbating negative emotional states, regardless of the environmental context.

In terms of the indirect effects, the results showed that the serial mediation of PRS and emotion regulation strategies (adaptive and maladaptive) in the effects of the environmental groups on negative emotions post-intervention was not significant. This means that neither the use of adaptive strategies nor the reduction in maladaptive strategies, in combination with PRS, explained the link between the type of environment and emotional recovery. This contrasts with the findings from Study 5, where the indirect effect of PRS and adaptive emotion regulation strategies was significant, suggesting that perceived restorativeness in that study played a more influential role in enhancing adaptive strategies, which in turn reduced negative emotions.

However, in the present study, the indirect effect of just PRS as a mediator between the experimental groups and negative emotions post-intervention was significant. This indicates that PRS alone, without involving emotion regulation strategies, played a critical role in influencing emotional recovery. Participants who perceived their environment as more restorative experienced a reduction in negative emotions, regardless of their use of specific emotion regulation strategies. This finding reinforces the direct importance of environmental restorativeness in promoting emotional well-being, suggesting that the restorative qualities of natural settings can directly enhance emotional recovery, independent of adaptive or maladaptive strategies' use.

The contrast between the present findings and those of Study 5 highlights the complexity of the mechanisms through which environments affect emotional outcomes. While PRS consistently plays a central role, the involvement of emotion regulation strategies may depend on contextual factors, the type of environment, or the nature of the intervention.

Alternative models were tested, as in Study 5, but did not lead to significantly better fit indices or offer a more comprehensive explanation of the relationships among the variables of interest. Future research could further explore these dynamics, particularly by considering longer exposures or more immersive environments to better understand how PRS interacts with emotion regulation strategies over time.

The differences in findings between this study and Study 5 may be partially explained by differences in the study design. Indeed, in Study 5, a within-subject design was employed, where each participant experienced all environmental conditions. This design allowed for more direct comparisons within individuals, increasing sensitivity to changes in how they perceived restorativeness and utilized emotion regulation strategies across different settings. The within-subject design's capacity to more accurately capture individual responses to different environments could have facilitated the identification of significant indirect effects. In contrast, the current study employed a between-subject design, wherein different participants were assigned to distinct experimental groups. While this design mitigates potential carryover effects between conditions, it may also introduce increased variability among participants. Individual differences in trait emotion regulation and sensitivity to environmental stimuli may have contributed to the non-significant indirect effects observed in this study. The limitations of the between-subject design may hinder the detection of subtle variations in adaptive and maladaptive strategy use, which were more pronounced in the within-subject design of Study 5.

A second potential explanatory model was tested considering the novel concept of location selection, as a further preliminary emotion regulation strategy. Indeed, the current study aimed to investigate participants' preferences for natural versus urban environments as locations for emotion regulation, grounded in the premise that natural settings are generally more effective in promoting emotional well-being.

First, it was hypothesized that participants exposed to experimental conditions with VR natural scenarios would report higher ratings for location selection in both up-regulation (managing negative low arousal and enhancing positive high arousal; H_{7a}) and down-regulation (managing negative high arousal and enhancing positive low arousal; H_{7b}). For up-regulation, results showed that participants in the forest experimental group exhibited higher ratings for location selection for emotion regulation compared to those in the urban experimental group. This finding supports the notion that natural settings can enhance positive emotional states. However, the absence of significant differences among the other natural scenarios suggests that preferences for up-regulation may vary based on specific characteristics of each environment. In terms of down-regulation, the results were even more pronounced, with participants in all VR natural scenarios' experimental groups rating their locations significantly higher than those in the urban experimental group. This indicates a strong inclination to select any natural settings for down-regulation. Overall, the findings support the hypothesis that natural environments are preferred for managing negative emotions, particularly in down-regulation contexts, and align with existing literature on the restorative properties of natural environments, underscoring their crucial role in emotional recovery and regulation.

Based on these findings, the present experimental study further explored the novel concept of location selection, considering both location selection for up-regulation and down-regulation as potential parallel mediators in the relationship between experimental conditions and post-intervention negative emotions. Specifically, it was hypothesized that participants exposed to VR natural scenarios would exhibit higher ratings for location selection for both up-regulation and down-regulation of emotions, that would lead to a greater reduction of the level of negative emotions post-intervention (H_8).

The results provide partial support for the hypothesized parallel mediation model, revealing the nuanced role of location selection in the relationship between experimental group and post-intervention negative emotions. Location selection for down-regulation emerged as a key factor in reducing negative emotions across the various experimental groups. Specifically, the exposition to VR nature scenarios significantly enhanced individuals' ratings of location selection for down-regulation compared to the urban condition. Participants perceived the nature scenarios as ideal for seeking relaxation and alleviating stress, which played a crucial role in reducing negative emotions post-intervention. In contrast, the analysis revealed that location selection for up-regulation did not serve as a significant mediator in the relationship between experimental groups and post-intervention negative emotions. This may indicate that participants may not perceive nature scenarios as a source for stimulating high-arousal positive emotions or effectively diminishing low-arousal negative emotions in the same way they do for down-regulation. As a result, the potential of nature to counteract specific negative emotions through up-regulation remains less pronounced in this context.

The absence of a direct effect of location selection for up-regulation on negative emotions post-intervention suggests that while participants might recognize the potential of certain nature scenarios for up-regulation, the immediate impact of this concept on reducing negative emotions is less apparent. This could be attributed to participants prioritizing different emotional goals based on their current emotional state. Given that they were experiencing elevated levels of negative emotions prior to exploring the VR scenarios due to the mood induction procedure, their immediate focus may have been on alleviating distress rather than uplifting their emotions. Consequently, the up-regulation component of location selection may not be a central factor when individuals are in a deteriorated emotional state.

This distinction underscores the complexity of emotional responses to various environmental contexts, indicating that individuals may be more inclined to use natural environments for calming and restorative experiences when they need to regulate their emotions. In contrast, the goal of energizing and uplifting emotional states may become secondary when immediate emotional relief is needed. Such insights highlight the nuanced interplay between emotional regulation processes and environmental influences, warranting further investigation into how different contexts can support various emotional goals.

The model tested in Study 6 shares similarities with the one tested in Study 4 in exploring the effects of different natural environments on emotional reactions, particularly focusing on the mediation processes through emotion regulation strategies (location selection for up-regulation and down-regulation). Both studies assess how different environmental cues (e.g., images or features) influence emotional outcomes and the potential mediation of location selection variables in these processes.

However, several differences between the two studies should be highlighted. First, in Study 6, the dependent variable of negative emotion is not divided into valence and arousal, as in Study 4, where the dependent variables were more specifically related to emotional reactions induced by the images, measuring emotion in terms of both valence and arousal (pleasantness and relaxation). Additionally, Study 6 employed a negative mood induction procedure before the exploration of the VR scenarios, which differs from Study 4's focus on just evaluating the images. This distinction is important because the induced negative mood in Study 6 might have influenced emotional responses and the perception of suitability of the environments more directly, compared to the more neutral or naturally elicited emotions in Study 4.

Some key differences between the results of the two studies can be traced. In terms of location selection for emotion regulation, in Study 4, all experimental images had a significant direct effect on location selection for up-regulation, but only the blue element image had a significant effect on down-regulation. In contrast, Study 6 found that all experimental groups with different nature VR scenarios had a significant direct effect on location selection for down-regulation, but only the Arctic and Forest groups had a significant effect on up-regulation.

Regarding emotional outcomes, Study 4 showed that both location selection for up-regulation and down-regulation had an impact on emotional pleasantness, and only down-regulation had an impact on emotional relaxation. On the other hand, in Study 6, location selection for up-regulation did not impact negative emotions post-intervention, whereas only location selection for down-regulation was associated with changes in negative emotions.

In terms of indirect effects, the studies show distinct patterns of mediation.

In Study 4, the primary and consistent mediation effect was observed in the relationship between the experimental images and emotional pleasantness, where location selection for up-regulation played a significant mediating role. This indicates that the experimental images influenced participants' emotional pleasantness by increasing the perception of the environments as locations that facilitated emotional up-regulation. The mediation of pleasantness through up-regulation highlights the importance of using nature to enhance positive high-arousal and to reduce negative low-arousal emotional states in response to the images presented.

On the other hand, Study 6 demonstrated a different pattern of mediation, with the experimental group's influence being mediated through the location selection for down-regulation to impact negative emotions post-intervention. Specifically, the VR natural scenarios increased the perception of the environments as more suitable for down-regulation, which in turn led to a reduction in negative emotions post-intervention. This suggests that in Study 6, the natural environments were particularly effective at helping participants down-regulate negative emotions, emphasizing the role of these settings in emotion regulation when faced with negative moods or emotional challenges.

Thus, while both studies reveal the mediating role of location selection for emotion regulation strategies, they differ in the emotional outcomes and regulation strategies involved. Study 4 primarily focuses on up-regulation and its mediation of emotional pleasantness, whereas Study 6 highlights the role of down-regulation in mitigating negative emotions following exposure to nature-based interventions.

In conclusion, both Study 4 and Study 6 provide valuable insights into the role of natural environments in emotion regulation, with a focus on location selection for up-regulation and down-regulation. While the studies share similarities in their models and mediation processes, they also reveal some inconsistencies. These differences point to the potential role of contextual factors, such as the method of emotional induction and the nature of the environments (e.g., images versus immersive VR), in shaping the involved emotional regulation process and the specific pathways through which nature influences emotional outcomes.

Overall, both studies emphasize the importance of emotion regulation strategies as mediators in the relationship between nature and emotional responses. Future research should further explore these processes to gain a deeper understanding of the role and differences of these two variables in emotion regulation.

The current study also investigated participants' ratings of preferences for the five experimental VR scenarios (H_9) and explored potential differences across the environmental settings in terms of location selection for emotion regulation (H_{10}) and perceived restorativeness (H_{11}). The aim was to uncover not only the overarching distinctions between natural and urban settings but also the unique characteristics and nuances among various natural environments. Understanding these factors is crucial for identifying which specific settings may be most beneficial for enhancing emotional well-being and cognitive functioning.

Regarding preference ratings, the results revealed significant differences, with the VR urban scenario consistently receiving lower ratings than the natural environments, thereby supporting the hypothesis (H_9). Specifically, participants overall favoured the forest and island scenarios as their preferred environments, with the urban scenario receiving the least favour, as hypothesized (H_{9a}). When tasked with selecting scenarios for managing negative emotions, participants predominantly chose the forest scenario, reinforcing its consideration as a potent environment for emotional regulation. The urban scenario, with only one participant selecting it for this purpose, underscores its perceived inadequacy in facilitating emotional recovery, as expected (H_{9b}). In addition to managing negative emotions, participants indicated their preferred scenario for restoring concentration. Results revealed a significant preference for the forest environment in this context too, with over half of the participants selecting it for this purpose. This suggests that the forest not only serves as an effective location for emotional regulation but also as an optimal setting for enhancing cognitive functions, such as concentration. Again, the urban scenario was the least favoured, as posited (H_{9c}), indicating a consistent trend across different contexts. This preference aligns with existing literature that highlights the human preference of natural settings over urban environments (Kaplan, 1987; Kahn, 1997; Ulrich, 1983; Knopf, 1987; Kaplan & Kaplan, 1989; Hartig & Evans, 1993).

The results further demonstrated that participants significantly favoured natural environments over urban ones, for location selection for both up-regulation (H_{10a}) and down-regulation (H_{10b}), as hypothesized. Participants rated natural scenarios, especially the forest and island, as more suitable for managing both negative emotions and enhancing positive ones. In contrast, urban environments were consistently rated lower, suggesting that they are less effective for emotion regulation. The strong preference for natural settings reinforces the idea that these environments provide unique advantages in supporting emotional goals.

Findings about place perceived restorativeness revealed significant differences across the experimental scenarios, with natural environments consistently rated as more restorative than urban settings, in line with the hypothesis (H_{11}) and prior literature (for a review: Menardo et al., 2021). The forest scenario, in particular, strongly emerged as the most restorative environments in comparison to the other natural scenarios.

Overall, these findings emphasize the significant distinctions between VR natural and urban scenarios, highlighting the clear advantages of natural settings in terms of participant preferences, perceived restorativeness, and location selection ratings. The analysis reveals that the forest and island scenarios are the most preferred environments, particularly effective in managing negative emotions and enhancing perceived restorativeness.

The preference for the island and forest environments aligns with existing literature that underscores the restorative potential of blue and green spaces. Research has consistently shown that blue spaces, characterized by features such as light reflections, wave motion, and soothing sounds, contribute significantly to psychological well-being (Völker & Kistemann, 2015; Ruiz-Gil et al., 2020). The forest scenario, which incorporates both green and blue elements (i.e., the presence of a river), suggests that environments located at the intersection of land and water may offer optimal restorative experiences. This is supported by prior studies indicating the psychological benefits of such settings (e.g., Herzog, 1985; White et al., 2010), which may reflect evolutionary adaptations to both terrestrial and aquatic habitats (Morgan, 1997). Moreover, the forest environment exhibited the highest levels of biodiversity – visual and auditory – which has been associated with enhanced restorative qualities and overall well-being benefits (Carrus et al., 2015; Fisher et al., 2021), particularly within forested areas (Nghiem et al., 2021; Rozario et al., 2024). These results are also in line with findings of Study 4, which highlighted the beneficial impact of the presence of blue elements in green areas.

Concerning the arctic scenario, findings suggest that it may also be restorative when compared to urban environments, thus highlighting the potential value of "white" and "polar" spaces, an area that remains underexplored in existing literature. The allure of frozen landscapes is well documented (Duffy, 2013; Lengen, 2015), particularly in polar regions (Shah, 2015; Summerson & Lieser, 2018), which may explain the popularity of polar tourism for sightseeing (Bauer, 2013), as well as the historically increased attraction of winter mountain locations for tourism, sport, health, and well-being. Emerging studies propose that white spaces can serve as therapeutic landscapes for well-being enhancement (e.g., Brooke & Williams, 2021). This study emphasizes the aesthetic appeal of polar environments and their association with emotional benefits. However, the arctic environment was rated as less restorative and less effective for emotion regulation than the forest and island settings. This discrepancy may be attributed to participants' unfamiliarity with these environments and the discomfort associated with cold conditions. Additionally, the relative lack of appealing natural elements, along with a limited colour palette and fewer low-level features, may influence perceptions of restorativeness (Li et al., 2023). Future research should further investigate these effects and explore the potential influences of such environments.

Concerning the flowery field environment, while this scenario received favourable ratings compared to the urban environment, it was the least preferred and least restorative among the natural settings. This may be due to a lower presence of biodiversity and a lack of water features.

Investigating the specific characteristics of natural environments could provide valuable insights into the factors and environmental features that enhance perceived restorativeness and emotional regulation across various natural settings. By identifying the elements that contribute to individuals' preferences and the restorative qualities of different environments, future research can inform the design of therapeutic landscapes and nature-based interventions that effectively promote emotional well-being and cognitive recovery. Such insights could ultimately lead to the development of more tailored approaches in therapeutic practices, maximizing the beneficial effects of natural settings on mental health outcomes.

Limitations and future research directions. While the current study contributes valuable insights into the effects of virtual scenarios on emotional recovery and regulation, several limitations warrant consideration.

First, although this study employed immersive 360-degree VR technology, it may not have fully captured the complete sensory experience of natural environments. While VR enhances immersion, it cannot replicate direct interactions with real-world settings. The absence of significant differences in emotion regulation strategies across conditions may reflect this limitation. Future studies should explore more immersive methods, such as real-world field studies, to better simulate environmental experiences and assess their impact on emotion regulation and emotional recovery.

Second, the use of a between-subjects design, while beneficial in mitigating carryover effects, may have introduced variability among participants. Individual differences in trait emotion regulation and sensitivity to environmental stimuli could have influenced the results, potentially obscuring subtle effects of the different virtual environments. Future studies might consider employing a within-subjects design to allow for more direct comparisons of participants' experiences across different virtual environments, thereby increasing sensitivity to detect changes in emotional recovery and regulation strategies' use.

Additionally, the relatively short duration of exposure to the virtual environments might not have provided enough time for participants to fully engage with emotional regulation strategies or experience the restorative effects of the settings. Extended exposure periods or repeated sessions could yield more pronounced effects, particularly in natural environments, where longer interaction might enhance restorative benefits and influence deeper cognitive and emotional processes. Future research could investigate the effects of prolonged or repeated exposure to various natural and urban settings on emotion regulation processes.

A further limitation of the current study is the lack of a control condition to account for the potential effects of time on emotional regulation and recovery. While the study compared emotional regulation across different virtual environments, without a control group, it is difficult to determine whether the observed changes in emotion regulation strategies were solely due to the virtual environments or if they were influenced by the passage of time itself. Future research should include a control condition that isolates the effects of time to better assess the specific impact of virtual environments on emotional outcomes and to ensure that the changes observed are attributable to the environmental stimuli rather than temporal factors.

Moreover, the reliance on self-reported measures to assess preferences, perceived restorativeness, and emotion regulation strategies may introduce biases, as participants' evaluations could be influenced by subjective interpretations or prior experiences with similar environments. Incorporating objective measures, such as physiological indicators of stress and relaxation, or neurological indexes related to emotion regulation processes, could provide a more nuanced understanding of the emotional responses elicited by different environments.

Furthermore, while the study focused on self-reported emotion regulation strategies, it is possible that other mediating factors, such as attention restoration or specific cognitive appraisals, influenced emotional outcomes. Future studies should examine a broader range of mediators and moderators to gain a more comprehensive understanding of how environmental settings impact emotional well-being.

Also, while the study successfully highlighted significant distinctions between natural and urban settings, the unique characteristics of specific natural environments require further investigation. The current study primarily highlighted participants' preferences for the forest and island scenarios, yet it did not deeply explore what specific elements of these environments contribute to their perceived effectiveness for emotional regulation and cognitive functioning. Future studies should consider to more deeply investigate specific environmental attributes that may enhance perceived restorativeness and emotional benefits, together with individual preferences' factors that could affect these evaluations.

Finally, the sample may not represent the broader population, as individual differences in personality, cultural background, and prior experiences with nature could influence responses to environmental stimuli. Investigating how these factors might moderate the effects of environmental settings on emotion regulation and emotional outcomes would be beneficial for generalizability.

In summary, addressing these limitations and exploring the suggested future research directions could contribute to a more comprehensive understanding of the relationship between virtual environments, emotional regulation, and well-being. By identifying the elements that enhance perceived restorativeness and emotional regulation, future research can inform the design of therapeutic landscapes and nature-based interventions that effectively promote emotional well-being and recovery. Such insights could ultimately lead to the development of more tailored approaches in therapeutic practices, maximizing the beneficial effects of natural settings on mental health outcomes.

5.4. Conclusion

In an effort to explore the intricate relationship between environmental contexts and emotional regulation, two experimental studies were conducted, focusing on the effects of exposure to natural and urban environments through 2D videos and immersive VR scenarios. These studies aimed to investigate whether interactions with these environments could effectively reduce negative emotions following a negative mood induction and how this process relates to the use of adaptive and maladaptive emotion regulation strategies. The findings from Study 5 and Study 6 underscore notable similarities in the impact of different environmental contexts on emotional outcomes, particularly regarding negative emotions.

First, the two studies consistently illustrate that engaging with natural environments results in a significant reduction of negative emotions after the intervention, whether through the 2D videos (Study 5) or through the exploration of immersive VR scenarios (Study 6). In contrast, exposure to busy urban environments failed to yield reductions in negative emotions at the same extent, emphasizing the distinct emotional benefits that nature uniquely offers.

Second, both studies revealed that engaging with either natural or urban environments effectively restored negative emotion levels to baseline following a negative mood induction procedure, indicating that both types of environments can aid in emotional recovery, albeit with varying degrees of effectiveness. Notably, exposure to natural environments resulted in lower levels of negative emotions post-intervention compared to baseline levels, while negative emotions following exposure to urban environments remained higher than baseline levels, even if these differences were not statistically significant.

Interestingly, neither study found significant differences in the use of emotion regulation strategies across the different types of environments. Additionally, both studies revealed a lower utilization of both adaptive and maladaptive strategies during the intervention compared to participants' usual trait levels.

To further understand the underlying mechanisms behind the effects of the experimental environments on negative emotions post-intervention, both studies explored potential mediators.

In Study 5, the mediating effects of perceived restorativeness and adaptive emotion regulation strategies were significant. This indicates that the emotional benefits of viewing natural environments were notably influenced by the perceived restorative quality of these settings, which, in turn, enhanced the use of adaptive emotion regulation strategies, ultimately leading to reduced negative emotions post-intervention. Conversely, Study 6 did not identify a significant mediation model regarding the impact of VR scenario exploration on emotional regulation strategies. This suggests a more complex relationship between environmental context and emotional recovery within virtual settings, highlighting the need for further investigation into these dynamics.

However, in Study 6, a further model examined the mediating effect of location selection for both up-regulation and down-regulation of emotions. The results offered partial support for this model, highlighting the nuanced role of location selection. Specifically, participants exposed to VR natural scenarios reported significantly higher ratings for locations considered as suitable for down-regulation compared to those in the urban experimental group, indicating that nature scenarios were perceived as ideal for relaxation and stress relief, which effectively reduced negative emotions post-intervention. In contrast, location selection for up-regulation did not emerge as a significant mediator. This may be attributed to participants' focus on seeking immediate emotional relief due to heightened negative emotions from the mood induction procedure.

The observed reduction in negative emotions across both studies may point to a potential effective emotional regulation process at play. However, the absence of pronounced effects on ER strategies raises some considerations. It is possible that the environments viewed or explored may have activated specific emotions, effectively diminishing negative feelings without necessitating explicit regulatory strategies.

Moreover, the interventions may have acted as forms of disengagement, alleviating distress without requiring or leading to active emotional regulation. These considerations are in line with prior literature suggesting the dual-process framework of emotion regulation, which can be both implicit (unconscious) and explicit (conscious), and both forms are necessary for well-being (Koole & Rothermund, 2011; Gyurak et al., 2011). The existence of automatic, unconscious processes influencing human emotion, cognition, and behaviour is widely accepted and confirmed by numerous studies (e.g., Christou-Champi et al., 2015; Mauss et al., 2007; Volokhov & Demaree, 2010; Wentura et al., 2014). Automatic emotion regulation, which does not require conscious knowledge and intention, can operate outside of conscious awareness and influence the course of other processes, including negative emotions (Kobylińska & Karwowska, 2015).

Another critical point is that the brief exposure time of only 2 minutes may not have been sufficient to induce significant changes in the use of ER strategies. Furthermore, the reliance on simulated forms of nature exposure, such as 2D videos and VR scenarios, could have limited the immersive effects of the environments, reducing their impact on deeper cognitive processes involved in emotion regulation.

Given these findings, future research should consider several avenues to enhance the understanding of these dynamics. Using real, immersive environments rather than simulated ones could provide richer emotional experiences. Additionally, longer exposure times might allow for more profound emotional engagement and subsequent regulation. Including physiological measures could further elucidate the interplay between emotional responses and environmental contexts.

Finally, exploring real-life situations that necessitate emotion management, possibly utilizing ecological momentary assessment (EMA) techniques, would provide valuable insights into the practical applications of these findings in everyday contexts.

In summary, the convergence of results from both studies underscores the emotional advantages of natural environments while also highlighting the complexities surrounding emotion regulation strategies. These insights pave the way for further exploration of nature-based interventions aimed at promoting emotional well-being and the integration of these findings into therapeutic practices.

GENERAL DISCUSSION

The current thesis aimed to deepen the understanding of the intricate relationship between natural environments and emotion regulation, a critical psychological process with significant implications for mental health and adaptive functioning.

The research focused on three primary objectives. First, two systematic reviews were conducted to explore the role of nature in emotion regulation (**Chapter 2**; Review 1) and emotion elicitation through virtual reality (**Chapter 3**; Review 2), summarizing prior studies conducted on these topics and identifying gaps in the existing literature. Second, the thesis involved the development and validation of a scale measuring the novel concept of location selection (**Chapter 4**; S_1 – S_4). Finally, the impact of natural environments on emotion regulation processes was assessed through experimental studies (**Chapter 5**) utilizing both 2D (S_5) and virtual reality (S_6) stimuli.

This general discussion synthesizes the key findings, theoretical contributions, and methodological advancements, while also outlining the limitations and future directions for this evolving field of study.

Summary of key findings and contributions.

The initial part of this thesis presents two systematic reviews that highlight the potential connection between exposure to nature and its effects on emotion elicitation and emotion regulation.

The **first review**, which focuses on the role of nature-related aspects in emotion regulation processes, demonstrates that engaging with natural environments can enhance positive emotion regulation strategies, such as mindfulness, while simultaneously decreasing maladaptive strategies like rumination. These findings are consistent with the broader literature, suggesting that nature plays a vital role in fostering psychological resilience and enhancing emotional well-being. However, the review also emphasizes the limited number and heterogeneity of existing studies, indicating a pressing need for more robust and generalizable evidence in this area. It also emerged that only a few studies have utilized virtual reality scenarios to explore these processes, which highlights a significant gap in the literature. This underscores the necessity for further investigation into the effectiveness of virtual environments in facilitating emotion regulation, as well as the mechanisms that underpin these effects.

Consequently, a **second review** was conducted with a broader focus to further elucidate the effectiveness of virtual natural environments in eliciting emotional responses. This review highlights several key findings: it reveals that virtual environments, particularly those designed to simulate green spaces, consistently evoke positive emotions while reducing arousal and stress levels. Notably, interventions that involved longer exposure durations and interactive elements, were most effective in enhancing emotional and physiological benefits. Among the different types of virtual natural environments, green spaces, especially virtual forests, emerged as particularly impactful in promoting relaxation and positive emotional states. Additionally, blue spaces, although less frequently studied, were found to contribute to reduced arousal and increased feelings of tranquillity when expansive water vistas were included in the simulations. These results underscore the potential of virtual reality as a valuable tool for facilitating emotional well-being, suggesting that further exploration into the diverse range of natural environments could yield important insights for enhancing emotion regulation strategies.

In summary, these systematic reviews collectively highlight the critical role of both actual and virtual natural environments in promoting emotional well-being and effective emotion regulation, while also emphasizing the need for further research to fill existing gaps and explore the mechanisms that underpin these beneficial effects.

The second phase of this thesis addressed the gap in knowledge regarding how individuals select specific environments, particularly natural spaces, for emotion regulation by conceptualizing location selection, as a new category within the Process Model of Emotion Regulation, and subsequently developing the Location Selection in Nature Scale. The validation of this scale represents a significant advancement in understanding how individuals actively seek specific environmental contexts for emotion regulation. Its development highlights individuals' agency in employing natural spaces as part of their emotional coping strategies. The scale underwent rigorous testing and refinement through four studies, ultimately achieving validation in both English and Italian contexts and demonstrating applicability to specific environmental stimuli.

Study 1 initiated the development process by generating an initial set of items based on the theoretical framework of the Circumplex Model of Emotions (Russell, 1980). Preliminary validation assessed the scale's psychometric properties, revealing two key factors: up-regulation (i.e., managing positive high arousal and negative low arousal emotions) and down-regulation (i.e., managing positive low arousal and negative high arousal emotions). To further evaluate the factorial structure of the scale, additional confirmatory factor analyses compared the identified two-factor model with various alternative configurations, including one-factor, two-factor models based on arousal or valence, a four-factor model based on valence and arousal, and a hierarchical bifactor model. The results consistently supported the two-factor model of up-regulation and down-regulation as the most parsimonious and theoretically grounded solution, aligning with the findings from the exploratory factor analysis and confirming its appropriateness for the Location Selection Scale.

Study 2 refined the scale into a more concise version while confirming its reliability and validity through analyses of test-retest reliability and convergent validity, which upheld the two-factor structure identified in S_1. Additional analyses tested alternative models, including a one-factor model and a hierarchical bifactor model, further confirming the appropriateness of the identified two-factor structure as the best representation of the scale. Predictive validity was also demonstrated, indicating that individuals with higher scores on the scale reported greater engagement with natural environments for emotion regulation purposes, alongside lower levels of low-arousal negative affect, higher levels of high-arousal positive affect, and greater life satisfaction.

Study 3 expanded the validation by adapting the scale for Italian speakers. The cross-cultural validation confirmed the retention of the two-factor structure and comparable psychometric properties within the Italian context, broadening its applicability across diverse linguistic and cultural settings. Similar to S_2, additional analyses were conducted to test alternative models, including a one-factor model and a hierarchical bifactor model, further supporting the two-factor structure as the most suitable representation of the scale.

Finally, **Study 4** proposed an adapted shortened version of the Italian scale in an empirical context, using specific environmental stimuli (images of urban parks with different natural elements) to investigate how participants selected different natural environments for emotion regulation purposes. The findings confirmed the two-factor structure of the scale, affirming its versatility and extending its applicability beyond general natural environments to the evaluation of specific settings. Additionally, measurement invariance across the experimental images was confirmed, further supporting the scale's robustness and consistency across diverse environmental contexts. This indicates that the scale can be effectively utilized in various contexts, thereby enhancing our understanding of how different environments can be selected for emotion regulation processes.

The study also aimed to examine the relationships among experimental images, location selection for up-regulation and down-regulation, and emotional responses related to pleasantness (valence) and relaxation (arousal). It was hypothesized that manipulated images with indicators, in reference to the baseline image of the urban park, would enhance the perception of locations as effective for both up- and down-regulation, leading to more favourable emotional outcomes. Results confirmed that experimental images significantly influence how locations are perceived for emotion regulation, particularly for up-regulation, with up-regulation linked to increased pleasantness and down-regulation associated with greater relaxation, underscoring the complex interplay between environmental stimuli, emotion regulation processes, and emotional experiences.

Collectively, these studies underscore the robustness and versatility of the Location Selection in Nature Scale as a tool for assessing the use of natural environments for emotion regulation. By capturing both the up-regulation and down-regulation of emotional states, the scale offers valuable insights into the active role of environmental context in emotion regulation processes. The successful validation of the scale represents a major methodological advance, offering researchers and practitioners a tool to quantitatively assess how individuals leverage different environmental contexts for emotional regulation. Its successful application in both English and Italian contexts highlights its cross-cultural utility and potential for broader adoption in emotion regulation and environmental psychology research. Furthermore, the scale's practical implications extend to mental health interventions, urban planning, and public health initiatives, offering insights that can inform strategies aimed at enhancing emotional well-being in diverse settings.

The third part of the thesis examined the effects of simulated natural and urban environments on emotion regulation processes to assess how different types of natural stimuli impact emotional recovery and the specific emotion regulation strategies employed, following negative mood induction.

Specifically, **Study 5** employed a within-subject design where participants were exposed to three different environmental stimuli via 2D videos: a natural environment, a busy urban street, and an urban city centre.

The results showed that exposure to the natural and urban centre environments significantly reduced negative emotions after the interventions, whereas after the urban busy street condition, negative emotions remained the same level of the pre-intervention, supporting the idea that natural environments provide a more conducive context for emotional recovery. However, the use of explicit emotion regulation strategies, i.e., adaptive and maladaptive, did not significantly differ across environmental conditions. Further, a theoretical model was tested to explore the relationships between environmental context, perceived restorativeness, emotion regulation strategies, and emotional recovery. The results partly supported the model: participants when exposed to the natural environment showed greater emotional recovery, which was mediated by higher perceptions of place's restorativeness and in turn the facilitation of greater use of adaptive emotion regulation strategies. To further validate the findings, four alternative models were tested to explore other potential relationships between the variables and to evaluate the robustness of the proposed pathways. Only one of the alternative models showed reasonable fit indices; however, none provided a better explanation of the data than the original model.

Study 6 built upon the findings of Study 5 by employing 360-degree VR environments to enhance the immersive experience, featuring four natural scenarios (arctic, forest, island, and flowery field) alongside one urban scenario.

This between-subject study successfully replicated the emotional recovery effects observed in S_5, with participants showing greater reductions in negative emotions after exposure to VR-simulated natural environments compared to those in the urban setting. Additionally, the hypothesis positing significant differences in the use of emotion regulation strategies between conditions was not confirmed in this study too, reinforcing the idea that the benefits of natural environments may operate through more passive and unconscious emotional recovery processes. However, unlike S_5, the significant serial mediation model involving perceived restorativeness and emotion regulation strategies was not confirmed, indicating that perceived restorativeness was the only significant mediator. To further investigate the relationships between environmental context, perceived restorativeness, emotion regulation strategies, and emotional recovery, four alternative models were tested, similar to Study 5. Although some of these models demonstrated reasonable fit indices, none provided additional significant effects or pathways beyond those identified in the original model, reinforcing its robustness. Moreover, an additional model was tested that incorporated location selection for up-regulation and for down-regulation as potential parallel mediators. The results indicated that participants favoured natural environments for down-regulation, which had a significant impact on emotional outcomes post-intervention, thereby facilitating emotional recovery. These findings underscore the importance of both perceived restorativeness and location selection in understanding the emotional benefits of virtual natural environments.

Together, these two experimental studies provide robust evidence for the emotional benefits of virtual natural environments. They demonstrate that natural settings—whether experienced through videos or VR—can significantly improve emotional recovery after negative mood induction. Moreover, they suggest that these environments may not require the adaptation of conscious emotion regulation strategies, but instead foster automatic emotional recovery, a finding that adds depth to existing models of emotion regulation and restorative environments.

Table 6.1 presents the key findings and contributions from the various studies conducted in this thesis, offering an overview of how they enhance the understanding of nature's role in emotion regulation.

Table 6.1. *Summary of key findings*

Section	Main findings
Systematic reviews	
Review 1: Systematic review of nature's impact on emotion regulation	• Exposure to nature, along with nature connectedness, enhances adaptive emotion regulation strategies (e.g., mindfulness) and reduces maladaptive strategies (e.g., rumination), fostering psychological and emotional well-being. • Nature connectedness serves as a mediator, amplifying the positive impact of nature exposure on emotion regulation processes. • Additional research is needed to establish consistent findings across various types of nature exposure, including the largely unexplored role of VR-based nature in emotion regulation.
Review 2: Systematic review of VR nature's role in eliciting emotions	• VR nature environments consistently evoke positive emotional responses and relaxation while reducing arousal and stress levels. • Longer exposure durations and interactive elements in virtual environments enhance emotional and physiological benefits. • More research is needed to understand how different types of VR nature scenarios uniquely elicit emotional responses and impact emotion regulation.
Scale development	
Study 1: Item generation and initial English validation	• Introducing Location Selection as a new category within the Process Model. • Developing a scale to measure how individuals use natural spaces for ER, with item generated based on the Circumplex Model of Emotions. • Two factors: up-regulation (managing positive high arousal and negative low arousal emotions) and down-regulation (managing positive low arousal and negative high arousal emotions).
Study 2: English validation	• The scale was refined into a concise version, confirming its reliability and its convergent, divergent and predictive validity.
Study 3: Italian validation	• The scale was translated into Italian, confirming its two-factor structure and psychometric properties among Italian speakers.
Study 4: Applied version	• The Italian scale effectively assessed selection of various natural environments for emotion regulation.
Experimental studies	
Study 5: Tests emotional impact and emotion regulation processes in natural vs. urban 2D video settings	• Video interventions reduced negative emotions in nature and urban centre settings, but not in the urban street condition. • Negative emotions returned to baseline levels after viewing the videos, in all conditions, with greater reduction in the nature condition. • No significant differences were found in the use of adaptive or maladaptive emotion regulation strategies across conditions. • PRS and adaptive ER serial mediation: Higher PRS in nature correlated with increased use of adaptive strategies, leading to reduced negative emotions.
Study 6: Assesses emotional impact and emotion regulation processes of VR natural and urban scenarios	• VR exploration led to significant reductions in negative emotions, with nature scenarios more effective than urban ones. • All groups returned to baseline negative emotions post-intervention, with greater reductions in VR nature groups. • No significant difference in adaptive vs. maladaptive strategy among groups. • PRS mediation: Higher PRS in nature groups linked to greater reductions in negative emotions, though not predictive of regulation strategy use. • Location selection for down-regulation mediation: Nature groups enhanced LS for down-regulation, predicting lower negative emotion post-intervention. • Participants rated VR nature scenes higher for both up- and down-regulation and PRS, favouring forest and island settings.

Limitations and future research directions.

Despite the valuable contributions of this thesis, it is important to acknowledge several limitations associated with each of its objectives and to outline future research directions that can address these gaps. **Table 6.2** provides a synthetic overview of the key limitations identified in the systematic reviews, scale development, and experimental studies.

Table 6.2. *Summary of key limitations*

Section	Main limitations
Reviews	• Limited database selection led to potential selection bias and omission of relevant studies. • Lack of formal quality assessment of included studies undermines reliability. • Strict inclusion criteria could have excluded pertinent studies using different terminology.
Scale development	• The focus of the scale on natural environments limits applicability to urban and indoor spaces. • Lack of investigation into individual factors leaves questions about their influence on location selection for emotion regulation.
Experimental studies	• Short duration of environmental exposure may limit emotional engagement, and the depth of emotional recovery. • Simulated exposure to the environments may not fully replicate real-world experiences, limiting the impact and affecting generalizability of the results. • Absence of a control condition without intervention. • Homogenous samples limit broader applicability of findings to diverse populations. • Reliance on self-reported measures introduces potential biases, necessitating more objective assessments (e.g., physiological indexes). • Structured experimental design and mood induction manipulation may not capture real-world experience and emotion regulation processes, limiting ecological validity.

While the systematic reviews in this thesis provide valuable insights, several limitations are worth noting.

First, both reviews used a limited selection of databases, which may have led to the omission of relevant studies and introduced selection bias. Review 1 relied on five databases, while Review 2 used only three, potentially narrowing the scope of literature captured. Second, the exclusion of grey literature may have constrained the findings, as this type of literature often contains valuable insights not published in peer-reviewed journals. Additionally, neither review conducted a formal quality assessment of the included studies, which is essential for ensuring the reliability of conclusions. This oversight may have resulted in the inclusion of studies with varying methodological rigor. Lastly, strict inclusion criteria may have inadvertently excluded pertinent studies that address related concepts without using specific terminology. This could limit the comprehensiveness of the reviews.

Future research should broaden the scope of literature reviews by incorporating additional databases and including grey literature to capture a more complete picture of the research landscape. Implementing formal quality assessments in future reviews would enhance the reliability of findings by ensuring they are based on high-quality evidence. Researchers should also adopt more flexible inclusion criteria that consider alternative terminology and concepts related to emotion regulation and elicitation. This approach would provide a more nuanced understanding of the relationships being investigated. Finally, studies examining virtual reality's role in emotion elicitation should analyse how various dimensions of user experience—such as usability, engagement, and satisfaction—affect emotional responses. Understanding these factors can help design more effective and emotionally resonant virtual experiences.

Despite the significant contributions of this thesis to developing the concept of location selection for emotion regulation and creating a specific scale to measure this construct, several limitations must be acknowledged.

First, the scale's current focus on natural environments limits its applicability to urban and indoor spaces. Since individuals regulate emotions in a variety of settings, adapting and validating the scale for these environments would enhance its versatility. Additionally, the validation process was conducted primarily in English and Italian cultural contexts, raising concerns about the scale's generalizability to other cultures. Moreover, although the samples were diverse in terms of demographic characteristics, no specific investigation was conducted to examine how individual factors like age, gender, or socioeconomic status may influence location selection for emotion regulation. This leaves open the question of whether such individual differences could affect how people choose environments for emotional recovery.

Given these limitations, future research should aim to broaden the scale's scope to include a wider variety of environments. Testing its effectiveness in urbanized and indoor settings would help determine whether it can reliably measure emotion regulation across diverse contexts and, if successful, provide further insights into how location selection for emotion regulation varies across different environments. Furthermore, given the influence of cultural factors on how individuals interact with their environments, future studies should include participants from various cultural and linguistic backgrounds to explore the scale's cross-cultural applicability. Lastly, future research should examine the role of individual factors, to gain deeper insights into how different demographic groups use environments for emotion regulation, potentially revealing distinct preferences or strategies.

Finally, this thesis significantly advances our understanding of the relationship between environmental settings and emotion regulation, particularly through the exploration of natural environments' effects on emotional recovery in two experimental studies. However, several limitations warrant discussion.

One notable limitation is the relatively short duration of exposure to the environmental stimuli in both studies, which may have constrained the depth of emotional engagement. While the experimental designs provided valuable insights into immediate emotional responses, longer exposure periods could yield more pronounced effects on emotion regulation strategies and emotional recovery processes. Further, the absence of a control condition without any intervention makes it challenging to determine whether the observed changes were specifically driven by the environmental stimuli or merely the passage of time. Additionally, although innovative methods like virtual reality were employed to enhance immersion, these technologies may not fully replicate the richness and complexity of real-world nature experiences. This limitation could affect the generalizability of findings, suggesting that future studies should incorporate field experiments to provide a more comprehensive understanding of how individuals interact with diverse environments for emotion regulation. The samples used in these studies were also relatively homogenous, primarily consisting of young adults from specific cultural backgrounds. This demographic limitation raises questions about the broader applicability of the findings, as individual differences in age, culture, and prior experiences with nature may significantly influence emotional responses and location selection preferences. Moreover, the reliance on self-reported measures to assess emotional responses and regulation strategies could introduce biases, as these evaluations may be influenced by subjective interpretations or previous experiences with similar environments. This calls for more objective measures to enhance the reliability of the findings. Finally, the experimental nature of the studies may not fully capture how individuals engage with natural environments in their daily lives. The structured settings of the experiments may differ significantly from real-world interactions, limiting the ecological validity of the results.

Future research should explore the impact of prolonged interactions with natural environments, whether through virtual reality or real-world settings, to better understand the mechanisms at play in emotion regulation processes. Incorporating field experiments can provide valuable insights into the complexities of real-world interactions with natural environments. Additionally, future studies should aim for more diverse samples that encompass individuals of various ages, cultural backgrounds, and prior experiences with nature. This approach would capture a wider range of emotional responses and location selection preferences, enhancing the generalizability of findings. Furthermore, integrating physiological measures alongside self-reported emotional data could provide a more nuanced perspective on emotional recovery processes. Tools such as heart rate variability or cortisol levels would help elucidate the physiological mechanisms through which natural environments exert their effects on emotion regulation. Further, real-world studies using ecological momentary assessment would provide valuable insights into how individuals use natural environments in everyday life for emotion regulation, capturing the dynamic and context-dependent nature of emotional experiences and regulation strategies as they unfold in daily contexts.

By addressing these limitations and pursuing these research directions, future studies can enhance knowledge of how environmental settings influence emotion regulation and recovery, ultimately informing therapeutic practices and interventions aimed at enhancing emotional well-being through nature-based approaches.

Conclusion.

In light of the findings, this thesis provides valuable insights into the intricate relationship between natural environments and emotion regulation, contributing to a growing body of research that underscores the significance of environmental settings in fostering emotional well-being. Through systematic reviews, the development and validation of the Location Selection in Nature Scale, and experimental studies utilizing both 2D and virtual reality stimuli, the research highlights the potential of nature as a vital resource for emotional recovery and regulation. The findings highlight nature as a vital resource for fostering emotional well-being, paving the way for further research and practical applications, particularly in developing nature-based interventions to improve emotional health in an increasingly urbanized world. While limitations have been noted, this work lays a solid foundation for future investigations, emphasizing the need to incorporate nature-based approaches into therapeutic practices aimed at enhancing mental health and emotional resilience.

APPENDICES

Appendix A.

Supplementary Materials for Chapter 2.

Appendix A.1.

Full list of identified records from the first search of Review 1, with reasons for exclusion.

Selected Articles		**Reference of the study**	**Reason for Exclusion**	
based on *Title & Abstract*	**based on *Full Text***		**based on *Title & Abstract***	**based on *Full Text***
------	------	1. Albert, C., Hack, J., Schmidt, S., & Schröter, B. (2021). Planning and governing nature-based solutions in river landscapes: Concepts, cases, and insights. *Ambio*, *50*(8), 1405-1413.	***No assessment of emotion regulation***	------
------	------	2. Alves, S., Gulwadi, G. B., & Nilsson, P. (2021). An Exploration of How Biophilic Attributes on Campuses Might Support Student Connectedness to Nature, Others, and Self. *Frontiers in Psychology*, *12*.	***No research article* (Conceptual review)**	------
1	**1**	3. Bakir-Demir, T., Berument, S. K., & Akkaya, S. (2021). Nature connectedness boosts the bright side of emotion regulation, which in turn reduces stress. *Journal of Environmental Psychology*, *76*, 101642.	------	------

2	**2**	4. Bakir-Demir, T., Berument, S. K., & Sahin-Acar, B. (2019). The relationship between greenery and self-regulation of children: The mediation role of nature connectedness. *Journal of Environmental Psychology*, *65*, 101327.	------	------
------	------	5. Barrable, A., Booth, D., Adams, D., & Beauchamp, G. (2021). Enhancing Nature Connection and Positive Affect in Children through Mindful Engagement with Natural Environments. *International Journal of Environmental Research and Public Health*, *18*(9), 4785.	***No assessment of emotion regulation***	------
3	------	6. Bergeman, C. S., Blaxton, J., & Joiner, R. (2021). Dynamic Systems, Contextual Influences, and Multiple Timescales: Emotion Regulation as a Resilience Resource. *The Gerontologist*, *61*(3), 304-311.	------	***No assessment of nature***
------	------	7. Berman, M. G., Cardenas-Iniguez, C., & Meidenbauer, K. L. (2021). An Environmental Neuroscience Perspective on the Benefits of Nature. *Nature and Psychology*, 61-88.	***No research article*** **(Chapter in a book)**	------
------	------	8. Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, *19*(12), 1207-1212.	***No assessment of emotion regulation***	------
4	------	9. Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., ... & Jonides, J. (2012). Interacting with nature improves cognition and affect for individuals with depression. *Journal of Affective Disorders*, *140*(3), 300-305.	------	***No assessment of emotion regulation***
------	------	10. Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology*, *25*(3), 249-259.	***No assessment of emotion regulation***	------
------	------	11. Beute, F., & de Kort, Y. A. (2014). Salutogenic effects of the environment: Review of health protective effects of nature and daylight. *Applied psychology: Health and Well-being*, *6*(1), 67-95.	***No research article*** **(Conceptual review)**	------
5	**3**	12. Beute, F., & de Kort, Y. A. (2018). Stopping the train of thought: A pilot study using an ecological momentary intervention with twice-daily exposure to natural versus urban scenes to lower stress and rumination. *Applied Psychology: Health and Well-Being*, *10*(2), 236-253.	------	------
6	------	13. Beute, F., & De Kort, Y. A. W. (2014). Natural resistance: Exposure to nature and self-regulation, mood, and physiology after ego-depletion. *Journal of Environmental Psychology*, *40*, 167-178.	------	***No assessment of emotion regulation***

------	------	14. Beute, F., De Kort, Y., & IJsselsteijn, W. (2016). Restoration in its natural context: How ecological momentary assessment can advance restoration research. *International Journal of Environmental Research and Public Health*, *13*(4), 420.	***No research article* (Conceptual review)**	------
7	------	15. Birch, J., Rishbeth, C., & Payne, S. R. (2020). Nature doesn't judge you–how urban nature supports young people's mental health and wellbeing in a diverse UK city. *Health & Place*, *62*, 102296.	------	***No assessment of emotion regulation***
8	------	16. Boemo, T., Nieto, I., Vazquez, C., & Sanchez-Lopez, A. (2022). Relations between emotion regulation strategies and affect in daily life: A systematic review and meta-analysis of studies using ecological momentary assessments. *Neuroscience & Biobehavioral Reviews*, 104747.	------	***No assessment of nature***
------	------	17. Booij, S. H., Bos, E. H., de Jonge, P., & Oldehinkel, A. J. (2016). The temporal dynamics of cortisol and affective states in depressed and non-depressed individuals. *Psychoneuroendocrinology*, *69*, 16-25.	***No assessment of nature***	------
------	------	18. Bos, E. H., Van der Meulen, L., Wichers, M., & Jeronimus, B. F. (2016). A primrose path? Moderating effects of age and gender in the association between green space and mental health. *International Journal of Environmental Research and Public Health*, *13*(5), 492.	***No assessment of emotion regulation***	------
------	------	19. Bratman, G. N. (2016). *Psychological Ecosystem Services: the Impacts of Nature Experience on Affect, Emotion Regulation, and Cognitive Function*. Stanford University.	***No research article* (Dissertation)**	------
------	------	20. Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., De Vries, S., Flanders, J., ... & Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. *Science Advances*, *5*(7), eaax0903.	***No research article* (Conceptual review)**	------
9	**4**	21. Bratman, G. N., Daily, G. C., Levy, B. J., & Gross, J. J. (2015). The benefits of nature experience: Improved affect and cognition. *Landscape and Urban Planning*, *138*, 41-50.	------	------
10	**5**	22. Bratman, G. N., Hamilton, J. P., Hahn, K. S., Daily, G. C., & Gross, J. J. (2015). Nature experience reduces rumination and subgenual prefrontal cortex activation. *Proceedings of the National Academy of Sciences*, *112*(28), 8567-8572.	------	------
------	------	23. Bratman, G. N., Olvera-Alvarez, H. A., & Gross, J. J. (2021). The affective benefits of nature exposure. *Social and Personality Psychology Compass*, e12630.	***No research article* (Conceptual review)**	------

------	------	24. Bray, I., Reece, R., Sinnett, D., Martin, F., & Hayward, R. (2022). Exploring the role of exposure to green and blue spaces in preventing anxiety and depression among young people aged 14–24 years living in urban settings: A systematic review and conceptual framework. *Environmental Research*, 114081.	***No research article* (Systematic review)**	------
------	------	25. Buttazzoni, A., Doherty, S., & Minaker, L. (2022). How do urban environments affect young people's mental health? A novel conceptual framework to bridge public health, planning, and neurourbanism. *Public Health Reports*, *137*(1), 48-61.	***No research article* (Conceptual review)**	------
------	------	26. Campos, J. J., Frankel, C. B., & Camras, L. (2004). On the nature of emotion regulation. *Child Development*, *75*(2), 377-394.	***No assessment of nature***	------
------	------	27. Chen, C. & Nakagawa, S. (2019). *Nature's Pathways on Human Health, in International Handbook of Forest Therapy*, eds. D. Kotte, Q. Li, W. S. Shin, A. Michalsen. Newcastle, UK: Cambridge Scholars Publishing.	***No research article* (Conceptual review)**	------
------	------	28. Davies, K., & Cohen, M. J. (1995). *Reconnecting with Nature: Educational Self-Esteem Sensory Activities for Reducing Drug Use and Irresponsible Relationships in Students at Risk*. In M. J. Cohen, Reconnecting with Nature: A restoration of the missing link in Western thinking, Chapter 11. Friday Harbor, WA: University of Global Education.	***No assessment of emotion regulation***	------
------	------	29. de Almeida, T. (2020). Regulation of Affective States: benefits of contact with the Nature. *International Journal of Advanced Engineering Research and Science*, *7*(2).	***No research article* (Conceptual review)**	------
------	------	30. Dewey, J. (1958). *Experience and Nature*. (Vol. 471). Courier Corporation.	***No research article* (Conceptual review)**	------
11	**6**	31. Dimitrov-Discher, A., Wenzel, J., Kabisch, N., Hemmerling, J., Bunz, M., Schöndorf, J., ... & Adli, M. (2022). Residential green space and air pollution are associated with brain activation in a social-stress paradigm. *Scientific Reports*, *12*(1), 1-11.	------	------
------	------	32. Dixon-Gordon, K. L., Aldao, A., & De Los Reyes, A. (2015). Emotion regulation in context: Examining the spontaneous use of strategies across emotional intensity and type of emotion. *Personality and Individual Differences*, *86*, 271-276.	***No assessment of nature***	------
------	------	33. Djernis, D., Lerstrup, I., Poulsen, D., Stigsdotter, U., Dahlgaard, J., & O'Toole, M. (2019). A systematic review and meta-analysis of nature-based mindfulness: Effects of moving mindfulness	***No research article* (Systematic review)**	------

		training into an outdoor natural setting. *International Journal of Environmental Research and Public Health, 16*(17), 3202.		
------	------	34. Dzhambov, A. M., Browning, M. H., Markevych, I., Hartig, T., & Lercher, P. (2020). Analytical approaches to testing pathways linking greenspace to health: A scoping review of the empirical literature. *Environmental Research, 186*, 109613.	***No research article* (Systematic review)**	------
12	------	35. Emami, E., Amini, R., & Motalebi, G. (2018). The effect of nature as positive distractibility on the Healing Process of Patients with cancer in therapeutic settings. *Complementary Therapies in Clinical Practice, 32*, 70-73.	------	***No assessment of emotion regulation***
------	------	36. Ensinger, K. (2016). Achtsamkeit, Naturerleben und die Erfahrung von Erholung. *Umweltpsychologie, 20*(2), 95-111.	***No English language***	------
13	**7**	37. Fido, D., Rees, A., Wallace, L., & Mantzorou, L. (2020). Psychopathy moderates the relationship between nature connectedness and cognitive reappraisal. *Ecopsychology, 12*(4), 301-308.	------	------
------	------	38. Gaffikin, L. (2013). The environment as a strategic healthcare partner. *Current Opinion in Obstetrics and Gynecology, 25*(6), 494-499.	***No assessment of emotion regulation***	------
------	------	39. Gatersleben, B., & Andrews, M. (2013). When walking in nature is not restorative—The role of prospect and refuge. *Health & Place, 20*, 91-101.	***No assessment of emotion regulation***	------
14	**8**	40. Golding, S. E., Gatersleben, B., & Cropley, M. (2018). An experimental exploration of the effects of exposure to images of nature on rumination. *International Journal of Environmental Research and Public Health, 15*(2), 300.	------	------
------	------	41. Guo, S., Wang, W., & Zhang, M. (2020). Exploring the impact of environmental regulations on happiness: new evidence from China. *Environmental Science and Pollution Research, 27*(16), 19484-19501.	***No assessment of emotion regulation/nature***	------
15	------	42. Han, Z., Kang, J., & Meng, Q. (2022). The effect of foreground and background of soundscape sequence on emotion in urban open spaces. *Applied Acoustics, 199*, 109039.	------	***No assessment of emotion regulation***
------	------	43. Haney, A. M., Motschman, C. A., Warner, O. M., Wesley, R. L., Wycoff, A. M., Trull, T. J., & McCarthy, D. M. (2022). Comparing associations between mood and breath alcohol concentration in the laboratory and natural environment. *Psychology of Addictive Behaviors. 36*(7), 885–894.	***No assessment of emotion regulation***	------

------	------	44. Hanley, A. W., Bettmann, J. E., Kendrick, C. E., Deringer, A., & Norton, C. L. (2020). Dispositional mindfulness is associated with greater nature connectedness and self-reported ecological behavior. *Ecopsychology*, *12*(1), 54-63.	***No assessment of emotion regulation***	------
16	------	45. Hanley, A. W., Derringer, S. A., & Hanley, R. T. (2017). Dispositional mindfulness may be associated with deeper connections with nature. *Ecopsychology*, *9*(4), 225-231.	------	***No assessment of emotion regulation***
------	------	46. Harper, N. J., Fernee, C. R., & Gabrielsen, L. E. (2021). Nature's role in outdoor therapies: an umbrella review. *International Journal of Environmental Research and Public Health*, *18*(10), 5117.	***No research article*** **(Conceptual review)**	------
17	------	47. Harrison, N. R., & Clark, D. P. (2020). Mindful awareness, but not acceptance, predicts engagement with natural beauty. *Ecopsychology*, *12*(1), 36-43.	------	***No full-text available***
------	------	48. Hartig, T. (2021). Restoration in nature: Beyond the conventional narrative. *Nature and Psychology*, 89-151.	***No research article*** **(Book chapter)**	------
18	------	49. Hartig, T., Mang, M., & Evans, G. W. (1991). Restorative effects of natural environment experiences. *Environment and Behavior*, *23*(1), 3-26.	------	***No assessment of emotion regulation***
------	------	50. Hartig, T., Mitchell, R., De Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health*, *35*, 207-228.	***No research article*** **(Conceptual review)**	------
19	------	51. Hiekkaranta, A. P., Kirtley, O. J., Lafit, G., Decoster, J., Derom, C., De Hert, M., ... & Myin-Germeys, I. (2021). Emotion regulation in response to daily negative and positive events in youth: The role of event intensity and psychopathology. *Behaviour Research and Therapy*, *144*, 103916.	------	***No assessment of nature***
------	------	52. Hoogendoorn, G., Sütterlin, B., & Siegrist, M. (2021). Tampering with nature: A systematic review. *Risk Analysis*, *41*(1), 141-156.	***No research article*** **(Systematic review)**	------
20	**9**	53. Huynh, T., & Torquati, J. C. (2019). Examining connection to nature and mindfulness at promoting psychological well-being. *Journal of Environmental Psychology*, *66*, 101370.	------	------
21	------	54. Ibes, D. C., & Forestell, C. A. (2022). The role of campus greenspace and meditation on college students' mood disturbance. *Journal of American College Health*, *70*(1), 99-106.	------	***No assessment of emotion regulation***

------	------	55. Jiang, S. (2020). Positive distractions and play in the public spaces of pediatric healthcare environments: A literature review. *Health Environments Research & Design Journal, 13*(3), 171-197.	***No research article*** **(Systematic review)**	------
------	------	56. Johnsen, S. Å. K. (2014). Using the Natural Environment for Emotion Regulation Conceptual and Empirical Explorations.	***No research article*** **(Doctoral Thesis)**	------
------	------	57. Johnsen, S. Å. K. (2011). The use of nature for emotion regulation: Toward a conceptual framework. *Ecopsychology*, *3*(3), 175-185.	***No research article*** **(Conceptual review)**	------
22	**10**	58. Johnsen, S. Å. K. (2013). Exploring the use of nature for emotion regulation: associations with personality, perceived stress, and restorative outcomes. *Nordic Psychology*, *65*(4), 306-321.	------	------
23	**11**	59. Johnsen, S. Å. K., & Rydstedt, L. W. (2013). Active use of the natural environment for emotion regulation. *Europe's Journal of Psychology*, *9*(4), 798-819.	------	------
------	------	60. Kaplan, D. M., Hughes, C. D., Schatten, H. T., Mehl, M. R., Armey, M. F., & Nugent, N. R. (2022). Emotional change in its "natural habitat": Measuring everyday emotion regulation with passive and active ambulatory assessment methods. *Journal of Psychotherapy Integration*. Advance online publication. https://doi.org/10.1037/int0000291	***No assessment of nature***	------
------	------	61. Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, *15*(3), 169-182.	***No research article*** **(Conceptual review)**	------
24	**12**	62. Korpela, K. M., Pasanen, T., Repo, V., Hartig, T., Staats, H., Mason, M., ... & Ward Thompson, C. (2018). Environmental strategies of affect regulation and their associations with subjective well-being. *Frontiers in Psychology*, *9*, 562.	------	------
25	**13**	63. Korpela, K., & Hartig, T. (1996). Restorative qualities of favorite places. *Journal of Environmental Psychology*, *16*(3), 221-233.	------	------
------	------	64. Korpela, K., & Staats, H. (2021). Solitary and social aspects of restoration in nature. *The Handbook of Solitude: Psychological Perspectives on Social Isolation, Social Withdrawal, and Being Alone*, 325-339.	***No research article*** **(Book chapter)**	------
26	------	65. Korpela, K., Borodulin, K., Neuvonen, M., Paronen, O., & Tyrväinen, L. (2014). Analyzing the mediators between nature-based outdoor recreation and emotional well-being. *Journal of Environmental Psychology*, *37*, 1-7.	------	***No assessment of emotion regulation***

------	------	66. Korpela, K., De Bloom, J., Sianoja, M., Pasanen, T., & Kinnunen, U. (2017). Nature at home and at work: Naturally good? Links between window views, indoor plants, outdoor activities and employee well-being over one year. *Landscape and Urban planning*, *160*, 38-47.	***No assessment of emotion regulation***	------
------	------	67. Lämmle, L., von Lindern, E., Rummel, D., Michaeli, M., & Ziegler, M. (2022). Shedding Light onto the City Blues Myth—The Potential of Stimulating and Activating Effects of Urban Public Spaces and the Role of City Relatedness. *International Journal of Environmental Research and Public Health*, *19*(13), 7606.	***No assessment of emotion regulation***	------
27	------	68. Li, Z., Wang, Y., Liu, H., & Liu, H. (2022). Physiological and psychological effects of exposure to different types and numbers of biophilic vegetable walls in small spaces. *Building and Environment*, *225*, 109645.	------	***No assessment of emotion regulation***
------	------	69. Lloret, J., Gómez, S., Rocher, M., Carreño, A., San, J., & Inglés, E. (2021). The potential benefits of water sports for health and well-being in marine protected areas: A case study in the Mediterranean. *Annals of Leisure Research*, 1-27.	***No assessment of emotion regulation***	------
28	**14**	70. Lopes, S., Lima, M., & Silva, K. (2020). Nature can get it out of your mind: The rumination reducing effects of contact with nature and the mediating role of awe and mood. *Journal of Environmental Psychology*, *71*, 101489.	------	------
------	------	71. Lymeus, F., Ahrling, M., Apelman, J., Florin, C. D. M., Nilsson, C., Vincenti, J., ... & Hartig, T. (2020). Mindfulness-based restoration skills training (ReST) in a natural setting compared to conventional mindfulness training: Psychological functioning after a five-week course. *Frontiers in Psychology*, *11*, 1560.	***No assessment of emotion regulation***	------
------	------	72. Macaulay, R., Johnson, K., Lee, K., & Williams, K. (2022). Comparing the effect of mindful and other engagement interventions in nature on attention restoration, nature connection, and mood. *Journal of Environmental Psychology*, *81*, 101813.	***No assessment of emotion regulation***	------
------	------	73. MacIntyre, T. E., Calogiuri, G., Donnelly, A. A., Warrington, G., Beckmann, J., Lahart, I., & Brick, N. (2019). Societal challenges, methodological issues and transdisciplinary approaches. *Physical Activity in Natural Settings*, 15-35.	***No research article*** **(Book chapter)**	------
------	------	74. MacIntyre, T. E., Walkin, A., Calogiuri, G., Oliver, G., Donnelly, A. A., Gritzka, S., & Warrington, G. (2019). Immersion, watersports and Blueways and the blue mind: Case studies in blue	***No assessment of emotion regulation***	------

		exercise. *Physical Activity in Natural Settings*, 210-225.		
------	------	75. Malekinezhad, F. A. H. I. M. E. H. (2018). *Restoration experience through perceived open space qualities and perceived restorativeness of students in Malaysian Universities.* PhD thesis, Universiti Teknologi Malaysia, Faculty of Built Environment.	***No assessment of emotion regulation***	------
29	------	76. Malekinezhad, F., Courtney, P., bin Lamit, H., & Vigani, M. (2020). Investigating the mental health impacts of university campus green space through perceived sensory dimensions and the mediation effects of perceived restorativeness on restoration experience. *Frontiers in Public Health*, *8*, 578241.	------	***No assessment of emotion regulation***
------	------	77. Mantler, A., & Logan, A. C. (2015). Natural environments and mental health. *Advances in Integrative Medicine*, *2*(1), 5-12.	***No research article*** **(Conceptual review)**	------
------	------	78. Marchand, W. R., Klinger, W., Block, K., VerMerris, S., Herrmann, T. S., Johnson, C., ... & Yabko, B. (2019). Mindfulness training plus nature exposure for veterans with psychiatric and substance use disorders: a model intervention. *International Journal of Environmental Research and Public Health*, *16*(23), 4726.	***No assessment of emotion regulation***	------
30	------	79. Mason, M. J., & Korpela, K. (2009). Activity spaces and urban adolescent substance use and emotional health. *Journal of Adolescence*, *32*(4), 925-939.	------	***No assessment of emotion regulation***
------	------	80. McEwan, K., Ferguson, F. J., Richardson, M., & Cameron, R. (2020). The good things in urban nature: A thematic framework for optimising urban planning for nature connectedness. *Landscape and Urban Planning*, *194*, 103687.	***No assessment of emotion regulation***	------
------	------	81. Meidenbauer, K. L., Stenfors, C. U., Bratman, G. N., Gross, J. J., Schertz, K. E., Choe, K. W., & Berman, M. G. (2020). The affective benefits of nature exposure: What's nature got to do with it?. *Journal of Environmental Psychology*, *72*, 101498.	***No assessment of emotion regulation***	------
------	------	82. Menardo, E., Di Marco, D., Ramos, S., Brondino, M., Arenas, A., Costa, P., ... & Pasini, M. (2022). Nature and mindfulness to cope with work-related stress: A narrative review. *International Journal of Environmental Research and Public Health*, *19*(10), 5948.	***No research article*** **(Narrative review)**	------
------	------	83. Mitmansgruber, H., Beck, T. N., Höfer, S., & Schüßler, G. (2009). When you don't like what you feel: Experiential avoidance, mindfulness and meta-emotion in emotion regulation. *Personality and Individual Differences*, *46*(4), 448-453.	***No assessment of nature***	------

31	**15**	84. Mochizuki-Kawai, H., Matsuda, I., & Mochizuki, S. (2020). Viewing a flower image provides automatic recovery effects after psychological stress. *Journal of Environmental Psychology*, *70*, 101445.	------	------
32	**16**	85. Mueller, M. A., & Flouri, E. (2020). Neighbourhood greenspace and children's trajectories of self-regulation: Findings from the UK Millennium Cohort Study. *Journal of Environmental Psychology*, *71*, 101472.	------	------
------	------	86. Murray, C. V., Jacobs, J. I. L., Rock, A. J., & Clark, G. I. (2021). Attachment style, thought suppression, self-compassion and depression: Testing a serial mediation model. *PLoS One, 16*(1), e0245056.	***No assessment of nature***	------
33	**17**	87. Mygind, L., Elsborg, P., Schipperijn, J., Boruff, B., Lum, J. A., Bølling, M., ... & Christian, H. (2022). Is vegetation cover in key behaviour settings important for early childhood socioemotional function? A preregistered, cross-sectional study. *Developmental Science*, *25*(3), e13200.	------	------
34	------	88. Neill, C., Gerard, J., & Arbuthnott, K. D. (2019). Nature contact and mood benefits: Contact duration and mood type. *The Journal of Positive Psychology*, *14*(6), 756-767.	------	***No assessment of emotion regulation***
------	------	89. Norwood, M. F., Lakhani, A., Fullagar, S., Maujean, A., Downes, M., Byrne, J., ... & Kendall, E. (2019). A narrative and systematic review of the behavioural, cognitive and emotional effects of passive nature exposure on young people: Evidence for prescribing change. *Landscape and Urban Planning*, *189*, 71-79.	***No research article* (Narrative review)**	------
------	------	90. Pálsdóttir, A. M., Stigsdotter, U. K., Persson, D., Thorpert, P., & Grahn, P. (2018). The qualities of natural environments that support the rehabilitation process of individuals with stress-related mental disorder in nature-based rehabilitation. *Urban Forestry & Urban Greening*, *29*, 312-321.	***No assessment of emotion regulation***	------
------	------	91. Panno, A., Theodorou, A., Carrus, G., Imperatori, C., Spano, G., & Sanesi, G. (2020). Nature reappraisers, benefits for the environment: a model linking cognitive reappraisal, the "being away" dimension of restorativeness and eco-friendly behavior. *Frontiers in Psychology*, *11*, 1986.	***No assessment of nature***	------
------	------	92. Parker, M. N., Tanofsky-Kraff, M., Crosby, R. D., Shank, L. M., Kwarteng, E. A., Loch, L. K., ... & Yanovski, J. A. (2022). State negative affect in relation to loss-of-control eating among children and adolescents in the natural environment. *Appetite*, *178*, 106166.	***No assessment of nature***	------

------	------	93. Pearson, M., Gaines, K., Pati, D., Colwell, M., Motheral, L., & Adams, N. G. (2019). The physiological impact of window murals on pediatric patients. *HERD: Health Environments Research & Design Journal*, *12*(2), 116-129.	***No assessment of emotion regulation***	------
35	------	94. Pirgie, L., Schwab, M., Sudkamp, J., Höltge, J., & Cervinka, R. (2016). Recreation in the national park-Visiting restorative places in the National Park Thayatal, Austria fosters connectedness and mindfulness. *Zeitschrift für Umweltpsychologie*, *20*, 59-74.	------	***No full-text available***
------	------	95. Preiszner, B., Papp, S., Pipoly, I., Seress, G., Vincze, E., Liker, A., & Bókony, V. (2017). Problem-solving performance and reproductive success of great tits in urban and forest habitats. *Animal Cognition*, *20*(1), 53-63.	***No assessment of emotion regulation***	------
------	------	96. Prescott, S. L., & Logan, A. C. (2016). Transforming life: a broad view of the developmental origins of health and disease concept from an ecological justice perspective. *International Journal of Environmental Research and Public Health*, *13*(11), 1075.	***No research article*** **(Narrative review)**	------
------	------	97. Ray, T. N., Franz, S. A., Jarrett, N. L., & Pickett, S. M. (2021). Nature enhanced meditation: effects on mindfulness, connectedness to nature, and pro-environmental behavior. *Environment and Behavior*, *53*(8), 864-890.	***No assessment of emotion regulation***	------
------	------	98. Reddon, J. R., & Durante, S. B. (2019). Prisoner exposure to nature: Benefits for wellbeing and citizenship. *Medical Hypotheses*, *123*, 13-18.	***No research article*** **(Narrative review)**	------
------	------	99. Richardson, M. (2019). Beyond restoration: considering emotion regulation in natural well-being. *Ecopsychology*, *11*(2), 123-129.	***No research article*** **(Review)**	------
36	**18**	100. Richardson, M., & McEwan, K. (2018). 30 days wild and the relationships between engagement with nature's beauty, nature connectedness and well-being. *Frontiers in Psychology*, *9*, 1500.	------	------
------	------	101. Richardson, M., & Sheffield, D. (2015). Reflective self-attention: A more stable predictor of connection to nature than mindful attention. *Ecopsychology*, *7*(3), 166-175.	***No assessment of emotion regulation***	------
------	------	102. Richardson, M., McEwan, K., Maratos, F., & Sheffield, D. (2016). Joy and calm: How an evolutionary functional model of affect regulation informs positive emotions in nature. *Evolutionary Psychological Science*, *2*(4), 308-320.	***No research article*** **(Review)**	------

------	------	103. Roe, J. (2008). *The restorative power of natural and built environments*. PhD Thesis. Heriot-Watt University.	***No research article* (Thesis)**	------
------	------	104. Rygal, N., & Swami, V. (2021). Simulated nature and positive body image: A comparison of the impact of exposure to images of blue and green spaces. *Body Image*, *39*, 151-155.	***No assessment of emotion regulation***	------
------	------	105. Sadowski, I., Böke, N., Mettler, J., Heath, N., & Khoury, B. (2020). Naturally mindful? The role of mindfulness facets in the relationship between nature relatedness and subjective well-being. *Current Psychology*, 1-16.	***No assessment of emotion regulation***	------
37	**19**	106. Sahni, P., & Kumar, J. (2021). Exploring the relationship of human–nature interaction and mindfulness: a cross-sectional study. *Mental Health, Religion & Culture*, *24*(5), 450-462.	------	------
38	------	107. Samus, A., Freeman, C., Van Heezik, Y., Krumme, K., & Dickinson, K. J. (2022). How do urban green spaces increase well-being? The role of perceived wildness and nature connectedness. *Journal of Environmental Psychology*, *82*, 101850.	------	***No assessment of emotion regulation***
------	------	108. Saraceno, J. (2017). *CBT Eco-Art Therapy: Mood Regulation with Young Adults in Nature*. Notre Dame de Namur University.	***No research article* (Thesis)**	------
39	------	109. Schirda, B., Valentine, T. R., Aldao, A., & Prakash, R. S. (2016). Age-related differences in emotion regulation strategies: Examining the role of contextual factors. *Developmental Psychology*, *52*(9), 1370.	------	***No assessment of nature***
------	------	110. Schweitzer, J. P., & Gionfra, S. (2018). Nature-based education for resilient cities. *Lifelong Learning and Education in Healthy and Sustainable Cities*, 355-376.	***No research article* (Book chapter)**	------
40	**20**	111. Severin, M. I., Raes, F., Notebaert, E., Lambrecht, L., Everaert, G., & Buysse, A. (2022). A qualitative study on emotions experienced at the coast and their influence on well-being. *Frontiers in Psychology*, *13*.	------	------
------	------	112. Smith, K. E., Mason, T. B., Juarascio, A., Weinbach, N., Dvorak, R., Crosby, R. D., & Wonderlich, S. A. (2020). The momentary interplay of affect, attention bias, and expectancies as predictors of binge eating in the natural environment. *International Journal of Eating Disorders*, *53*(4), 586-594.	***No assessment of emotion regulation***	------
41	------	113. Snell, T. L., Lam, J. C., Lau, W. W. Y., Lee, I., Maloney, E. M., Mulholland, N., ... & Wynne, L. J. (2016). Contact with nature in childhood and	------	***No assessment of emotion regulation***

		adult depression. *Children, Youth and Environments*, *26*(1), 111-124.		
42	------	114. Snell, T. L., Simmonds, J. G., & Klein, L. M. (2020). Exploring the impact of contact with nature in childhood on adult personality. *Urban Forestry & Urban Greening*, *55*, 126864.	------	***No assessment of emotion regulation***
43	**21**	115. Stewart, M., & Haaga, D. A. (2018). State mindfulness as a mediator of the effects of exposure to nature on affect and psychological well-being. *Ecopsychology*, *10*(1), 53-60.	------	------
------	------	116. Sun, Y., Li, F., He, T., Meng, Y., Yin, J., Yim, I. S., ... & Wu, J. (2023). Physiological and affective responses to green space virtual reality among pregnant women. *Environmental Research*, *216*, 114499.	***No assessment of emotion regulation***	------
44	**22**	117. Swami, V., Barron, D., Todd, J., Horne, G., & Furnham, A. (2020). Nature exposure and positive body image:(Re-) examining the mediating roles of connectedness to nature and trait mindfulness. *Body Image*, *34*, 201-208.	------	------
------	------	118. Swami, V., Robinson, C., & Furnham, A. (2022). Positive Rational Acceptance of Body Image Threats Mediates the Association Between Nature Exposure and Body Appreciation. *Ecopsychology*, *14*(2), 118-125.	***No assessment of emotion regulation***	------
------	------	119. Takeuchi, H., Taki, Y., Hashizume, H., Sassa, Y., Nagase, T., Nouchi, R., & Kawashima, R. (2011). Cerebral blood flow during rest associates with general intelligence and creativity. *PLoS One*, *6*(9), e25532.	***No assessment of emotion regulation***	------
------	------	120. Tomasso, L. P., Yin, J., Cedeño Laurent, J. G., Chen, J. T., Catalano, P. J., & Spengler, J. D. (2021). The relationship between nature deprivation and individual wellbeing across urban gradients under COVID-19. *International Journal of Environmental Research and Public Health*, *18*(4), 1511.	***No assessment of emotion regulation***	------
------	------	121. Tost, H., Reichert, M., Braun, U., Reinhard, I., Peters, R., Lautenbach, S., ... & Meyer-Lindenberg, A. (2019). Neural correlates of individual differences in affective benefit of real-life urban green space exposure. *Nature Neuroscience*, *22*(9), 1389-1393.	***No assessment of emotion regulation***	------
------	------	122. Van den Berg, M. M., Maas, J., Muller, R., Braun, A., Kaandorp, W., Van Lien, R., ... & Van den Berg, A. E. (2015). Autonomic nervous system responses to viewing green and built settings: differentiating between sympathetic and parasympathetic activity. *International Journal of Environmental Research and Public Health*, *12*(12), 15860-15874.	***No assessment of emotion regulation***	------

------	------	123. Vincent, E., Battisto, D., & Grimes, L. (2010). The effects of presence and influence in nature images in a simulated hospital patient room. *HERD: Health Environments Research & Design Journal*, *3*(3), 56-69.	***No assessment of emotion regulation***	------
------	------	124. Weeland, J., Moens, M. A., Beute, F., Assink, M., Staaks, J. P., & Overbeek, G. (2019). A dose of nature: Two three-level meta-analyses of the beneficial effects of exposure to nature on children's self-regulation. *Journal of Environmental Psychology*, *65*, 101326.	***No research article*** **(Review)**	------
------	------	125. Wolsko, C., & Lindberg, K. (2013). Experiencing connection with nature: The matrix of psychological well-being, mindfulness, and outdoor recreation. *Ecopsychology*, *5*(2), 80-91.	***No assessment of emotion regulation + No full-text available***	------
------	------	126. Xie, J., Sun, Q., Wang, S., Li, X., & Fan, F. (2020). Does environmental regulation affect export quality? theory and evidence from China. *International Journal of Environmental Research and Public Health*, *17*(21), 8237.	***No assessment of emotion regulation/nature***	------
------	------	127. Zeier, P., Meine, L. E., & Wessa, M. (2022). It's worth the trouble: Stressor exposure is related to increased cognitive reappraisal ability. *Stress and Health*, *38*(3), 602-609.	***No assessment of nature***	------
45	**23**	128. Zhang, L., Tan, P. Y., Gan, D. R. Y., & Samsudin, R. (2022). Assessment of mediators in the associations between urban green spaces and self-reported health. *Landscape and Urban Planning*, *226*, 104503.	------	------
TOTAL EXCLUDED PAPERS			**83**	**22**

Note. Different colours indicate the database in which articled have been found. Specifically: PsycInfo (in yellow), PubMed (in green), Google Scholar (in blue), Science Direct (in red), PubPsych (in purple).

Appendix A.2.

Full list of identified records from the second search of Review 2, with reasons for exclusion.

Selected Articles based on *Title & Abstract*	Selected Articles based on *Full Text*	Reference of the study	Reason for Exclusion based on *Title & Abstract*	Reason for Exclusion based on *Full Text*
------	------	1. Bouter, D. C., Ravensbergen, S. J., Lakerveld, J., Hoogendijk, W. J. G., & Grootendorst-van Mil, N. H. (2023). Associations between the urban environment and psychotic experiences in adolescents. *Schizophrenia research*, *260*, 123–131.	***No assessment of emotion regulation***	------
1	**1**	2. Browning, M. H., Shin, S., Drong, G., McAnirlin, O., Gagnon, R. J., Ranganathan, S., ... & Heller, W. (2023). Daily exposure to virtual nature reduces symptoms of anxiety in college students. *Scientific reports*, *13*(1), 1239.	------	------
------	------	3. Catissi, G., de Oliveira, L. B., da Silva Victor, E., Savieto, R. M., Borba, G. B., Hingst-Zaher, E., ... & Leão, E. R. (2023). Nature Photographs as Complementary Care in Chemotherapy: A Randomized Clinical Trial. *International Journal of Environmental Research and Public Health*, *20*(16), 6555.	***No assessment of emotion regulation***	------
2	------	4. Chhajer, R., & Hira, N. (2024). Exploring positive psychology intervention and mindfulness-based intervention in nature: impact on well-being of school students in India. *Frontiers in Public Health*, *12*.	------	***No assessment of emotion regulation***
3	------	5. Dettweiler, U., Gerchen, M., Mall, C., Simon, P., & Kirsch, P. (2023). Choice matters: Pupils' stress regulation, brain development and brain function in an outdoor education project. *British Journal of Educational Psychology*, *93*, 152-173.	------	***No assessment of emotion regulation***
------	------	6. Hartanto, A., Teo, N. L. A., Lua, V. Y., Tay, K. J., Chen, N. R., & Majeed, N. M. (2023). Does Watching Videos With Natural Scenery Restore Attentional Resources?. *Experimental Psychology*.	***No assessment of emotion regulation***	------
------	------	7. Hsieh, C. H., Yang, J. Y., Huang, C. W., & Chin, W. C. B. (2023). The effect of water sound level in virtual reality: A study of restorative benefits in young adults through immersive	***No assessment of emotion regulation***	------

		natural environments. *Journal of Environmental Psychology*, *88*, 102012.		
4	------	8. Ibrahim, F. A., Mehta, U. M., Thekkumkara, S. N., Rakesh, K. R., Swetha, G., Kumar, C. N., ... & Thirthalli, J. (2023). Multivariate associations between cognition and neighborhood geospatial characteristics in schizophrenia. *Asian Journal of Psychiatry*, *84*, 103593.	------	***No assessment of nature***
------	------	9. Imperatori, C., Massullo, C., De Rossi, E., Carbone, G. A., Theodorou, A., Scopelliti, M., ... & Panno, A. (2023). Exposure to nature is associated with decreased functional connectivity within the distress network: A resting state EEG study. *Frontiers in Psychology*, *14*, 1171215.	***No assessment of emotion regulation***	------
5	------	10. Ivaldi, A. (2023). Understanding and restoring the self in nature for well-being: A phenomenological analysis of walking coaching experiences. *The Humanistic Psychologist*.	------	***No assessment of emotion regulation***
6	------	11. Lanza, K., Alcazar, M., Chen, B., & Kohl III, H. W. (2023). Connection to nature is associated with social-emotional learning of children. *Current Research in Ecological and Social Psychology*, *4*, 100083.	------	***No assessment of emotion regulation***
------	------	12. Lanza, K., Alcazar, M., Chen, B., & Kohl III, H. W. (2023). Connection to nature is associated with social-emotional learning of children. *Current Research in Ecological and Social Psychology*, *4*, 100083.	***Duplication***	------
------	------	13. Lau, S. S., Leung, S. S., Wong, J. W., Lee, T. C., Cartwright, S. R., Wong, J. T., ... & Choi, R. P. (2023). Brief repeated virtual nature contact for three weeks boosts university students' nature connectedness and psychological and physiological health during the COVID-19 pandemic: A pilot study. *Frontiers in Public Health*, *10*, 1057020.	***No assessment of emotion regulation***	------
------	------	14. Li, Z., Zhang, W., Cui, J., Wang, L., Liu, H., & Liu, H. (2024). Biophilic environment with visual-olfactory stimuli contributes to psychophysiological restoration and cognitive enhancement. *Building and Environment*, *250*, 111202.	***No assessment of emotion regulation***	------
7	2	15. Liang, J. H., Yang, R. Y., Liu, M. L., Pu, Y. Q., Bao, W. W., Zhao, Y., ... & Chen, Y. J. (2024). Urban green, blue spaces and their joint effect are associated with lower risk of emotional and behavior problem in children and adolescents, a large population-based study in Guangzhou, China. *Environmental Research*, *240*, 117475.	------	------
8	3	16. Ma, J., Williams, J. M., Morris, P. G., & Chan, S. W. (2023). Effectiveness of a mindful	------	------

		nature walking intervention on sleep quality and mood in university students during Covid-19: A randomised control study. *Explore*, *19*(3), 405-416.		
------	------	17. Mostajeran, F., Fischer, M., Steinicke, F., & Kühn, S. (2023). Effects of exposure to immersive computer-generated virtual nature and control environments on affect and cognition. *Scientific Reports*, *13*(1), 220.	***No assessment of emotion regulation***	------
------	------	18. Mostajeran, F., Steinicke, F., Reinhart, S., Stuerzlinger, W., Riecke, B. E., & Kühn, S. (2023). Adding virtual plants leads to higher cognitive performance and psychological well-being in virtual reality. *Scientific Reports*, *13*(1), 8053.	***No assessment of emotion regulation***	------
------	------	19. Ning, W., Yin, J., Chen, Q., & Sun, X. (2023). Effects of brief exposure to campus environment on students' physiological and psychological health. *Frontiers in Public Health*, *11*, 1051864.	***No assessment of emotion regulation***	------
------	------	20. Ochiai, H., Ikei, H., Jo, H., Ohishi, M., & Miyazaki, Y. (2023). Relaxation Effect of Nature Sound Exposure on Gambling Disorder Patients: A Crossover Study. *Journal of Integrative and Complementary Medicine*.	***No assessment of emotion regulation***	------
9	------	21. Oswald, T. K., Kohler, M., Rumbold, A. R., Kedzior, S. G., & Moore, V. M. (2023). The acute psychological effects of screen time and the restorative potential of nature immersion amongst adolescents: A randomised pre-post pilot study. *Journal of Environmental Psychology*, *92*, 102183.	------	***No assessment of emotion regulation***
------	------	22. Owens, M., & Bunce, H. (2023). The effect of brief exposure to virtual nature on mental wellbeing in adolescents. *Scientific Reports*, *13*(1), 17769.	***No assessment of emotion regulation***	------
------	------	23. Randler, C., Vanhöfen, J., Härtel, T., Neunhoeffer, F., Engeser, C., & Fischer, C. (2023). Psychological restoration depends on curiosity, motivation, and species richness during a guided bird walk in a suburban blue space. *Frontiers in Psychology*, *14*, 1176202.	***No assessment of emotion regulation***	------
------	------	24. Rodriguez, M., & Kross, E. (2023). Sensory emotion regulation. *Trends in Cognitive Sciences*.	***No assessment of nature + No research article* (Conceptual review)**	------
10	------	25. Sallay, V., Martos, T., Rosta-Filep, O., Horváth, Z., & Korpela, K. (2023). Profiles of perceived physical features and emotional experiences in favorite places: Discovering	------	***No assessment of emotion regulation***

		ambivalent place preferences. *Journal of Environmental Psychology*, *90*, 102084.		
11	------	26. Sanyer, M. M., Bettmann, J. E., Anstadt, G., Ganesh, K., & Hanley, A. W. (2023). Decenter to reenter nature: Relationships between decentering, self-transcendence, and nature connectedness. *Psychology of Consciousness: Theory, Research, and Practice*, *10*(3), 205.	------	***No assessment of emotion regulation***
12	------	27. Sun, Y., Li, F., He, T., Meng, Y., Yin, J., Yim, I. S., ... & Wu, J. (2023). Physiological and affective responses to green space virtual reality among pregnant women. *Environmental Research*, *216*, 114499.	------	***No assessment of emotion regulation***
------	**------**	28. Theodorou, A., Romano, L., Bratman, G. N., Carbone, G. A., Rodelli, R., Casagrande, G., & Panno, A. (2023). Different types of virtual natural environments enhance subjective vitality through restorativeness. *Journal of Environmental Psychology*, *87*, 101981.	***No assessment of emotion regulation***	------
13	**4**	29. Theodorou, A., Spano, G., Bratman, G. N., Monneron, K., Sanesi, G., Carrus, G., ... & Panno, A. (2023). Emotion regulation and virtual nature: cognitive reappraisal as an individual-level moderator for impacts on subjective vitality. *Scientific Reports*, *13*(1), 5028.	------	------
------	**------**	30. Wilkie, S., Platt, T., & Trotter, H. (2023). Does a brief virtual dose of an environment affect subjective wellbeing and judgements of perceived restorativeness? Considering the role of place preference. *Current Research in Ecological and Social Psychology*, 100127.	***No assessment of emotion regulation***	------
------	**------**	31. Wood, C., Wicks, C., & Barton, J. (2023). Green spaces for mental disorders. *Current Opinion in Psychiatry*, *36*(1), 41-46.	***No research article*** **(Review)**	------
------	**------**	32. Yan, T., Jin, H., & Jin, Y. (2023). The mediating role of emotion in the effects of landscape elements on thermal comfort: A laboratory study. *Building and Environment*, *233*, 110130.	***No assessment of emotion regulation***	------
------	**------**	33. Yan, Z., Liao, J., Dale, K. R., Arpan, L. M., & Raney, A. A. (2024). The effects of awe-inspiring nature videos on connectedness to nature and proenvironmental intentions. *Psychology of Popular Media*.	***No assessment of emotion regulation***	------
14	------	34. Yang, Y., Kim, H., Kang, M., Baik, H., Choi, Y., Jang, E. J., ... & Choi, K. H. (2023). The effectiveness of nature-based therapy for community psychological distress and well-being during COVID-19: a multi-site trial. *Scientific Reports*, *13*(1), 22370.	------	***No assessment of nature ****

15	------	35. Zeng, X., Luo, P., Wang, T., Wang, H., & Shen, X. (2023). Screening visual environment impact factors and the restorative effect of four visual environment components in large-space alternative care facilities. *Building and Environment*, *235*, 110221.	------	***No assessment of nature + No assessment of emotion regulation***
------	------	36. Zhang, G., Wu, G., & Yang, J. (2023). The restorative effects of short-term exposure to nature in immersive virtual environments (IVEs) as evidenced by participants' brain activities. *Journal of Environmental Management*, *326*, 116830.	***No assessment of emotion regulation***	------
------	------	37. Zhang, H., Zhang, X., Yang, Y., & Ma, J. (2023). From nature experience to visitors' pro-environmental behavior: the role of perceived restorativeness and well-being. *Journal of Sustainable Tourism*, 1-22.	***No assessment of emotion regulation***	------
TOTAL EXCLUDED PAPERS			**22**	**11**

Note. Different colours indicate the database in which articled have been found. Specifically: PsycInfo (in yellow), PubMed (in green), Google Scholar (in blue), Science Direct (in red), PubPsych (in purple).

* The Nature Based Therapy used in the study also incorporated mindfulness practices, thus it was not possible to distinguish the nature's effects alone.

Appendix A.3.

List of selected articles from the first search of Review 1 based on title and abstract.

1. Bakir-Demir, T., Berument, S. K., & Akkaya, S. (2021). Nature connectedness boosts the bright side of emotion regulation, which in turn reduces stress. *Journal of Environmental Psychology*, *76*, 101642.
2. Bakir-Demir, T., Berument, S. K., & Sahin-Acar, B. (2019). The relationship between greenery and self-regulation of children: The mediation role of nature connectedness. *Journal of Environmental Psychology*, *65*, 101327.
3. Bergeman, C. S., Blaxton, J., & Joiner, R. (2021). Dynamic Systems, Contextual Influences, and Multiple Timescales: Emotion Regulation as a Resilience Resource. *The Gerontologist*, *61*(3), 304-311.
4. Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., ... & Jonides, J. (2012). Interacting with nature improves cognition and affect for individuals with depression. *Journal of Affective Disorders*, *140*(3), 300-305.
5. Beute, F., & de Kort, Y. A. (2018). Stopping the train of thought: A pilot study using an ecological momentary intervention with twice-daily exposure to natural versus urban scenes to lower stress and rumination. *Applied Psychology: Health and Well-Being*, *10*(2), 236-253.
6. Beute, F., & De Kort, Y. A. W. (2014). Natural resistance: Exposure to nature and self-regulation, mood, and physiology after ego-depletion. *Journal of Environmental Psychology*, *40*, 167-178.
7. Birch, J., Rishbeth, C., & Payne, S. R. (2020). Nature doesn't judge you–how urban nature supports young people's mental health and wellbeing in a diverse UK city. *Health & Place, 62*, 102296.
8. Boemo, T., Nieto, I., Vazquez, C., & Sanchez-Lopez, A. (2022). Relations between emotion regulation strategies and affect in daily life: A systematic review and meta-analysis of studies using ecological momentary assessments. *Neuroscience & Biobehavioral Reviews*, 104747.
9. Bratman, G. N., Daily, G. C., Levy, B. J., & Gross, J. J. (2015). The benefits of nature experience: Improved affect and cognition. *Landscape and Urban Planning*, *138*, 41-50.
10. Bratman, G. N., Hamilton, J. P., Hahn, K. S., Daily, G. C., & Gross, J. J. (2015). Nature experience reduces rumination and subgenual prefrontal cortex activation. *Proceedings of the National Academy of Sciences*, *112*(28), 8567-8572.

11. Dimitrov-Discher, A., Wenzel, J., Kabisch, N., Hemmerling, J., Bunz, M., Schöndorf, J., ... & Adli, M. (2022). Residential green space and air pollution are associated with brain activation in a social-stress paradigm. *Scientific Reports*, *12*(1), 1-11.
12. Emami, E., Amini, R., & Motalebi, G. (2018). The effect of nature as positive distractibility on the Healing Process of Patients with cancer in therapeutic settings. *Complementary Therapies in Clinical Practice*, *32*, 70-73.
13. Fido, D., Rees, A., Wallace, L., & Mantzorou, L. (2020). Psychopathy moderates the relationship between nature connectedness and cognitive reappraisal. *Ecopsychology*, *12*(4), 301-308.
14. Golding, S. E., Gatersleben, B., & Cropley, M. (2018). An experimental exploration of the effects of exposure to images of nature on rumination. *International Journal of Environmental Research and Public Health, 15*(2), 300.
15. Han, Z., Kang, J., & Meng, Q. (2022). The effect of foreground and background of soundscape sequence on emotion in urban open spaces. *Applied Acoustics*, *199*, 109039.
16. Hanley, A. W., Derringer, S. A., & Hanley, R. T. (2017). Dispositional mindfulness may be associated with deeper connections with nature. *Ecopsychology*, *9*(4), 225-231.
17. Harrison, N. R., & Clark, D. P. (2020). Mindful awareness, but not acceptance, predicts engagement with natural beauty. *Ecopsychology*, *12*(1), 36-43.
18. Hartig, T., Mang, M., & Evans, G. W. (1991). Restorative effects of natural environment experiences. *Environment and Behavior*, *23*(1), 3-26.
19. Hiekkaranta, A. P., Kirtley, O. J., Lafit, G., Decoster, J., Derom, C., De Hert, M., ... & Myin-Germeys, I. (2021). Emotion regulation in response to daily negative and positive events in youth: The role of event intensity and psychopathology. *Behaviour Research and Therapy*, *144*, 103916.
20. Huynh, T., & Torquati, J. C. (2019). Examining connection to nature and mindfulness at promoting psychological well-being. *Journal of Environmental Psychology*, *66*, 101370.
21. Ibes, D. C., & Forestell, C. A. (2022). The role of campus greenspace and meditation on college students' mood disturbance. *Journal of American College Health*, *70*(1), 99-106.
22. Johnsen, S. Å. K. (2013). Exploring the use of nature for emotion regulation: associations with personality, perceived stress, and restorative outcomes. *Nordic Psychology*, *65*(4), 306-321.

23. Johnsen, S. Å. K., & Rydstedt, L. W. (2013). Active use of the natural environment for emotion regulation. *Europe's Journal of Psychology*, *9*(4), 798-819.

24. Korpela, K. M., Pasanen, T., Repo, V., Hartig, T., Staats, H., Mason, M., ... & Ward Thompson, C. (2018). Environmental strategies of affect regulation and their associations with subjective well-being. *Frontiers in Psychology*, *9*, 562.

25. Korpela, K., & Hartig, T. (1996). Restorative qualities of favorite places. *Journal of Environmental Psychology*, *16*(3), 221-233.

26. Korpela, K., Borodulin, K., Neuvonen, M., Paronen, O., & Tyrväinen, L. (2014). Analyzing the mediators between nature-based outdoor recreation and emotional well-being. *Journal of Environmental Psychology*, *37*, 1-7.

27. Li, Z., Wang, Y., Liu, H., & Liu, H. (2022). Physiological and psychological effects of exposure to different types and numbers of biophilic vegetable walls in small spaces. *Building and Environment*, *225*, 109645.

28. Lopes, S., Lima, M., & Silva, K. (2020). Nature can get it out of your mind: The rumination reducing effects of contact with nature and the mediating role of awe and mood. *Journal of Environmental Psychology*, *71*, 101489.

29. Malekinezhad, F., Courtney, P., bin Lamit, H., & Vigani, M. (2020). Investigating the mental health impacts of university campus green space through perceived sensory dimensions and the mediation effects of perceived restorativeness on restoration experience. *Frontiers in Public Health*, *8*, 578241.

30. Mason, M. J., & Korpela, K. (2009). Activity spaces and urban adolescent substance use and emotional health. *Journal of Adolescence*, *32*(4), 925-939.

31. Mochizuki-Kawai, H., Matsuda, I., & Mochizuki, S. (2020). Viewing a flower image provides automatic recovery effects after psychological stress. *Journal of Environmental Psychology*, *70*, 101445.

32. Mueller, M. A., & Flouri, E. (2020). Neighbourhood greenspace and children's trajectories of self-regulation: Findings from the UK Millennium Cohort Study. *Journal of Environmental Psychology*, *71*, 101472.

33. Mygind, L., Elsborg, P., Schipperijn, J., Boruff, B., Lum, J. A., Bølling, M., ... & Christian, H. (2022). Is vegetation cover in key behaviour settings important for early childhood socioemotional function? A preregistered, cross-sectional study. *Developmental Science*, *25*(3), e13200.

34. Neill, C., Gerard, J., & Arbuthnott, K. D. (2019). Nature contact and mood benefits: Contact duration and mood type. *The Journal of Positive Psychology*, *14*(6), 756-767.

35. Pirgie, L., Schwab, M., Sudkamp, J., Höltge, J., & Cervinka, R. (2016). Recreation in the national park-Visiting restorative places in the National Park Thayatal, Austria fosters connectedness and mindfulness. *Zeitschrift für Umweltpsychologie*, *20*, 59-74.
36. Richardson, M., & McEwan, K. (2018). 30 days wild and the relationships between engagement with nature's beauty, nature connectedness and well-being. *Frontiers in Psychology, 9*, 1500.
37. Sahni, P., & Kumar, J. (2021). Exploring the relationship of human–nature interaction and mindfulness: a cross-sectional study. *Mental Health, Religion & Culture*, *24*(5), 450-462.
38. Samus, A., Freeman, C., Van Heezik, Y., Krumme, K., & Dickinson, K. J. (2022). How do urban green spaces increase well-being? The role of perceived wildness and nature connectedness. *Journal of Environmental Psychology*, *82*, 101850.
39. Schirda, B., Valentine, T. R., Aldao, A., & Prakash, R. S. (2016). Age-related differences in emotion regulation strategies: Examining the role of contextual factors. *Developmental Psychology*, *52*(9), 1370.
40. Severin, M. I., Raes, F., Notebaert, E., Lambrecht, L., Everaert, G., & Buysse, A. (2022). A qualitative study on emotions experienced at the coast and their influence on well-being. *Frontiers in Psychology*, *13*.
41. Snell, T. L., Lam, J. C., Lau, W. W. Y., Lee, I., Maloney, E. M., Mulholland, N., ... & Wynne, L. J. (2016). Contact with nature in childhood and adult depression. *Children, Youth and Environments*, *26*(1), 111-124.
42. Snell, T. L., Simmonds, J. G., & Klein, L. M. (2020). Exploring the impact of contact with nature in childhood on adult personality. *Urban Forestry & Urban Greening*, *55*, 126864.
43. Stewart, M., & Haaga, D. A. (2018). State mindfulness as a mediator of the effects of exposure to nature on affect and psychological well-being. *Ecopsychology*, *10*(1), 53-60.
44. Swami, V., Barron, D., Todd, J., Horne, G., & Furnham, A. (2020). Nature exposure and positive body image:(Re-) examining the mediating roles of connectedness to nature and trait mindfulness. *Body Image*, *34*, 201-208.
45. Zhang, L., Tan, P. Y., Gan, D. R. Y., & Samsudin, R. (2022). Assessment of mediators in the associations between urban green spaces and self-reported health. *Landscape and Urban Planning*, *226*, 104503.

Appendix A.4.

List of selected articles from the second search of Review 1 based on title and abstract.

1. Browning, M. H., Shin, S., Drong, G., McAnirlin, O., Gagnon, R. J., Ranganathan, S., ... & Heller, W. (2023). Daily exposure to virtual nature reduces symptoms of anxiety in college students. *Scientific reports*, *13*(1), 1239.
2. Chhajer, R., & Hira, N. (2024). Exploring positive psychology intervention and mindfulness-based intervention in nature: impact on well-being of school students in India. *Frontiers in Public Health, 12*.
3. Dettweiler, U., Gerchen, M., Mall, C., Simon, P., & Kirsch, P. (2023). Choice matters: Pupils' stress regulation, brain development and brain function in an outdoor education project. *British Journal of Educational Psychology*, *93*, 152-173.
4. Ibrahim, F. A., Mehta, U. M., Thekkumkara, S. N., Rakesh, K. R., Swetha, G., Kumar, C. N., ... & Thirthalli, J. (2023). Multivariate associations between cognition and neighborhood geospatial characteristics in schizophrenia. *Asian Journal of Psychiatry*, *84*, 103593.
5. Ivaldi, A. (2023). Understanding and restoring the self in nature for well-being: A phenomenological analysis of walking coaching experiences. *The Humanistic Psychologist*.
6. Lanza, K., Alcazar, M., Chen, B., & Kohl III, H. W. (2023). Connection to nature is associated with social-emotional learning of children. *Current Research in Ecological and Social Psychology*, *4*, 100083.
7. Liang, J. H., Yang, R. Y., Liu, M. L., Pu, Y. Q., Bao, W. W., Zhao, Y., ... & Chen, Y. J. (2024). Urban green, blue spaces and their joint effect are associated with lower risk of emotional and behavior problem in children and adolescents, a large population-based study in Guangzhou, China. *Environmental Research*, *240*, 117475.
8. Ma, J., Williams, J. M., Morris, P. G., & Chan, S. W. (2023). Effectiveness of a mindful nature walking intervention on sleep quality and mood in university students during Covid-19: A randomised control study. *Explore*, *19*(3), 405-416.
9. Oswald, T. K., Kohler, M., Rumbold, A. R., Kedzior, S. G., & Moore, V. M. (2023). The acute psychological effects of screen time and the restorative potential of

nature immersion amongst adolescents: A randomised pre-post pilot study. *Journal of Environmental Psychology*, *92*, 102183.

10. Sallay, V., Martos, T., Rosta-Filep, O., Horváth, Z., & Korpela, K. (2023). Profiles of perceived physical features and emotional experiences in favorite places: Discovering ambivalent place preferences. *Journal of Environmental Psychology*, *90*, 102084.
11. Sanyer, M. M., Bettmann, J. E., Anstadt, G., Ganesh, K., & Hanley, A. W. (2023). Decenter to reenter nature: Relationships between decentering, self-transcendence, and nature connectedness. *Psychology of Consciousness: Theory, Research, and Practice*, *10*(3), 205.
12. Sun, Y., Li, F., He, T., Meng, Y., Yin, J., Yim, I. S., ... & Wu, J. (2023). Physiological and affective responses to green space virtual reality among pregnant women. *Environmental Research*, *216*, 114499.
13. Theodorou, A., Spano, G., Bratman, G. N., Monneron, K., Sanesi, G., Carrus, G., ... & Panno, A. (2023). Emotion regulation and virtual nature: cognitive reappraisal as an individual-level moderator for impacts on subjective vitality. *Scientific Reports*, *13*(1), 5028.
14. Yang, Y., Kim, H., Kang, M., Baik, H., Choi, Y., Jang, E. J., ... & Choi, K. H. (2023). The effectiveness of nature-based therapy for community psychological distress and well-being during COVID-19: a multi-site trial. *Scientific Reports*, *13*(1), 22370.
15. Zeng, X., Luo, P., Wang, T., Wang, H., & Shen, X. (2023). Screening visual environment impact factors and the restorative effect of four visual environment components in large-space alternative care facilities. *Building and Environment*, *235*, 110221.

Appendix B.

Supplementary Materials for Chapter 4.

Appendix B.1.

Location Selection in Nature Scale – Full English version (Study 1)

Instructions: The following questionnaire asks you about **visiting nature to help manage your emotions**. Please rate how much you agree or disagree with the statements below using the scale provided. We are genuinely interested in your opinion. There are no right or wrong answers, so please choose the response you feel most comfortable with and best reflects your own behaviour.

Response options: 1 = Strongly disagree; 4 = Neutral; 7 = Strongly agree

CODE	ITEM							
N-H_1	I visit nature when I want to unwind from stress.	1	2	3	4	5	6	7
N-H_2	I go to nature when I want to feel less tense.	1	2	3	4	5	6	7
N-H_3	I go to nature when I want to feel less anxious.	1	2	3	4	5	6	7
N-H_4	I visit nature when I want to feel less angry.	1	2	3	4	5	6	7
N-H_5	I go to nature when I want to feel less annoyed.	1	2	3	4	5	6	7
N-L_1	I go to nature when I want to feel less sad.	1	2	3	4	5	6	7
N-L_2	I go to nature when I want to feel less depressed.	1	2	3	4	5	6	7
N-L_3	I visit nature when I want to feel less bored.	1	2	3	4	5	6	7
N-L_4	I visit nature when I want to feel less fatigued.	1	2	3	4	5	6	7
N-L_5	I visit nature when I want to feel less gloomy.	1	2	3	4	5	6	7
P-H_1	I visit nature when I want to feel more uplifted.	1	2	3	4	5	6	7
P-H_2	I visit nature when I want to feel more cheerful.	1	2	3	4	5	6	7
P-H_3	I go to nature when I want to feel more enthusiastic.	1	2	3	4	5	6	7
P-H_4	I go to nature when I want to feel more inspired.	1	2	3	4	5	6	7
P-H_5	I go to nature when I want to feel more energized.	1	2	3	4	5	6	7
P-L_1	I go to nature when I want to feel more relaxed.	1	2	3	4	5	6	7
P-L_2	I visit nature when I want to feel a sense of tranquility.	1	2	3	4	5	6	7
P-L_3	I visit nature when I want to feel more at ease.	1	2	3	4	5	6	7
P-L_4	I go to nature when I want to feel calmer.	1	2	3	4	5	6	7
P-L_5	I visit nature when I want to feel more content.	1	2	3	4	5	6	7

Appendix B.2.

Situation Selection scale – English version (Study 1, Study 2 – T_1)

(SS; Webb et al., 2018; with 3 additional items: Duijndam et al., 2021)

Instructions: Below are several statements. Please indicate to what extent these statements suit you. The questions are very much alike, but please answer each question using the response options listed below.

Response options: 1 = Not at all like me; 2 = Somewhat not like me; 3 = A bit like me; 4 = Somewhat like me; 5 = Very much like me

CODE	ITEM	
SS_Eng_1	I select activities that help me to feel good.	1 2 3 4 5
SS_Eng_2	If a situation makes me feel good, then I try to stick around.	1 2 3 4 5
SS_Eng_3	I gravitate towards people, situations, and activities that put me in a good mood.	1 2 3 4 5
SS_Eng_4	I keep doing something if it seems to be improving my mood.	1 2 3 4 5
SS_Eng_5	I am attracted to activities that put me in a good mood.	1 2 3 4 5
SS_Dis_1	I shy away from situations that might upset me.	1 2 3 4 5
SS_Dis_2	I steer clear of people who put me in a bad mood.	1 2 3 4 5
SS_Dis_3	If I know a situation will be uncomfortable or annoying, I tend to avoid it.	1 2 3 4 5
SS_Dis_4	If I find myself in an uncomfortable situation, I try to get out of it as quickly as I can.	1 2 3 4 5
SS_Dis_5	I tend to avoid situations that have a negative impact on my mood.	1 2 3 4 5

Appendix B.3.

Process Model of Emotion Regulation Questionnaire – English version (Study 1, Study 2 – T_1)

(PMERQ; Olderbak et al., 2022)

Instructions: We are interested in which strategies people use to regulate their emotions, specifically to decrease the negative emotion that they feel. Please rate your agreement with the following statements using the response options listed below. There is no right or wrong answer.

Response options: 1 = Strongly disagree; 2 = Disagree; 3 = Somewhat disagree; 4 = Somewhat agree; 5 = Agree; 6 = Strongly agree

CODE	ITEM	
PMERQ_SS_Eng_1	To feel less anxious, I tackle stressful situations head-on.	1 2 3 4 5 6
PMERQ_SS_Eng_2	When I have something unpleasant to discuss with someone, I confront them to feel less bad.	1 2 3 4 5 6
PMERQ_SS_Eng_3	I confront upsetting situations head-on to feel less upset.	1 2 3 4 5 6
PMERQ_SS_Dis_1	I avoid situations others tell me will be unpleasant, to feel less bad.	1 2 3 4 5 6
PMERQ_SS_Dis_2	I avoid upsetting conversations to feel less upset.	1 2 3 4 5 6
PMERQ_SS_Dis_3	To feel less anxious, I avoid stressful situations.	1 2 3 4 5 6
PMERQ_SM_Eng_1	To reduce how bad conflicts make me feel, I work to solve the disagreement.	1 2 3 4 5 6
PMERQ_SM_Eng_2	I work to negotiate a resolution to conflicts I have with others, to decrease how bad I feel.	1 2 3 4 5 6
PMERQ_SM_Eng_3	During a conflict, to calm myself down I work toward finding a compromise.	1 2 3 4 5 6

PMERQ_SM_Dis_1	I steer contentious conversations toward a different topic, to reduce how upset they make me feel.	1 2 3 4 5 6
PMERQ_SM_Dis_2	During conflicts I change the topic toward something less upsetting, to feel less bad.	1 2 3 4 5 6
PMERQ_SM_Dis_3	To feel less upset during a heated conversation, I change the subject.	1 2 3 4 5 6
PMERQ_AD_Eng_1	To reduce how anxious I feel during stressful conversations, I focus on things the person says that are not negative.	1 2 3 4 5 6
PMERQ_AD_Eng_2	I concentrate on the least negative aspects of an upsetting situation, to feel less upset.	1 2 3 4 5 6
PMERQ_AD_Eng_3	To reduce how bad I feel during unpleasant conversations, I focus on anything the person says that is not unpleasant.	1 2 3 4 5 6
PMERQ_AD_Dis_1	During stressful conversations, I distract myself to feel less anxious.	1 2 3 4 5 6
PMERQ_AD_Dis_2	To feel less upset during upsetting situations, I divert my attention away from what is happening.	1 2 3 4 5 6
PMERQ_AD_Dis_3	I distract myself during unpleasant situations to feel less bad.	1 2 3 4 5 6
PMERQ_CG_Eng_1	To reduce how upset I feel when something upsetting happens, I think of this as a chance to grow.	1 2 3 4 5 6
PMERQ_CG_Eng_2	When something upsetting happens, to feel less upset, I think about the possible benefits of the situation.	1 2 3 4 5 6
PMERQ_CG_Eng_3	To feel less nervous during a stressful situation, I think about the good things that could come from the situation.	1 2 3 4 5 6
PMERQ_CG_Dis_1	When something does not go as planned, I re-evaluate its importance to reduce how bad I feel.	1 2 3 4 5 6
PMERQ_CG_Dis_2	If something does not work out as I wanted, to feel less bad I decide that perhaps it was not so important.	1 2 3 4 5 6

PMERQ_CG_Dis_3	When going for something I want gets me in a stressful situation, to feel less anxious I question the importance of what I want.	1 2 3 4 5 6
PMERQ_RM_Eng_1	I express how I feel to my friends as a way to feel less bad.	1 2 3 4 5 6
PMERQ_RM_Eng_2	To feel less stressed, I ask others for help.	1 2 3 4 5 6
PMERQ_RM_Eng_3	I talk with others about what makes me nervous, to feel less anxious.	1 2 3 4 5 6
PMERQ_RM_Dis_1	I suppress my emotion expressions during stressful conversations to feel less anxious.	1 2 3 4 5 6
PMERQ_RM_Dis_2	To calm down, I do not show others how I feel.	1 2 3 4 5 6
PMERQ_RM_Dis_3	I do not tell others when I am upset, as a way to reduce how upset I feel.	1 2 3 4 5 6

Appendix B.4.

Connectedness to Nature Scale – English version (Study 1, Study 2 – T1)

(CNS; Mayer & Frantz, 2004 – short version: Rosa et al., 2022)

Instructions: Please answer each of these questions in terms of *the way you generally feel*. There are no right or wrong answers. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

Response options: 1 = Strongly disagree; 3 = Neutral; 5 = Strongly agree

CODE	ITEM					
CNS_1	I think of the natural world as a community to which I belong.	1	2	3	4	5
CNS_2	When I think of my life, I imagine myself to be part of a larger cyclical process of living.	1	2	3	4	5
CNS_3	I often feel a kinship with animals and plants.	1	2	3	4	5
CNS_4	I feel as though I belong to the Earth as equally as it belongs to me.	1	2	3	4	5
CNS_5	I often feel part of the web of life.	1	2	3	4	5
CNS_6	I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.	1	2	3	4	5
CNS_7	Like a tree can be part of a forest, I feel embedded within the broader natural world.	1	2	3	4	5

Appendix B.5.

Items from the Monitor of Engagement with the Natural Environment – English version (Study 1, Study 2 – T_1)

(MENE; Natural England, 2018)

General instructions: The following questions are about free time you have spent outside in green and natural spaces. This includes visit to…

- *green spaces* in towns and cities (e.g. parks, canals)
- the *countryside* (e.g. farmland, woodland, hills and rivers)
- the *coast* (e.g. beaches, cliffs) and activities in the open sea

✓ DO include:

- visits of any duration (including short trips to the park, dog walking, etc)

However, do NOT include

- time in your garden
- time outside as part of your job

ITEM 1 – Instructions: In the last 12 months, how often, on average have you spent free time outside in green and natural spaces? *Please select one answer.*

Response options: 1 = Every day; 2 = More than twice a week, but not every day; 3 = Twice a week; 4 = Once a week; 5 = Once or twice a month; 6 = Once every 2-3 months; 7 = Less often; 8 = Never; 9 = Don't know; 10 = Prefer not to say

ITEM 2 – Instructions: How many times, if at all, did you make this type of visit to green and natural spaces in the last 14 days? *Please type in a number*.

If you did not take any of these types of visit in the last 14 days please enter 0.
If you are unsure please give your best estimate.

Open text box (*Max 100*): ______

Appendix B.6.

Childhood Nature Exposure – English version (Study 1, Study 2 – T_1)

(Blue Health Survey, Grellier et al., 2017)

Instructions: How strongly do you agree with each of these statements regarding your childhood experiences of natural spaces (aged 0 to 16 years of age).

Response options: 1 = Strongly disagree – 7 = Strongly agree

CODE	ITEM							
CNE_1	As a child, there was easily accessible natural spaces near my home(s)	1	2	3	4	5	6	7
CNE_2	As a child, my parents/guardians were comfortable with me playing in and around natural spaces	1	2	3	4	5	6	7
CNE_3	As a child, I often visited natural spaces	1	2	3	4	5	6	7

Appendix B.7.

CFA for Alternative Models (Study 1)

This Appendix presents details about the CFA of the alternative models tested.

One-factor model.

Table B.1. *Factor loadings for the one-factor structure of the short version of the LS Scale (Study 1)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
General factor	N-L_3	1.02	0.093	0.833	1.198	10.90	< .001	0.595
	N-L_4	1.12	0.091	0.941	1.296	12.35	< .001	0.656
	N-L_5	1.23	0.084	1.062	1.393	14.55	< .001	0.740
	N-H_1	1.23	0.068	1.098	1.363	18.20	< .001	0.860
	N-H_2	1.20	0.069	1.067	1.337	17.45	< .001	0.837
	N-H_3	1.29	0.077	1.138	1.438	16.80	< .001	0.816
	P-L_1	1.16	0.064	1.035	1.286	18.08	< .001	0.857
	P-L_2	1.06	0.068	0.926	1.192	15.57	< .001	0.776
	P-L_4	1.17	0.069	1.034	1.303	16.99	< .001	0.822
	P-H_2	1.14	0.071	0.995	1.274	15.97	< .001	0.790
	P-H_3	1.07	0.083	0.902	1.228	12.81	< .001	0.676
	P-H_5	1.16	0.084	0.994	1.323	13.79	< .001	0.713

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Two-factor model based on arousal.

Table B.2. *Factor loadings for the two-correlated-factor structure based on arousal of the short version of the LS Scale (Study 1)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
Low-arousal	N-L_3	1.018	0.093	0.835	1.201	10.92	< .001	0.596
	N-L_4	1.120	0.091	0.943	1.298	12.37	< .001	0.657
	N-L_5	1.228	0.084	1.062	1.393	14.56	< .001	0.740
	P-L_1	1.159	0.064	1.033	1.285	18.02	< .001	0.856
	P-L_2	1.056	0.069	0.922	1.190	15.41	< .001	0.774
	P-L_4	1.165	0.070	1.029	1.301	16.76	< .001	0.819
High-arousal	N-H_1	1.230	0.068	1.097	1.363	18.17	< .001	0.859
	N-H_2	1.201	0.069	1.066	1.336	17.40	< .001	0.836
	N-H_3	1.286	0.077	1.135	1.437	16.73	< .001	0.814
	P-H_2	1.134	0.071	0.995	1.273	15.96	< .001	0.790
	P-H_3	1.066	0.083	0.903	1.229	12.82	< .001	0.677
	P-H_5	1.159	0.084	0.994	1.323	13.80	< .001	0.713

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.
Covariance between factors: *B* = 1.004, *SE* = 0.010, 95% *CI* [0.985, 1.022], $p < .001$.

Two-factor model based on valence.

Table B.3. *Factor loadings for the two-correlated-factor structure based on valence of the short version of the LS Scale (Study 1)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
Positive	P-L_1	1.161	0.064	1.035	1.287	18.08	< .001	0.857
	P-L_2	1.062	0.068	0.928	1.196	15.56	< .001	0.778
	P-L_4	1.172	0.069	1.036	1.307	16.98	< .001	0.824
	P-H_2	1.136	0.071	0.996	1.275	15.97	< .001	0.791
	P-H_3	1.065	0.083	0.902	1.228	12.80	< .001	0.676
	P-H_5	1.158	0.084	0.994	1.323	13.78	< .001	0.713
Negative	N-L_3	1.013	0.094	0.830	1.196	10.84	< .001	0.594
	N-L_4	1.119	0.091	0.941	1.297	12.34	< .001	0.656
	N-L_5	1.228	0.084	1.063	1.394	14.55	< .001	0.740
	N-H_1	1.232	0.068	1.100	1.365	18.21	< .001	0.861
	N-H_2	1.205	0.069	1.070	1.340	17.45	< .001	0.839
	N-H_3	1.292	0.077	1.141	1.443	16.77	< .001	0.818

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.
Covariance between factors: *B* = 0.995, *SE* = 0.010, 95% *CI* [0.976, 1.015], $p < .001$.

Four-factor model based on valence and arousal.

Table B.4. *Factor loadings for the four-correlated-factor structure based on valence and arousal of the short version of the LS Scale (Study 1)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
Positive low arousal	P-L_1	1.226	0.062	1.104	1.348	19.70	< .001	0.905
	P-L_2	1.106	0.067	0.975	1.238	16.47	< .001	0.811
	P-L_4	1.186	0.069	1.051	1.321	17.19	< .001	0.834
Positive high arousal	P-H_2	1.178	0.071	1.039	1.316	16.65	< .001	0.820
	P-H_3	1.310	0.077	1.159	1.462	16.97	< .001	0.832
	P-H_5	1.287	0.081	1.129	1.446	15.88	< .001	0.792
Negative low arousal	N-L_3	1.283	0.088	1.110	1.456	14.54	< .001	0.752
	N-L_4	1.246	0.089	1.071	1.420	13.99	< .001	0.730
	N-L_5	1.226	0.086	1.057	1.396	14.19	< .001	0.739
Negative high arousal	N-H_1	1.295	0.066	1.166	1.424	19.73	< .001	0.905
	N-H_2	1.238	0.068	1.105	1.371	18.21	< .001	0.861
	N-H_3	1.279	0.078	1.126	1.431	16.47	< .001	0.809

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Table B.5. *Factor covariances for the four-correlated-factor structure based on valence and arousal of the short version of the LS Scale (Study 1)*

				95% Confidence Interval				
		Estimate	SE	Lower	Upper	Z	p	Stand. Estimate
P-L	P-H	0.766	0.034	0.700	0.833	22.454	< .001	0.766
	N-L	0.756	0.039	0.680	0.832	19.443	< .001	0.756
	N-H	0.971	0.013	0.946	0.996	76.869	< .001	0.971
P-H	N-L	1.032	0.019	0.994	1.070	53.883	< .001	1.032
	N-H	0.781	0.033	0.717	0.846	23.810	< .001	0.781
N-L	N-H	0.783	0.037	0.711	0.855	21.220	< .001	0.783

Appendix B.8.

Location Selection in Nature Scale – Short English version

(Study 2 – T_1, Study 2 – T_2)

Instructions: The following questionnaire asks you about **visiting nature to help manage your emotions**. Please rate how much you agree or disagree with the statements below using the scale provided. We are genuinely interested in your opinion. There are no right or wrong answers, so please choose the response you feel most comfortable with and best reflects your own behavior.

Response options: 1 = Strongly disagree; 4 = Neutral; 7 = Strongly agree

CODE	**ITEM**							
N-H_1	I visit nature when I want to unwind from stress.	1	2	3	4	5	6	7
N-H_2	I go to nature when I want to feel less tense.	1	2	3	4	5	6	7
N-H_3	I go to nature when I want to feel less anxious.	1	2	3	4	5	6	7
N-L_1	I visit nature when I want to feel less bored.	1	2	3	4	5	6	7
N-L_2	I visit nature when I want to feel less fatigued.	1	2	3	4	5	6	7
N-L_3	I visit nature when I want to feel less gloomy.	1	2	3	4	5	6	7
P-H_1	I visit nature when I want to feel more cheerful.	1	2	3	4	5	6	7
P-H_2	I go to nature when I want to feel more enthusiastic.	1	2	3	4	5	6	7
P-H_3	I go to nature when I want to feel more energized.	1	2	3	4	5	6	7
P-L_1	I go to nature when I want to feel more relaxed.	1	2	3	4	5	6	7
P-L_2	I visit nature when I want to feel a sense of tranquility.	1	2	3	4	5	6	7
P-L_3	I go to nature when I want to feel calmer.	1	2	3	4	5	6	7

Appendix B.9.

Big Five Inventory-10 – English version (Study 2 – T_1)

(BFI-10; Rammstedt & John, 2007)

Instructions: How well do the following statements describe your personality?

Response options: 1 = Disagree strongly; 2 = Disagree a little; 3 = Neither agree nor disagree; 4 = Agree a little; 5 = Agree strongly

CODE	I see myself as someone who …	
Extraversion_1_R	… is reserved	1 2 3 4 5
Agreeableness_1	… is generally trusting	1 2 3 4 5
Conscientiousness_1_R	… tends to be lazy	1 2 3 4 5
Neuroticism_1_R	… is relaxed, handles stress well	1 2 3 4 5
Openness_1_R	… has few artistic interests	1 2 3 4 5
Extraversion_2	… is outgoing, sociable	1 2 3 4 5
Agreeableness_2_R	… tends to find fault with others	1 2 3 4 5
Conscientiousness_2	… does a thorough job	1 2 3 4 5
Neuroticism_2	… gets nervous easily	1 2 3 4 5
Openness_2	… has an active imagination	1 2 3 4 5

Appendix B.10.

Time in Nature for Emotion regulation – English version (Study 2 – T2)

(*ad hoc* items)

Instructions: This section of the survey focuses on your recent behaviour related to spending time in nature to regulate your emotions. We are particularly interested in how often you visit nature to manage various emotional states.
Please reflect on your experiences over the past two weeks and indicate the frequency with which you have engaged in these activities.

Response options: 0 = Never; 1 = Once; 2 = A few times (2-3 times); 3 = Sometimes (4-5 times); 4 = Often (6-7 times); 5 = Very often (8-10 times); 6 = Every day

CODE	ITEM							
ER_N-H	In the past two weeks, how often have you visited nature to manage **stress and anxiety**?	0	1	2	3	4	5	6
ER_N-L	In the past two weeks, how often have you visited nature to alleviate feelings of **fatigue and gloom**?	0	1	2	3	4	5	6
ER_P-H	In the past two weeks, how often have you visited nature to boost **energy and enthusiasm**?	0	1	2	3	4	5	6
ER_N-L	In the past two weeks, how often have you visited nature to **relax and find tranquility**?	0	1	2	3	4	5	6

Appendix B.11.

IWP Multi-Affect Indicator – English version (Study 2 – T_2)

(Warr & Parker, 2010)

Instructions: For the past two weeks, please indicate below approximately how often you have felt the following in your daily life. Everyone has a lot of overlapping feelings, so you'll have a total for all the items that is much greater than 100% of the time.

Response options: 1 = Never (0% of the time); 2 = A little of the time (1% to roughly 20%); 3 = Some of the time (Roughly 21% to 40%); 4 = About half the time (Roughly 41% to 60%); 5 = Much of the time (Roughly 61% to 80%); 6 = A lot of the time (Roughly 81% to 99%); 7 = Always (100% of the time)

CODE	I have felt:	Approximate amount of your time in your daily life in the past 2 weeks						
IWP_P-H_1	Enthusiastic	1	2	3	4	5	6	7
IWP_N-H_1	Nervous	1	2	3	4	5	6	7
IWP_P-L_1	Calm	1	2	3	4	5	6	7
IWP_N-L_1	Depressed	1	2	3	4	5	6	7
IWP_P-H_2	Joyful	1	2	3	4	5	6	7
IWP_N-H_2	Anxious	1	2	3	4	5	6	7
IWP_P-L_2	Relaxed	1	2	3	4	5	6	7
IWP_N-L_2	Dejected	1	2	3	4	5	6	7
IWP_P-H_3	Inspired	1	2	3	4	5	6	7
IWP_N-H_3	Tense	1	2	3	4	5	6	7
IWP_P-L_3	Laid-back	1	2	3	4	5	6	7
IWP_N-L_3	Despondent	1	2	3	4	5	6	7
IWP_P-H_4	Excited	1	2	3	4	5	6	7
IWP_N-H_4	Worried	1	2	3	4	5	6	7
IWP_P-L_4	At ease	1	2	3	4	5	6	7
IWP_N-L_4	Hopeless	1	2	3	4	5	6	7

Appendix B.12.

Ultra-Brief Screening Scale for Anxiety and Depression

– English version (Study 2 – T_2)

(Kroenke et al., 2009)

Instructions: Over the last 2 weeks, how often have you been bothered by the following problems?

Response options: 0 = Not at All; 1 = Several Days; 2 = More Than Half the Days; 3 = Nearly Every Day

CODE	ITEM				
Anxiety_1	Feeling nervous, anxious, or on edge	1	2	3	4
Anxiety_2	Not being able to stop or control worrying	1	2	3	4
Depression_1	Feeling down, depressed, or hopeless	1	2	3	4
Depression_2	Little interest or pleasure in doing things	1	2	3	4

Appendix B.13.

Satisfaction With Life Scale – English version (Study 2 – T_2)

(SWLS; Diener et al., 1985)

Instructions: Below are five statements that you may agree or disagree with. Using the 1 - 7 scale below, indicate your agreement with each item by selecting the appropriate number for each them. Please be open and honest in your responding.

Response options: 1 = Strongly disagree; 2 = Disagree; 3 = Slightly disagree; 4 = Neither agree nor disagree; 5 = Slightly agree; 6 = Agree; 7 = Strongly agree

CODE	ITEM	
SWLS_1	In most ways my life is close to my ideal	1 2 3 4 5 6 7
SWLS_2	The conditions of my life are excellent	1 2 3 4 5 6 7
SWLS_3	I am satisfied with my life	1 2 3 4 5 6 7
SWLS_4	So far I have gotten the important things I want in life	1 2 3 4 5 6 7
SWLS_5	If I could live my life over, I would change almost nothing	1 2 3 4 5 6 7

Appendix B.14.

CFA for Alternative Model (Study 2)

This Appendix presents details about the CFA of the alternative models tested.

One-factor model.

Table B.6. *Factor loadings for the one-factor structure of the short version of the LS Scale (Study 2)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
General factor	N-L_1	1.426	0.074	1.282	1.570	19.389	< .001	0.880
	N-L_2	1.354	0.068	1.221	1.488	19.885	< .001	0.894
	N-L_3	1.266	0.087	1.095	1.438	14.478	< .001	0.724
	N-H_1	1.379	0.071	1.239	1.518	19.383	< .001	0.880
	N-H_2	1.461	0.072	1.319	1.603	20.180	< .001	0.901
	N-H_3	1.264	0.089	1.090	1.437	14.253	< .001	0.716
	P-L_1	1.198	0.076	1.050	1.347	15.813	< .001	0.771
	P-L_2	1.244	0.084	1.079	1.408	14.808	< .001	0.737
	P-L_3	1.323	0.070	1.187	1.460	18.968	< .001	0.869
	P-H_1	1.431	0.077	1.281	1.582	18.629	< .001	0.859
	P-H_2	1.264	0.084	1.098	1.429	14.969	< .001	0.742
	P-H_3	1.320	0.070	1.183	1.457	18.918	< .001	0.867

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Appendix B.15.

Location Selection in Nature Scale – Short Italian version

(Study 3)

Instructions: Il seguente questionario ti chiede delle **tue visite nella natura per aiutarti a gestire le tue emozioni**. Per favore, valuta quanto sei d'accordo o in disaccordo con le affermazioni riportate di seguito utilizzando la scala fornita. Siamo davvero interessati alla tua opinione. Non ci sono risposte giuste o sbagliate, quindi scegli la risposta con cui ti senti più a tuo agio e che meglio riflette il tuo comportamento.

Response options: 1 = Fortemente in disaccordo; 4 = Neutrale; 7 = Fortemente d'accordo

CODE	ITEM	
N-H_1	Visito la natura quando voglio staccare dallo stress.	1 2 3 4 5 6 7
N-H_2	Vado nella natura quando voglio sentirmi meno teso.	1 2 3 4 5 6 7
N-H_3	Vado nella natura quando voglio sentirmi meno ansioso.	1 2 3 4 5 6 7
N-L_1	Visito la natura quando voglio sentirmi meno annoiato.	1 2 3 4 5 6 7
N-L_2	Visito la natura quando voglio sentirmi meno affaticato.	1 2 3 4 5 6 7
N-L_3	Visito la natura quando voglio sentirmi meno cupo.	1 2 3 4 5 6 7
P-H_1	Visito la natura quando voglio sentirmi più allegro.	1 2 3 4 5 6 7
P-H_2	Vado nella natura quando voglio sentirmi più entusiasta.	1 2 3 4 5 6 7
P-H_3	Vado nella natura quando voglio sentirmi più energico.	1 2 3 4 5 6 7
P-L_1	Vado nella natura quando voglio sentirmi più rilassato.	1 2 3 4 5 6 7
P-L_2	Visito la natura quando voglio sentire un senso di tranquillità.	1 2 3 4 5 6 7
P-L_3	Vado nella natura quando voglio sentirmi più calmo.	1 2 3 4 5 6 7

Appendix B.16.

Situation Selection scale – Italian version (Study 3)

(SS; Webb et al., 2018; with 3 additional items: Duijndam et al., 2021)

Instructions: Sotto sono elencate diverse affermazioni. Ti preghiamo di indicare in quale misura queste affermazioni ti descrivono. Le domande sono molto simili tra loro, ma per favore rispondi a ciascuna domanda utilizzando le opzioni di risposta elencate di seguito.

Response options: 1 = per niente come me; 2 = poco come me; 3 = un po' come me; 4 = abbastanza come me; 5 = molto come me

CODE	ITEM	
SS_Eng_1	Scelgo attività che mi aiutano a sentirmi bene.	1 2 3 4 5
SS_Eng_2	Se una situazione mi fa sentire bene, cerco di restarci.	1 2 3 4 5
SS_Eng_3	Tendo a frequentare persone, situazioni e attività che mi mettono di buon umore.	1 2 3 4 5
SS_Eng_4	Continuo a fare qualcosa se sembra migliorare il mio umore.	1 2 3 4 5
SS_Eng_5	Sono attratto da attività che mi mettono di buon umore.	1 2 3 4 5
SS_Dis_1	Mi allontano dalle situazioni che potrebbero turbarmi.	1 2 3 4 5
SS_Dis_2	Evito persone che mi mettono di cattivo umore.	1 2 3 4 5
SS_Dis_3	Se so che una situazione sarà spiacevole o fastidiosa, tendo ad evitarla.	1 2 3 4 5
SS_Dis_4	Se mi trovo in una situazione spiacevole, cerco di uscirne il più velocemente possibile.	1 2 3 4 5
SS_Dis_5	Tendo ad evitare situazioni che hanno un impatto negativo sul mio umore.	1 2 3 4 5

Appendix B.17.

Process Model of Emotion Regulation Questionnaire – Italian version

(Study 3)

(PMERQ; Olderbak et al., 2022)

Instructions: Siamo interessati a quali strategie le persone utilizzano per regolare le proprie emozioni, in particolare per diminuire le emozioni negative che provano. Ti preghiamo di indicare il tuo grado di accordo con le seguenti affermazioni utilizzando le opzioni di risposta elencate di seguito. Non esiste una risposta giusta o sbagliata.

Response options: 1 = Fortemente in disaccordo; 2 = In disaccordo; 3 = Un po' in disaccordo; 4 = Un po' d'accordo; 5 = D'accordo; 6 = Fortemente d'accordo

CODE	**ITEM**	
PMERQ_SS_Eng_1	Per sentirmi meno ansioso, affronto direttamente le situazioni stressanti.	1 2 3 4 5 6
PMERQ_SS_Eng_2	Quando ho qualcosa di spiacevole da discutere con qualcuno, lo confronto per sentirmi meno male.	1 2 3 4 5 6
PMERQ_SS_Eng_3	Affronto direttamente le situazioni sgradevoli per sentirmi meno turbato.	1 2 3 4 5 6
PMERQ_SS_Dis_1	Evito situazioni che gli altri mi dicono saranno sgradevoli, per sentirmi meno male.	1 2 3 4 5 6
PMERQ_SS_Dis_2	Evito conversazioni sgradevoli per sentirmi meno turbato.	1 2 3 4 5 6
PMERQ_SS_Dis_3	Per sentirmi meno ansioso, evito situazioni stressanti.	1 2 3 4 5 6
PMERQ_SM_Eng_1	Per ridurre quanto male mi fanno sentire i conflitti, lavoro per risolvere il disaccordo.	1 2 3 4 5 6

PMERQ_SM_Eng_2	Lavoro per negoziare una risoluzione ai conflitti che ho con gli altri, per ridurre quanto mi sento male.	1 2 3 4 5 6
PMERQ_SM_Eng_3	Durante un conflitto, per calmarmi lavoro verso la ricerca di un compromesso.	1 2 3 4 5 6
PMERQ_SM_Dis_1	Indirizzo le conversazioni conflittuali verso un argomento diverso, per ridurre quanto mi fanno sentire turbato.	1 2 3 4 5 6
PMERQ_SM_Dis_2	Durante i conflitti cambio argomento verso qualcosa di meno sgradevole, per sentirmi meno male.	1 2 3 4 5 6
PMERQ_SM_Dis_3	Per sentirmi meno turbato durante una conversazione accesa, cambio argomento.	1 2 3 4 5 6
PMERQ_AD_Eng_1	Per ridurre quanto mi sento ansioso durante conversazioni stressanti, mi concentro su cose che la persona dice che non sono negative.	1 2 3 4 5 6
PMERQ_AD_Eng_2	Mi concentro sugli aspetti meno negativi di una situazione sgradevole, per sentirmi meno turbato.	1 2 3 4 5 6
PMERQ_AD_Eng_3	Per ridurre quanto mi sento male durante conversazioni sgradevoli, mi concentro su qualsiasi cosa dica la persona che non è sgradevole.	1 2 3 4 5 6
PMERQ_AD_Dis_1	Durante conversazioni stressanti, mi distraggo per sentirmi meno ansioso.	1 2 3 4 5 6
PMERQ_AD_Dis_2	Per sentirmi meno turbato durante situazioni sgradevoli, distolgo la mia attenzione da ciò che sta accadendo.	1 2 3 4 5 6
PMERQ_AD_Dis_3	Mi distraggo durante situazioni sgradevoli per sentirmi meno male.	1 2 3 4 5 6
PMERQ_CG_Eng_1	Per ridurre quanto mi sento turbato quando succede qualcosa di sgradevole, considero questo come un’opportunità per crescere.	1 2 3 4 5 6
PMERQ_CG_Eng_2	Quando succede qualcosa di sgradevole, per sentirmi meno turbato, penso ai possibili benefici della situazione.	1 2 3 4 5 6

PMERQ_CG_Eng_3	Per sentirmi meno nervoso durante una situazione stressante, penso alle cose positive che potrebbero derivare dalla situazione.	1 2 3 4 5 6
PMERQ_CG_Dis_1	Quando qualcosa non va come previsto, rivaluto la sua importanza per ridurre quanto mi sento male.	1 2 3 4 5 6
PMERQ_CG_Dis_2	Se qualcosa non va come volevo, per sentirmi meno male decido che forse non era così importante.	1 2 3 4 5 6
PMERQ_CG_Dis_3	Quando cercare qualcosa che voglio mi mette in una situazione stressante, per sentirmi meno ansioso metto in discussione l'importanza di ciò che voglio.	1 2 3 4 5 6
PMERQ_RM_Eng_1	Esprimo come mi sento ai miei amici come modo per sentirmi meno male.	1 2 3 4 5 6
PMERQ_RM_Eng_2	Per sentirmi meno stressato, chiedo aiuto agli altri.	1 2 3 4 5 6
PMERQ_RM_Eng_3	Parlo con gli altri di ciò che mi rende nervoso, per sentirmi meno ansioso.	1 2 3 4 5 6
PMERQ_RM_Dis_1	Sopprimo le mie espressioni emotive durante conversazioni stressanti per sentirmi meno ansioso.	1 2 3 4 5 6
PMERQ_RM_Dis_2	Per calmarmi, non mostro agli altri come mi sento.	1 2 3 4 5 6
PMERQ_RM_Dis_3	Non dico agli altri quando sono turbato, come modo per ridurre quanto mi sento turbato.	1 2 3 4 5 6

Appendix B.18.

Connectedness to Nature Scale – Italian version (Study 3)

(CNS; Italian version: Lovati et al., 2023)

Instructions: Si prega di rispondere a ciascuna di queste domande in termini di *come ti senti generalmente*. Non ci sono risposte giuste o sbagliate. Utilizzando la seguente scala, nello spazio fornito accanto a ogni domanda dichiari semplicemente e onestamente per quanto possibile che cosa stai sperimentando attualmente.

Response options: 1 = Fortemente in disaccordo; 4 = Neutrale; 5 = Fortemente d'accordo

CODE	ITEM					
CNS_1	Penso al mondo naturale come a una comunità a cui appartengo	1	2	3	4	5
CNS_2	Quando penso alla mia vita, mi immagino parte di un più ampio processo ciclico di vita.	1	2	3	4	5
CNS_3	Sento spesso un'affinità con animali e piante	1	2	3	4	5
CNS_4	Sento come se appartenessi alla Terra allo stesso modo in cui mi appartiene.	1	2	3	4	5
CNS_5	Mi sento spesso parte della rete della vita.	1	2	3	4	5
CNS_6	Sento che tutti gli abitanti della Terra, umani e non umani, condividono una comune "forza vitale".	1	2	3	4	5
CNS_7	Come un albero può essere parte di una foresta, mi sento integrato nel più ampio mondo naturale.	1	2	3	4	5

Appendix B.19.

Items from the Monitor of Engagement with the Natural Environment – Italian version (Study 3)

(MENE; Natural England, 2018)

General instructions: Le seguenti domande riguardano il tempo libero che hai trascorso all'aperto in spazi verdi e naturali. Questo include visite a…

- **spazi verdi in città e paesi** (es., parchi, canali)
- **campagna** (es., terreni agricoli, boschi, colline e fiumi)
- **costa** (es., spiagge, scogliere) e attività in **mare aperto**

✓ Include:

- visite di qualsiasi durata (comprese brevi passeggiate nel parco, passeggiate con il cane, ecc.)

Tuttavia, NON include:

- il tempo trascorso nel tuo giardino
- il tempo trascorso all'aperto come parte del tuo lavoro

ITEM 1 – Instructions: Negli ultimi 12 mesi, quanto spesso, in media, hai trascorso il tuo tempo libero all'aperto in spazi verdi e naturali? *Seleziona una risposta*.

Response options: 1 = Ogni giorno; 2 = Più di due volte a settimana, ma non tutti i giorni; 3 = Due volte a settimana; 4 = Una volta a settimana; 5 = Una o due volte al mese; 6 = Una volta ogni 2-3 mesi; 7 = Più raramente; 8 = Mai; 9 = Non so; 10 = Preferisco non rispondere

ITEM 2 – Instructions: Quante volte, se mai, hai fatto questo tipo di visite a spazi verdi e naturali negli ultimi 14 giorni? *Per favore inserisci un numero.*

Se negli ultimi 14 giorni non hai fatto nessuna di queste visite, inserisci 0.
Se non sei sicuro, fornisci la tua migliore stima.

Open text box (*Max 100*): ______

Appendix B.20.

Childhood Nature Exposure – Italian version (Study 3)

(Blue Health Survey, Grellier et al., 2017)

Instructions: Quanto sei d'accordo con ciascuna di queste affermazioni riguardanti le tue esperienze durante l'infanzia in spazi naturali (dai 0 ai 16 anni)?

Response options: 1 = Fortemente in disaccordo – 7 = Fortemente d'accordo

CODE	ITEM							
CNE_1	Da bambino, c'erano spazi naturali facilmente accessibili vicino a casa mia	1	2	3	4	5	6	7
CNE_2	Da bambino, i miei genitori/tutori erano a loro agio nel permettermi di giocare in e intorno agli spazi naturali	1	2	3	4	5	6	7
CNE_3	Da bambino, visitavo spesso spazi naturali	1	2	3	4	5	6	7

Appendix B.21.

Big Five Inventory-10 – Italian version (Study 3)

(BFI-10; Rammstedt & John, 2007; Italian version: Guido et al., 2015)

Instructions: Quanto bene le seguenti affermazioni descrivono la tua personalità?

Response options: 1 = Per niente d'accordo – 5 = Del tutto d'accordo

CODE	Mi vedo come una persona che...	
Extraversion_1_R	... è riservata	1 2 3 4 5
Agreeableness_1	... generalmente si fida	1 2 3 4 5
Conscientiousness_1_R	... tende a essere pigra	1 2 3 4 5
Neuroticism_1_R	... è rilassata, sopporta bene lo stress	1 2 3 4 5
Openness_1_R	... ha pochi interessi artistici	1 2 3 4 5
Extraversion_2	... è spigliata, socievole	1 2 3 4 5
Agreeableness_2_R	... tende a trovare i difetti negli altri	1 2 3 4 5
Conscientiousness_2	... è coscienziosa nel lavoro	1 2 3 4 5
Neuroticism_2	... si agita facilmente	1 2 3 4 5
Openness_2	... ha una fervida immaginazione	1 2 3 4 5

Appendix B.22.

CFA for Alternative Model (Study 3)

This Appendix presents details about the CFA of the alternative models tested.

One-factor model.

Table B.7. *Factor loadings for the one-factor structure of the Italian adaptation of the LS Scale (Study 3)*

				95% Confidence Interval				
Factor	**Indicator**	***Estimate***	***SE***	***Lower***	***Upper***	***z***	***p***	***Stand. Estimate***
General factor	N-L_1	1.190	0.085	1.024	1.356	14.047	< .001	0.704
	N-L_2	1.290	0.084	1.125	1.455	15.336	< .001	0.750
	N-L_3	1.359	0.085	1.193	1.526	16.000	< .001	0.773
	N-H_1	1.502	0.072	1.361	1.642	20.952	< .001	0.916
	N-H_2	1.434	0.069	1.299	1.568	20.842	< .001	0.913
	N-H_3	1.494	0.081	1.336	1.652	18.543	< .001	0.851
	P-L_1	1.442	0.070	1.304	1.579	20.554	< .001	0.906
	P-L_2	1.222	0.069	1.087	1.357	17.759	< .001	0.828
	P-L_3	1.312	0.073	1.169	1.456	17.880	< .001	0.832
	P-H_1	1.327	0.077	1.177	1.478	17.314	< .001	0.815
	P-H_2	1.252	0.081	1.092	1.411	15.376	< .001	0.752
	P-H_3	1.223	0.084	1.059	1.388	14.544	< .001	0.722

Note. N-H = negative high arousal emotions; N-L = negative low arousal emotions; P-H = positive high arousal emotions; P-L = positive low arousal emotions.

Appendix B.23.

Manipulation check items (Study 4)

(*ad hoc* items)

Instructions: Indica in che misura hai notato la presenza dei seguenti elementi nel luogo rappresentato nell'immagine.

Response options: 0 = Per nulla – 10 = Del tutto

	Per nulla										Del tutto
	0	1	2	3	4	5	6	7	8	9	10
Elementi acquatici											
Fiori											
Varietà di colori											
Varietà di animali											

Appendix B.24.

Location Selection in Nature Scale – adapted Italian version

(Study 4, Study 6)

Instructions: Il seguente questionario ti chiede di riflettere sulla possibilità di visitare il luogo rappresentato nell'immagine per gestire le tue emozioni. Valuta il tuo grado di accordo o disaccordo con le seguenti affermazioni.

Response options: 1 = Fortemente in disaccordo; 4 = Neutrale; 7 = Fortemente d'accordo

CODE	ITEM	
N-H_1	Visiterei questo luogo quando voglio staccare dallo stress.	1 2 3 4 5 6 7
N-H_2	Andrei in questo luogo quando voglio sentirmi meno ansioso.	1 2 3 4 5 6 7
N-L_1	Andrei in questo luogo quando voglio sentirmi meno cupo.	1 2 3 4 5 6 7
N-L_2	Visiterei questo luogo quando voglio sentirmi meno annoiato.	1 2 3 4 5 6 7
P-H_1	Andrei in questo luogo quando voglio sentirmi più energico.	1 2 3 4 5 6 7
P-H_2	Visiterei questo luogo quando voglio sentirmi più entusiasta.	1 2 3 4 5 6 7
P-L_1	Visiterei questo luogo quando voglio sentirmi più calmo.	1 2 3 4 5 6 7
P-L_2	Andrei in questo luogo quando voglio sentirmi più tranquillo.	1 2 3 4 5 6 7

Appendix B.25.

Perceived Restorativeness Scale – adapted Italian version (Study 4)

(PRS; Hartig et al., 1996; Italian version: Pasini et al., 2009)

Instructions: Immaginando di trovarti nel luogo rappresentato nell'immagine, valuta le tue percezioni, esprimendo il tuo grado di accordo con le seguenti affermazioni. 0 = per niente e 10 = del tutto.

Response options: 0 = Per nulla – 10 = Del tutto

CODE	**ITEM**											
PRS_1	In questo luogo posso rilassarmi e recuperare forza mentale ed energia.	0	1	2	3	4	5	6	7	8	9	10
PRS_2	In questo luogo sono libero dalle mie preoccupazioni.	0	1	2	3	4	5	6	7	8	9	10
PRS_3	Questo luogo è affascinante.	0	1	2	3	4	5	6	7	8	9	10
PRS_4	Questo luogo sembra caotico.	0	1	2	3	4	5	6	7	8	9	10
PRS_5	Questo luogo si addice a quello che sono.	0	1	2	3	4	5	6	7	8	9	10

Appendix B.26.

Affective Quality of Place – adapted Italian version (Study 4)

(Mehrabian & Russell, 1974; Italian version: Perugini et al., 2002)

Instructions: Qui di seguito troverai una serie di coppie di aggettivi con connotazione opposta. Valuta la tua percezione del luogo rappresentato nell'immagine rispetto agli aggettivi di ciascuna scala.

	-3	-2	-1	0	+1	+2	+3	
Sgradevole	○	○	○	○	○	○	○	Piacevole
Brutto	○	○	○	○	○	○	○	Bello
Accogliente	○	○	○	○	○	○	○	Opprimente
Tranquillo	○	○	○	○	○	○	○	Caotico
Stressante	○	○	○	○	○	○	○	Rilassante
Calmo	○	○	○	○	○	○	○	Confusionario

Appendix B.27.

Self-Assessment Manikin – adapted Italian version (Study 4)

(SEM; Bradley & Lang, 1994)

Instructions: Qui di seguito troverai una serie di coppie di aggettivi con connotazione opposta. Valuta lo stato mentale che ti suscita il luogo rappresentato nell'immagine.

	-3	-2	-1	0	+1	+2	+3	
Triste	○	○	○	○	○	○	○	Felice
Agitato	○	○	○	○	○	○	○	Rilassato
Malinconico	○	○	○	○	○	○	○	Contento
Calmo	○	○	○	○	○	○	○	Nervoso
Allegro	○	○	○	○	○	○	○	Scontento
Riposato	○	○	○	○	○	○	○	Affaticato

Appendix B.28.

Scale Analyses (Study 4)

This Appendix presents details about the EFA, CFA and reliability analyses conducted for each experimental image's data.

Baseline image.

Table B.8. *Factor loadings for EFA based on parallel analysis of the applied version of the LS Scale – baseline image*

	Factor		
	1	2	Uniqueness
N-L_1	0.545		0.435
N-L_2	0.864		0.391
N-H_1		0.854	0.246
N-H_2		0.725	0.307
P-L_1		0.890	0.209
P-L_2		0.958	0.138
P-H_1	0.754		0.348
P-H_2	0.738		0.323

Table B.9. *Factor loadings for the 2-factors structure of the applied version of the LS Scale – baseline image*

				95% Confidence Interval				
Factor	Indicator	Estimate	SE	Lower	Upper	z	p	Stand. Estimate
Up-regulation	N-L_1	1.199	0.101	1.001	1.397	11.851	< .001	0.753
	N-L_2	1.190	0.105	0.984	1.395	11.359	< .001	0.728
	P-H_1	1.349	0.102	1.148	1.549	13.181	< .001	0.808
	P-H_2	1.315	0.097	1.126	1.505	13.614	< .001	0.828
Down-regulation	N-H_1	1.264	0.084	1.100	1.428	15.094	< .001	0.862
	N-H_2	1.324	0.094	1.141	1.508	14.136	< .001	0.827
	P-L_1	1.329	0.082	1.168	1.491	16.144	< .001	0.897
	P-L_2	1.333	0.078	1.180	1.487	17.008	< .001	0.925

Table B.10. *Reliability analysis for the applied version of the LS Scale – baseline image*

	Cronbach's α
LS total score	0.917
LS for up-regulation	0.861
LS for down-regulation	0.929

Blue element image.

Table B.11. *Factor loadings for EFA based on parallel analysis of the applied version of the LS Scale – blue element image*

	Factor		
	1	2	Uniqueness
N-L_1	0.569		0.314
N-L_2	0.816		0.253
N-H_1		0.909	0.163
N-H_2		0.811	0.217
P-L_1		0.965	0.100
P-L_2		0.966	0.110
P-H_1	0.889		0.241
P-H_2	0.973		0.114

Table B.12. *Factor loadings for the 2-factors structure of the applied version of the LS Scale – blue element image*

				95% Confidence Interval				
Factor	Indicator	Estimate	SE	Lower	Upper	z	p	Stand. Estimate
Up-regulation	N-L_1	1.183	0.090	1.007	1.360	13.116	< .001	0.792
	N-L_2	1.399	0.092	1.219	1.580	15.193	< .001	0.868
	P-H_1	1.405	0.091	1.227	1.584	15.417	< .001	0.875
	P-H_2	1.402	0.083	1.240	1.565	16.901	< .001	0.925
Down-regulation	N-H_1	1.199	0.072	1.058	1.339	16.704	< .001	0.911
	N-H_2	1.265	0.082	1.104	1.425	15.427	< .001	0.869
	P-L_1	1.278	0.070	1.141	1.416	18.206	< .001	0.956
	P-L_2	1.235	0.069	1.100	1.370	17.917	< .001	0.947

Table B.13. *Reliability analysis for the applied version of the LS Scale – blue element image*

	Cronbach's α
LS total score	0.935
LS for up-regulation	0.920
LS for down-regulation	0.956

25% floral coverage image.

Table B.14. *Factor loadings for EFA based on parallel analysis of the applied version of the LS Scale – 25% floral coverage image*

	Factor		
	1	2	Uniqueness
N-L_1	0.611		0.370
N-L_2	0.897		0.226
N-H_1		0.971	0.084
N-H_2		0.616	0.338
P-L_1		0.880	0.196
P-L_2		0.965	0.110
P-H_1	0.774		0.310
P-H_2	0.958		0.149

Table B.15. *Factor loadings for the 2-factors structure of the applied version of the LS Scale – 25% floral coverage image*

				95% Confidence Interval				
Factor	Indicator	Estimate	SE	Lower	Upper	z	p	Stand. Estimate
Up-regulation	N-L_1	1.170	0.092	0.989	1.350	12.701	< .001	0.775
	N-L_2	1.398	0.093	1.216	1.581	15.021	< .001	0.864
	P-H_1	1.302	0.089	1.128	1.476	14.668	< .001	0.851
	P-H_2	1.366	0.084	1.202	1.531	16.305	< .001	0.908
Down-regulation	N-H_1	1.258	0.070	1.122	1.395	18.042	< .001	0.952
	N-H_2	1.087	0.083	0.925	1.250	13.107	< .001	0.783
	P-L_1	1.210	0.074	1.066	1.354	16.455	< .001	0.904
	P-L_2	1.153	0.066	1.024	1.281	17.598	< .001	0.939

Table B.16. *Reliability analysis for the applied version of the LS Scale – 25% floral coverage image*

	Cronbach's α
LS total score	0.926
LS for up-regulation	0.910
LS for down-regulation	0.938

50% floral coverage image.

Table B.17. *Factor loadings for EFA based on parallel analysis of the applied version of the LS Scale – 50% floral coverage image*

	Factor		
	1	2	Uniqueness
N-L_1	0.654		0.334
N-L_2	0.806		0.341
N-H_1		0.923	0.147
N-H_2		0.800	0.335
P-L_1		0.895	0.158
P-L_2		0.957	0.123
P-H_1	0.834		0.304
P-H_2	0.975		0.112

Table B.18. *Factor loadings for the 2-factors structure of the applied version of the LS Scale – 50% floral coverage image*

				95% Confidence Interval				
Factor	Indicator	Estimate	SE	Lower	Upper	z	p	Stand. Estimate
Up-regulation	N-L_1	1.169	0.086	1.000	1.338	13.533	< .001	0.808
	N-L_2	1.318	0.097	1.129	1.508	13.627	< .001	0.811
	P-H_1	1.285	0.089	1.110	1.460	14.407	< .001	0.840
	P-H_2	1.433	0.085	1.267	1.600	16.857	< .001	0.927
Down-regulation	N-H_1	1.142	0.067	1.011	1.272	17.140	< .001	0.926
	N-H_2	1.104	0.080	0.947	1.260	13.828	< .001	0.812
	P-L_1	1.098	0.065	0.971	1.225	16.950	< .001	0.920
	P-L_2	1.154	0.066	1.024	1.284	17.382	< .001	0.934

Table B.19. *Reliability analysis for the applied version of the LS Scale – 50% floral coverage image*

	Cronbach's α
LS total score	0.920
LS for up-regulation	0.908
LS for down-regulation	0.941

Floral chromatic biodiversity image.

Table B.20. *Factor loadings for EFA based on parallel analysis of the applied version of the LS Scale – floral chromatic biodiversity image*

	Factor		
	1	2	Uniqueness
N-L_1	0.597		0.284
N-L_2	0.740		0.362
N-H_1		0.901	0.167
N-H_2		0.672	0.288
P-L_1		0.937	0.140
P-L_2		0.959	0.140
P-H_1	0.866		0.241
P-H_2	1.005		0.075

Table B.21. *Factor loadings for the 2-factors structure of the applied version of the LS Scale – floral chromatic biodiversity image*

				95% Confidence Interval				
Factor	Indicator	Estimate	SE	Lower	Upper	z	p	Stand. Estimate
Up-regulation	N-L_1	1.190	0.086	1.023	1.358	13.906	< .001	0.821
	N-L_2	1.233	0.093	1.051	1.415	13.277	< .001	0.794
	P-H_1	1.467	0.093	1.285	1.648	15.843	< .001	0.887
	P-H_2	1.486	0.085	1.319	1.653	17.459	< .001	0.941
Down-regulation	N-H_1	1.173	0.070	1.036	1.311	16.721	< .001	0.914
	N-H_2	1.182	0.083	1.019	1.344	14.240	< .001	0.829
	P-L_1	1.186	0.069	1.051	1.321	17.216	< .001	0.929
	P-L_2	1.128	0.066	0.998	1.258	16.970	< .001	0.921

Table B.22. *Reliability analysis for the applied version of the LS Scale – floral chromatic biodiversity image*

	Cronbach's α
LS total score	0.935
LS for up-regulation	0.918
LS for down-regulation	0.940

Faunal biodiversity image.

Table B.23. *Factor loadings for EFA based on parallel analysis of the applied version of the LS Scale – faunal biodiversity image*

	Factor		
	1	2	Uniqueness
N-L_1	0.581		0.329
N-L_2	0.798		0.393
N-H_1		0.870	0.190
N-H_2		0.700	0.215
P-L_1		0.980	0.114
P-L_2		0.957	0.122
P-H_1	0.798		0.289
P-H_2	0.958		0.141

Table B.24. *Factor loadings for the 2-factors structure of the applied version of the LS Scale – faunal biodiversity image*

				95% Confidence Interval				
Factor	Indicator	Estimate	SE	Lower	Upper	z	p	Stand. Estimate
Up-regulation	N-L_1	1.258	0.098	1.066	1.449	12.877	< .001	0.785
	N-L_2	1.326	0.106	1.118	1.535	12.468	< .001	0.765
	P-H_1	1.437	0.095	1.251	1.624	15.096	< .001	0.866
	P-H_2	1.534	0.093	1.352	1.715	16.524	< .001	0.917
Down-regulation	N-H_1	1.307	0.080	1.149	1.464	16.276	< .001	0.898
	N-H_2	1.405	0.092	1.225	1.585	15.299	< .001	0.866
	P-L_1	1.424	0.080	1.267	1.582	17.706	< .001	0.942
	P-L_2	1.424	0.082	1.265	1.584	17.473	< .001	0.935

Table B.25. *Reliability analysis for the applied version of the LS Scale – faunal biodiversity image*

	Cronbach's α
LS total score	0.935
LS for up-regulation	0.899
LS for down-regulation	0.949

Appendix B.29.

Correlation Analyses (Study 4)

This Appendix presents detailed tables of correlational analyses between location selection variables (up-regulation and down-regulation) with perceived restorativeness, place perception (pleasantness and relaxation), and emotional reactions (pleasantness and relaxation), conducted for each experimental image.

Table B.26. *Correlational analysis for the baseline image*

		1	2	3	4	5	6	7
1. Place perceived restorativeness	*Pearson's r*	—						
	p-value	—						
2. Location selection for up-regulation	*Pearson's r*	0.579	—					
	p-value	< .001	—					
3. Location selection for down-regulation	*Pearson's r*	0.723	0.662	—				
	p-value	< .001	< .001	—				
4. Emotional reactions – pleasantness	*Pearson's r*	0.611	0.577	0.520	—			
	p-value	< .001	< .001	< .001	—			
5. Emotional reactions – relaxation	*Pearson's r*	0.504	0.319	0.491	0.524	—		
	p-value	< .001	< .001	< .001	< .001	—		
6. Place perception – pleasantness	*Pearson's r*	0.640	0.420	0.522	0.525	0.673	—	
	p-value	< .001	< .001	< .001	< .001	< .001	—	
7. Place perception – relaxation	*Pearson's r*	0.391	0.126	0.304	0.300	0.608	0.691	—
	p-value	< .001	0.076	< .001	< .001	< .001	< .001	—

Table B.27. *Correlational analysis for the image with blue element*

		1	2	3	4	5	6	7
1. Place perceived restorativeness	*Pearson's r*	—						
	p-value	—						
2. Location selection for up-regulation	*Pearson's r*	0.581	—					
	p-value	< .001	—					
3. Location selection for down-regulation	*Pearson's r*	0.755	0.636	—				
	p-value	< .001	< .001	—				
4. Emotional reactions – pleasantness	*Pearson's r*	0.468	0.574	0.402	—			
	p-value	< .001	< .001	< .001	—			
5. Emotional reactions – relaxation	*Pearson's r*	0.533	0.336	0.513	0.508	—		
	p-value	< .001	< .001	< .001	< .001	—		
6. Place perception – pleasantness	*Pearson's r*	0.568	0.402	0.493	0.555	0.727	—	
	p-value	< .001	< .001	< .001	< .001	< .001	—	
7. Place perception – relaxation	*Pearson's r*	0.435	0.256	0.429	0.397	0.789	0.794	—
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	—

Table B.28. *Correlational analysis for the image with 25% floral coverage*

		1	2	3	4	5	6	7
1. Place perceived restorativeness	*Pearson's r*	—						
	p-value	—						
2. Location selection for up-regulation	*Pearson's r*	0.675	—					
	p-value	< .001	—					
3. Location selection for down-regulation	*Pearson's r*	0.806	0.627	—				
	p-value	< .001	< .001	—				
4. Emotional reactions – pleasantness	*Pearson's r*	0.537	0.564	0.487	—			
	p-value	< .001	< .001	< .001	—			
5. Emotional reactions – relaxation	*Pearson's r*	0.531	0.342	0.516	0.502	—		
	p-value	< .001	< .001	< .001	< .001	—		
6. Place perception – pleasantness	*Pearson's r*	0.610	0.432	0.542	0.570	0.729	—	
	p-value	< .001	< .001	< .001	< .001	< .001	—	
7. Place perception – relaxation	*Pearson's r*	0.504	0.322	0.521	0.442	0.815	0.811	—
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	—

Table B.29. *Correlational analysis for the image with 50% floral coverage*

		1	2	3	4	5	6	7
1. Place perceived restorativeness	*Pearson's r*	—						
	p-value	—						
2. Location selection for up-regulation	*Pearson's r*	0.628	—					
	p-value	< .001	—					
3. Location selection for down-regulation	*Pearson's r*	0.722	0.593	—				
	p-value	< .001	< .001	—				
4. Emotional reactions – pleasantness	*Pearson's r*	0.578	0.593	0.454	—			
	p-value	< .001	< .001	< .001	—			
5. Emotional reactions – relaxation	*Pearson's r*	0.493	0.316	0.458	0.551	—		
	p-value	< .001	< .001	< .001	< .001	—		
6. Place perception – pleasantness	*Pearson's r*	0.550	0.438	0.478	0.622	0.778	—	
	p-value	< .001	< .001	< .001	< .001	< .001	—	
7. Place perception – relaxation	*Pearson's r*	0.432	0.302	0.406	0.509	0.842	0.865	—
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	—

Table B.30. *Correlational analysis for the image with chromatic floral biodiversity*

		1	2	3	4	5	6	7
1. Place perceived restorativeness	*Pearson's r*	—						
	p-value	—						
2. Location selection for up-regulation	*Pearson's r*	0.647	—					
	p-value	< .001	—					
3. Location selection for down-regulation	*Pearson's r*	0.793	0.680	—				
	p-value	< .001	< .001	—				
4. Emotional reactions – pleasantness	*Pearson's r*	0.624	0.636	0.540	—			
	p-value	< .001	< .001	< .001	—			
5. Emotional reactions – relaxation	*Pearson's r*	0.584	0.418	0.532	0.588	—		
	p-value	< .001	< .001	< .001	< .001	—		
6. Place perception – pleasantness	*Pearson's r*	0.563	0.434	0.492	0.643	0.791	—	
	p-value	< .001	< .001	< .001	< .001	< .001	—	
7. Place perception – relaxation	*Pearson's r*	0.478	0.290	0.418	0.507	0.821	0.813	—
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	—

Table B.31. *Correlational analysis for the image with faunal biodiversity*

		1	2	3	4	5	6	7
1. Place perceived restorativeness	*Pearson's r*	—						
	p-value	—						
2. Location selection for up-regulation	*Pearson's r*	0.676	—					
	p-value	< .001	—					
3. Location selection for down-regulation	*Pearson's r*	0.802	0.687	—				
	p-value	< .001	< .001	—				
4. Emotional reactions – pleasantness	*Pearson's r*	0.564	0.594	0.525	—			
	p-value	< .001	< .001	< .001	—			
5. Emotional reactions – relaxation	*Pearson's r*	0.580	0.372	0.549	0.549	—		
	p-value	< .001	< .001	< .001	< .001	—		
6. Place perception – pleasantness	*Pearson's r*	0.582	0.414	0.583	0.590	0.703	—	
	p-value	< .001	< .001	< .001	< .001	< .001	—	
7. Place perception – relaxation	*Pearson's r*	0.491	0.264	0.491	0.442	0.775	0.784	—
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	—

Appendix C.

Supplementary Materials for Chapter 5.

Appendix C.1.

Pilot studies – Study 5

This Appendix presents the two pilot studies conducted on the experimental videos used as stimuli for the first experimental studies.

Methods.

For both pilot studies, a within-subject methodology was employed, where all participants were asked to evaluate the presented environments—two environments in the first pilot study and three in the second. The studies were conducted via a questionnaire implemented on the *Qualtrics* platform, with participants recruited through social media announcements. Completing the questionnaire took approximately 15 minutes.

The pilot studies were structured around a questionnaire divided into several sections: collection of socio-demographic data (i.e., gender, age, education level, and employment status), viewing of the experimental video and subsequent evaluation of the video. Participants responded to a series of questions regarding the video's quality, any playback issues, perceived familiarity with and safety of the environment, and perceptions of the environment's visual and auditory elements. The sections related to video viewing and evaluation were repeated for each experimental video, which were presented in random order.

The experimental videos used in the main study were evaluated in this context. Specifically, the first pilot study focused solely on natural and urban street conditions, while the second pilot study introduced a new condition involving an urban centre environment based on the results of the first study. The pilot studies employed the same measures as the main study to evaluate the manipulation check and control variables (see **Chapter 5**, Section **5.2.1. Method**).

Specifically, the studies assessed environmental characteristics, focusing on natural and urban elements, with the second pilot study also examining historical-cultural value elements. Additionally, they evaluated participants' perceptions of familiarity and safety within the environment, as well as their overall experience, including the quality of the video and audio.

For both pilot studies, repeated measures ANOVA analyses were conducted to explore potential differences between the experimental videos with respect to the dependent variables examined. The goal was to assess whether there were statistically significant differences in participants' responses across the different environments for the manipulation check variables and to explore the consistency of the control variables across the experimental videos. Post hoc comparisons using Tukey's method were then conducted to identify any significant differences between the conditions.

Pilot study 1.

Sample. The first pilot study was completed by a sample of 11 participants (9 women and 2 men) aged between 21 and 34 years ($M = 25.7$; $SD = 3.55$). The majority of participants held a Bachelor's degree (45.5%) and were either current students (36.4%) or working students (45.5%).

Results. Descriptive analyses of the manipulation check and control variables associated with the two environmental videos are presented in **Table C.1.**

Repeated measures ANOVA analyses were conducted for the manipulation check variables to evaluate potential differences in the perception of natural and urban elements across the two experimental videos. The analysis revealed a statistically significant difference in the perception of natural elements between the scenarios, $F(1, 10) = 68.6$, $\eta^2 = 0.78$, $p < .001$. Post hoc Tukey comparisons showed that the nature video was perceived as having significantly more natural elements compared to the urban street video, $t(10) = 8.28$, *mean difference* = 2.18, $p_{tukey} < .001$. In terms of urban elements, the results also revealed a statistically significant difference between the experimental videos, $F(1, 10) = 268$, $\eta^2 = 0.90$, $p < .001$. Post hoc Tukey comparisons revealed that the nature video was perceived to have significantly less urban elements compared to the urban street video, $t(10) = -16.4$, *mean difference* = -2.73, $p_{tukey} < .001$. These results confirm that the experimental videos were perceived as intended, accurately reflecting the environments they depicted.

Differences in control variables were examined using repeated measures ANOVAs to ensure consistency across experimental conditions for potentially relevant factors such as familiarity with the environments, perceived safety, and video/audio quality.

Results showed no significant differences in familiarity between the environmental videos, $F(1, 10) = 2.46$, $\eta^2 = 0.14$, $p = .150$. Similarly, no significant differences were found in terms of video and audio quality between the experimental conditions, $F(1, 10) = 0.01$, $\eta^2 = 0.00$, $p = .927$. Regarding safety, the analysis revealed a statistically significant difference in safety perceptions across the environments, $F(1, 10) = 45$, $\eta^2 = 0.70$, $p < .001$. Post hoc comparisons showed that the nature video was perceived as significantly safer than the urban street video, $t(10) = 6.71$, *mean difference* = 3, $p_{tukey} < .001$. Overall, the analysis confirmed that the experimental conditions were consistent in terms of familiarity with the environments and the quality of video and audio, while highlighting significant differences in perceived safety.

Given significant difference in terms of safety, a second pilot study was conducted with the addition of a third experimental video: the urban centre. It was hypothesized that this condition might be perceived as safer than the busy urban street condition, thereby offering an urban environment with a sense of safety more comparable to that of the natural environment. This adjustment was made to ensure the inclusion of a more neutral urban setting without a negative perception of safety, since this variable may play a relevant role in the emotional regulation processes targeted in the study.

Table C.1. *Descriptive statistics for manipulation check and control variables across the environmental videos: means and standard deviations in parentheses (Piloting 1 for Study 5)*

Variables	Environmental videos	
	Nature	*Urban street*
Natural elements	4.64 (0.51)	1.23 (0.34)
Urban elements	1.57 (0.53)	4.30 (0.42)
Familiarity	0.09 (2.07)	1.64 (2.01)
Safety	2.64 (0.67)	-0.36 (1.29)
Video quality	4.55 (1.07)	4.57 (0.73)

Pilot study 2.

Sample. The second pilot study was completed by a sample of 13 participants (7 women and 6 men), aged between 22 and 34 years, with a mean age of 24.7 years (*SD* = 3.09). The majority of participants held a Bachelor's degree (69.2%) and were either students (69.2%) or working students (23.1%).

Results. Descriptive analyses of the manipulation check and control variables associated across the three environmental videos are presented in **Table C.2**.

Repeated measures ANOVA analyses were conducted for the manipulation check variables to evaluate potential differences in the perception of natural, urban and historical elements between the three experimental videos. Regarding the perception of naturalness, a significant main effect of the type of environment was found, $F(2, 12) = 83.6$, $\eta^2 = .812$, $p < .001$. Specifically, post hoc comparisons revealed that the natural environment was rated with a significantly higher perception of naturalness compared to the urban street environment, $t(12) = 9.88$, *mean difference* = 4.25, $p_{tukey} < .001$, and the urban centre, $t(12) = 9.18$, *mean difference* = 3.90, $p_{tukey} < .001$. No statistically significant differences were found between the urban street environment and the urban centre. Similarly, in terms of perceived urbanity, a statistically significant difference was observed among all the presented scenarios, $F(2, 12) = 67.5$, $\eta^2 = 0.812$, $p < .001$, with all urban scenarios being rated with a higher perception of urbanity compared to the natural environment video. Post hoc comparisons showed that the nature environment was rated with a significantly lower degree of urbanity compared to the urban street environment, $t(12) = -8.91$, *mean difference* = -4.50, $p_{tukey} < .001$; and the urban centre scenario, $t(12) = -10.57$, *mean difference* = -3.48, $p_{tukey} < .001$. Additionally, the urban street scenario was rated with a lower degree of urbanity compared to the urban centre environment, $t(12) = 2.81$, *mean difference* = 1.02, $p_{tukey} = .039$. Finally, a statistically significant difference was found between the experimental videos regarding the perception of historical-cultural value, $F(2, 12) = 18.2$, $\eta^2 = 0.476$, $p < .001$. Post hoc comparisons indicated that the natural video was rated with a significantly lower perception of historical-cultural value compared to the urban centre environment, $t(12) = -5.99$, *mean difference* = -2.51, $p_{tukey} <.001$. Also, the urban street environment was perceived with less historical-cultural value than the urban centre environment, $t(12) = -4.23$, *mean difference* = -1.83, $p_{tukey} = .003$. No significant differences were found between the natural and urban street environments. In summary, results indicate that the environments were perceived as intended in terms of naturalness, urbanity, and historical-cultural value.

Further analyses were conducted on the control variables. Regarding video quality, no statistically significant difference was found among the experimental videos, $F(2, 12) = .049$, $\eta^2 = 0.001$, $p = .952$. The results show that the quality of the videos was rated as good across all three videos. Similarly, no significant main effect of the type of environment was found on the perception of familiarity, $F(2, 12) = .01$, $\eta^2 = 0.000$, $p = .988$. Finally, regarding the perception of safety, a statistically significant difference was found between the experimental videos, $F(2, 12) = 4.09$, $\eta^2 = 0.179$, $p = .030$. Specifically, post hoc comparisons revealed that the natural environment was rated as significantly safer compared to the urban street environment, $t(12) = 3.01$, *mean difference* = 1.62, $p_{tukey} = .027$. No significant differences were observed between the natural environment and the urban centre environment, nor between the urban centre and the busy urban street environment. These findings validate the initial hypothesis concerning perceived safety in the urban centre condition, demonstrating that the urban centre condition effectively creates an urban environment with a level of perceived safety comparable to that of the natural environment.

Table C.2. *Descriptive statistics for manipulation check and control variables across the environmental videos: means and standard deviations in parentheses (Piloting 2 for Study 5)*

Variables	Environmental videos		
	Nature	*Urban centre*	*Urban street*
Natural elements	5.08 (0.90)	1.17 (.97)	0.83 (1.03)
Urban elements	0.69 (0.90)	4.17 (0.77)	5.19 (1.18)
Cultural value	1.46 (1.24)	3.98 (0.83)	2.15 (1.35)
Familiarity	0.46 (1.81)	0.46 (2.07)	0.54 (1.94)
Safety	1.92 (1.19)	0.46 (1.76)	0.31 (1.84)
Video quality	4.67 (1.34)	4.75 (.99)	4.69 (1.08)

Appendix C.2.

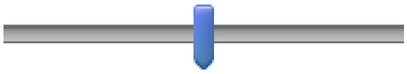
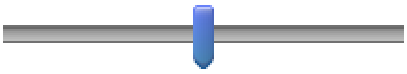
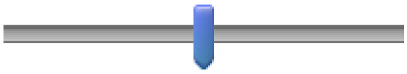
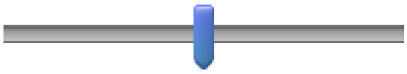
Emotion Regulation strategies – trait version (Study 5, Study 6)

(*ad hoc* items)

Instructions: Di seguito ti verrà presentata una lista di strategie di comportamenti/pensieri che possono essere messe in atto per gestire le proprie emozioni, cioè per aumentare le emozioni positive e diminuire quelle negative. Valuta quanto utilizzi di solito ciascuna strategia per gestire le tue emozioni quando devi affrontare una situazione negativa e/o stressante, tenendo conto che *0 = per nulla e 100 = moltissimo*. Per ognuno dei comportamenti/pensieri ti verrà fornita una definizione su cui basarti per indicare la tua risposta.

Response options: 0 = Per nulla – 100 = Moltissimo

	0 10 20 30 40 50 60 70 80 90 100
Negazione: Comportarsi e agire come se nulla fosse successo, rimuovendo o ignorando pensieri ed emozioni legate all'evento negativo	
Risoluzione del problema: Focalizzarsi su idee e sui passi da fare per cambiare la situazione negativa o risolvere il problema	
Controllo: Attendere il momento opportuno per agire, evitando di fare qualcosa prematuramente	
Reminiscenza positiva: Rivivere mentalmente emozioni, pensieri ed eventi positivi legati a ricordi piacevoli del passato	
Evitamento cognitivo: Tentativo consapevole di evitare di pensare o ricordare certi pensieri o eventi negativi	
Pensare positivamente: Elaborare l'evento negativo come una situazione che verrà superata positivamente e da cui poter imparare	

Rivalutazione: Interpretare più positivamente un evento negativo, guardandolo da un'altra prospettiva e attribuendogli un'importanza minore	
Soppressione espressiva: Inibire o ridurre l'espressione di segnali esterni delle proprie emozioni (per esempio, espressione facciale o verbale)	
Espressione emotiva: Comunicare ad altri o esprimere liberamente le proprie emozioni in modo verbale e/o comportamentale	
Ruminazione: Pensare in modo ripetitivo ed eccessivo su ciò che è successo	

Appendix C.3.

Positive and Negative Affect Schedule (Study 5, Study 6)

(PANAS; Watson et al., 1988; Italian version: Terraciano et al., 2003)

Instructions: Ti chiediamo di indicare quanto ti senti nel modo descritto da ogni parola, in questo momento, tenendo conto che *1 = per nulla* e *5 = molto*.

Response options: 1 = Per nulla – 5 = Molto

CODE	**ITEM**					
PANAS_pos_1	Determinato/a	1	2	3	4	5
PANAS_pos_2	Attivo/a	1	2	3	4	5
PANAS_pos_3	Interessato/a	1	2	3	4	5
PANAS_pos_4	Attento/a	1	2	3	4	5
PANAS_pos_5	Entusiasta	1	2	3	4	5
PANAS_pos_6	Concentrato/a	1	2	3	4	5
PANAS_pos_7	Forte	1	2	3	4	5
PANAS_pos_8	Ispirato/a	1	2	3	4	5
PANAS_pos_9	Eccitato/a	1	2	3	4	5
PANAS_pos_10	Orgoglioso/a	1	2	3	4	5
PANAS_neg_1	Impaurito/a	1	2	3	4	5
PANAS_neg_2	Turbato/a	1	2	3	4	5
PANAS_neg_3	Nervoso/a	1	2	3	4	5
PANAS_neg_4	Agitato/a	1	2	3	4	5
PANAS_neg_5	Spaventato/a	1	2	3	4	5
PANAS_neg_6	Angosciato/a	1	2	3	4	5
PANAS_neg_7	Colpevole	1	2	3	4	5
PANAS_neg_8	Vergogna	1	2	3	4	5
PANAS_neg_9	Irritabile	1	2	3	4	5
PANAS_neg_10	Ostile	1	2	3	4	5

Appendix C.4.

Emotion Regulation strategies – state version (Study 5, Study 6)

(*ad hoc* items)

Instructions: Di seguito ti verrà presentata una lista di strategie di comportamenti/pensieri che possono essere messe in atto per gestire le proprie emozioni, cioè per aumentare le emozioni positive e diminuire quelle negative. Ripensa all'evento negativo che hai descritto all'inizio dello studio e alle emozioni ad esso associate e valuta quanto hai utilizzato ciascuna strategia per gestire le tue emozioni durante la visione del video precedente (for Study 5) / durante l'esplorazione dello scenario in realtà virtuale (for Study 5), tenendo conto rispetto all'utilizzo che 0 = *per nulla* e 100 = *moltissimo*. Per ognuno dei comportamenti/pensieri ti verrà fornita una definizione su cui basarti per indicare la tua risposta.

Response options: 0 = Per nulla – 100 = Moltissimo

The same items as those used in the trait version were applied.

Appendix C.5.

Environmental characteristics (Study 5, Study 6)

(adapted from: Aletta et al., 2019)

Instructions: Indica in che misura hai percepito la presenza dei seguenti elementi sonori e visivi all'interno dell'ambiente rappresentato nello scenario virtuale, considerando che 0 = *assolutamente no* e 6 = *domina completamente.*

Response options: 0 = Assolutamente no – 6 = Domina completamente

CODE	ITEM	
urban_1	Rumore da traffico stradale (es., clacson, motori, sirene, etc.)	0 1 2 3 4 5 6
urban_2	Suoni urbani (es., allarmi, costruzioni, conversazioni ad alta voce, etc.)	0 1 2 3 4 5 6
urban_3	Veicoli (es., auto, moto, biciclette, etc.)	0 1 2 3 4 5 6
urban_4	Elementi artificiali e antropici (es., case, strade, muri, etc.)	0 1 2 3 4 5 6
nature_1	Vegetazione naturale (es., alberi, fiori, cespugli, etc.)	0 1 2 3 4 5 6
nature_2	Suoni naturali (es., vento, fogliame, acqua, etc.)	0 1 2 3 4 5 6
nature_3	Suoni biologici (es., cinguettio degli uccelli, ronzio di insetti, animali, etc.)	0 1 2 3 4 5 6
nature_4	Elementi acquatici (es., ruscello, fontana, cascata, etc.)	0 1 2 3 4 5 6
historical_1	Elementi di importanza storica (es., edifici, oggetti, paesaggi o altri manufatti)	0 1 2 3 4 5 6
historical_2	Siti di valore culturale ed estetico (es., edifici, oggetti, paesaggi o altri manufatti)	0 1 2 3 4 5 6
historical_3	Opere con valore artistico e architettonico (es., edifici, monumenti, statue, etc.)	0 1 2 3 4 5 6
historical_4	Elementi di interesse spirituale (es., chiese, monasteri, santuari, etc.)	0 1 2 3 4 5 6

Appendix C.6.

Reliability Analyses – Study 5

Table C.3. *Summary of reliability analyses across experimental conditions in Study 5*

Variables	Cronbach's α		
	Nature	*Urban centre*	*Urban street*
PANAS 1 – pre-MIP			
Positive affect	0.916	0.894	0.904
Negative affect	0.930	0.906	0.909
PANAS 2 – MIP video			
Positive affect	0.898	0.873	0.908
Negative affect	0.908	0.934	0.909
PANAS 3 – MIP recall			
Positive affect	0.928	0.931	0.936
Negative affect	0.924	0.910	0.887
PANAS 4 – Post-experimental condition			
Positive affect	0.937	0.931	0.943
Negative affect	0.938	0.934	0.926
Emotion regulation strategies – Adaptive (trait: α = 0.756)			
Experimental condition	0.780	0.836	0.841
Emotion regulation strategies – Maladaptive (trait: α = 0.825)			
Experimental condition	0.714	0.590	0.630
Place restorativeness	0.825	0.861	0.804
Environmental Characteristics			
Urban elements	0.723	0.681	0.774
Natural elements	0.543	0.630	0.766
Historical-cultural elements	0.761	0.827	0.832
Place perceptions			
Pleasantness	0.807	0.799	0.827
Relaxation	0.880	0.881	0.863
Emotional reactions			
Pleasantness	0.781	0.914	0.860
Relaxation	0.822	0.898	0.873

Appendix C.7.

Content Analysis – Study 5

This Appendix presents the content analysis of participants' comments in the MIP recall procedure in Study 5.

An exploratory content analysis was conducted examining participants' comments regarding their negative autobiographical memories, collected under three experimental conditions. Participants' comment submission times averaged 6.09 minutes (SD = 3.50) for the nature video condition, 5.69 minutes (SD = 2.90) for the urban centre video condition, and 5.93 minutes (SD = 2.60) for the urban street video condition.

Across all conditions, participants reflected on a variety of significant and emotionally charged life events. Central themes included:

- *Loss and grief*: A recurring theme was the profound impact of losing loved ones. Participants frequently described the death of family members, such as parents, grandparents, and childhood friends. These experiences were often accompanied by a deep sense of grief and unresolved sorrow, highlighting the emotional weight of dealing with loss and the difficulty of finding closure.
- *Personal failures and challenges*: Experiences of failure, whether academic, career-related, or personal, were prominently mentioned. Participants expressed feelings of inadequacy and frustration over unmet goals and setbacks. These failures were often intertwined with a sense of self-blame and a struggle to overcome perceived shortcomings.
- *Relationship conflicts and social isolation*: Issues with personal relationships, including rejection, disputes with friends or family, and social exclusion, were significant. Participants described emotional pain from being misunderstood

or neglected, as well as the loneliness resulting from social isolation. These conflicts often led to lingering feelings of sadness and frustration.

- *Trauma and health struggles*: Comments also revealed traumatic experiences, such as physical altercations, accidents, and severe health crises. The emotional impact of these events included fear, anxiety, and agitation. The strain of coping with health issues, both physical and mental, was a common thread.

The analysis of comments also revealed a spectrum of emotions that participants associated with their negative memories:

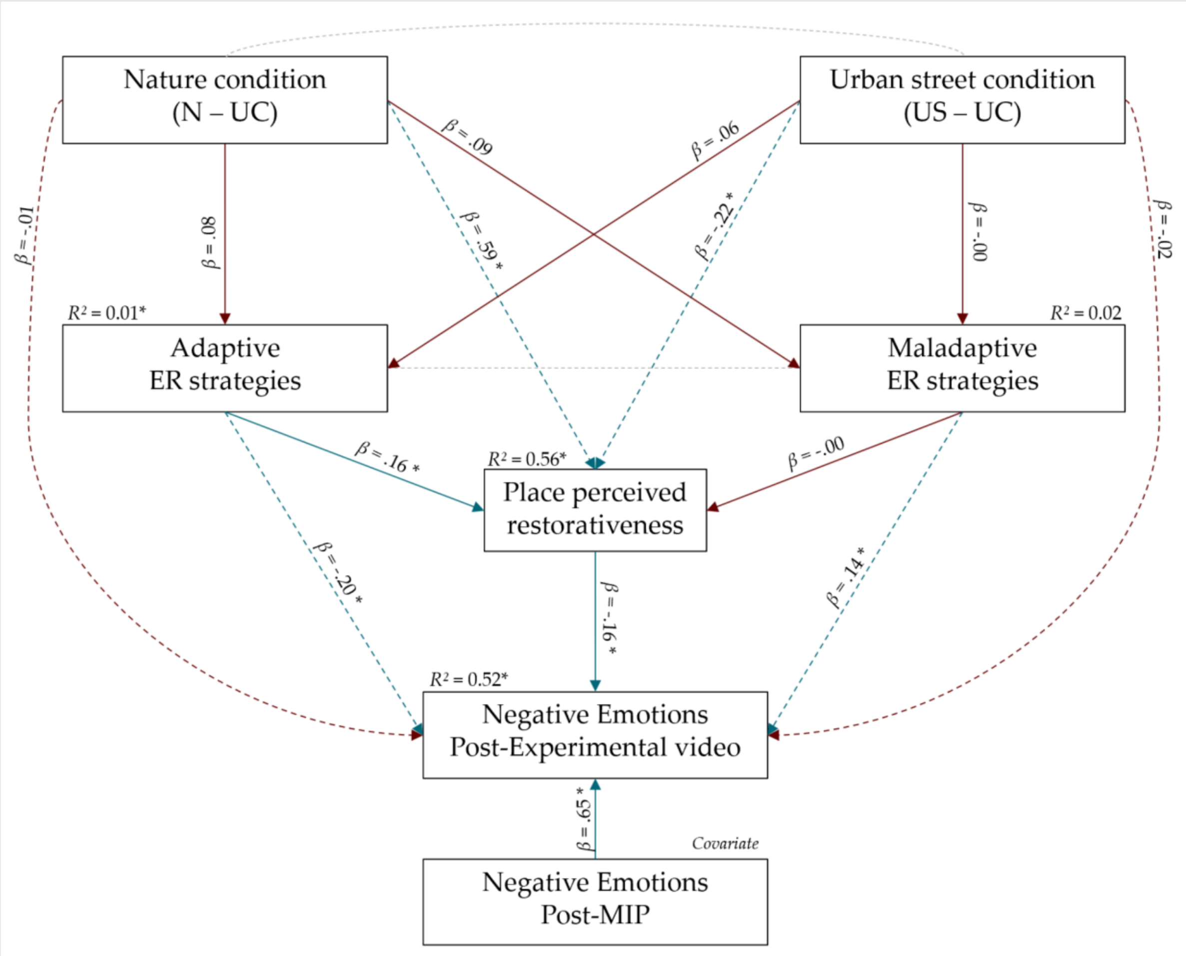
- *Sadness and grief*: Many comments conveyed a deep sense of sadness and ongoing grief, particularly in relation to the loss of loved ones. This emotion was often accompanied by reflections on the enduring impact of these losses.
- *Frustration and inadequacy*: Participants frequently expressed frustration and feelings of inadequacy, especially when recounting personal failures or conflicts. These emotions were linked to a sense of not meeting expectations or experiencing setbacks.
- *Anxiety and fear*: Experiences involving trauma, health crises, and major life changes were associated with anxiety and fear. These emotions reflected the stress and uncertainty that participants faced during and after these events.
- *Loneliness and isolation*: Feelings of loneliness and isolation were prevalent in comments about social exclusion and relationship difficulties. Participants described how these experiences left them feeling disconnected and emotionally vulnerable.

Appendix C.8.

Alternative Models Testing (Study 5)

This Appendix presents details about the alternative models tested in Study 5.

Figure C.1. *Conceptual serial-parallel mediation model of Alternative Model 1 tested in Study 5, with standardized coefficients, linking experimental conditions to negative emotions post-intervention with mediation through ER strategies and PRS*



Note. Solid line: direct effects; dashed line: indirect effects; green lines: statistically significant effects; red lines: non-significant effects; *: significant effects ($p < .050$).

Table C.4. *Parameter estimates for the direct effects of the Alternative Model 1 (serial-parallel mediation model) tested in Study 5*

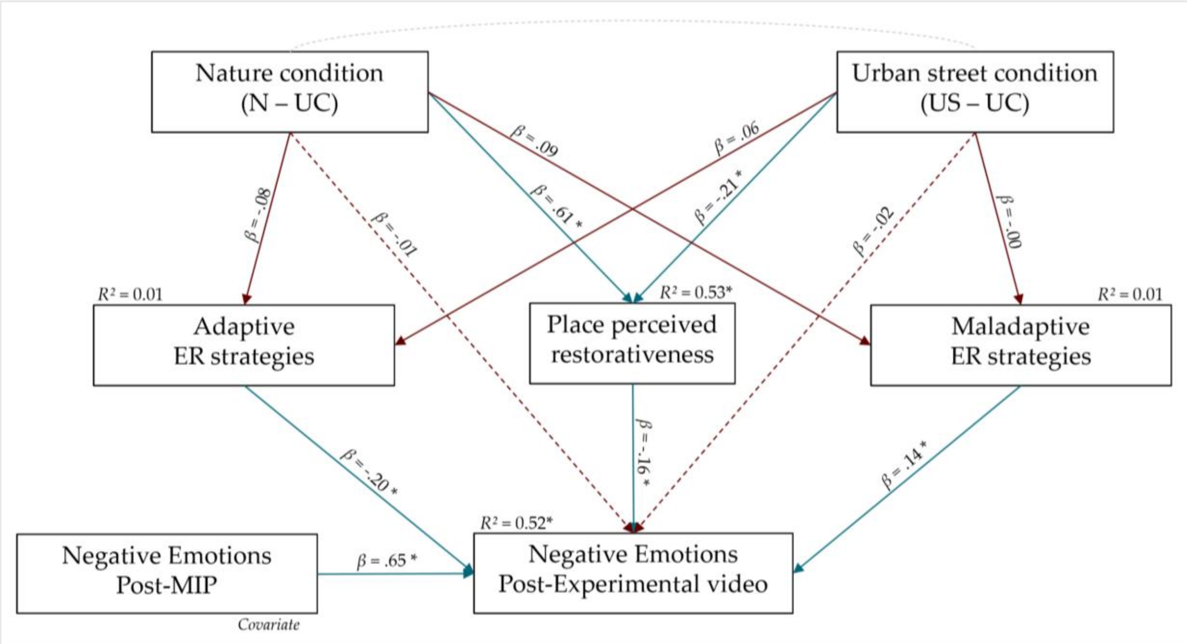
				95 % Confidence Intervals				
Dependent	**Predictor**	***Estimate***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
PANAS 4	ER Adaptive	-0.007	0.002	-0.011	-0.003	-0.203	-3.521	< .001
PANAS 4	ER Maladaptive	0.005	0.002	0.001	0.010	0.143	2.460	0.014
PANAS 4	PRS	-0.044	0.022	-0.088	-0.001	-0.162	-1.978	0.048
PANAS 4	Nature	-0.021	0.120	-0.260	0.206	-0.012	-0.174	0.862
PANAS 4	Urban street	-0.025	0.128	-0.267	0.235	-0.015	-0.196	0.844
PANAS 4	PANAS 3	0.620	0.067	0.491	0.751	0.648	9.209	< .001
PRS	ER Adaptive	0.020	0.007	0.007	0.034	0.162	2.961	0.003
PRS	ER Maladaptive	-0.000	0.007	-0.013	0.013	-0.002	-0.046	0.963
PRS	Nature	3.732	0.377	2.963	4.402	0.593	9.897	< .001
PRS	Urban street	-1.360	0.403	-2.171	-0.596	-0.216	-3.375	< .001
ER Adaptive	Nature	3.846	4.456	-5.398	11.915	0.075	0.863	0.388
ER Adaptive	Urban street	3.176	4.701	-6.702	11.945	0.062	0.676	0.499
ER Maladaptive	Nature	3.937	4.031	-4.470	11.643	0.087	0.977	0.329
ER Maladaptive	Urban street	-0.152	3.880	-7.996	7.097	-0.003	-0.039	0.969

Table C.5. *Parameter estimates for the indirect effects of the Alternative Model 1 (serial-parallel mediation model) tested in Study 5*

			95 % Confidence Intervals				
Indirect paths	***Estimate***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
Path a	-0.003	0.005	-0.016	0.004	-0.002	-0.687	0.492
Path b	0.000	0.002	-0.003	0.005	0.000	0.030	0.976
Path c	-0.166	0.082	-0.327	-0.007	-0.096	-2.024	0.043
Path d	-0.026	0.032	-0.096	0.030	-0.015	-0.827	0.408
Path e	0.021	0.026	-0.020	0.087	0.012	0.824	0.410
Path f	-0.003	0.005	-0.015	0.007	-0.002	-0.525	0.599
Path g	-0.000	0.001	-0.003	0.002	-0.000	-0.002	0.999
Path h	0.060	0.037	0.002	0.147	0.035	1.614	0.106
Path i	-0.022	0.036	-0.095	0.046	-0.013	-0.610	0.542
Path l	-0.001	0.022	-0.046	0.048	-0.000	-0.037	0.970
Path m	-0.001	0.001	-0.002	-0.000	-0.026	-1.683	0.092
Path n	0.000	0.000	-0.001	0.001	0.000	0.040	0.968

Note. Path a: Nature ⇒ ER Adaptive ⇒ PRS ⇒ PANAS 4 – NA; Path b: Nature ⇒ ER Maladaptive ⇒ PRS ⇒ PANAS 4 – NA; Path c: Nature ⇒ PRS ⇒ PANAS 4 – NA; Path d: Nature ⇒ ER Adaptive ⇒ PANAS 4 – NA; Path e: Nature ⇒ ER Maladaptive ⇒ PANAS 4 – NA; Path f: Urban street ⇒ ER Adaptive ⇒ PRS ⇒ PANAS 4 – NA; Path g: Urban street ⇒ ER Maladaptive ⇒ PRS ⇒ PANAS 4 – NA; Path h: Urban street ⇒ PRS ⇒ PANAS 4 – NA; Path i: Urban street ⇒ ER Adaptive ⇒ PANAS 4 – NA; Path l: Urban street ⇒ ER Maladaptive ⇒ PANAS 4 – NA; Path m: ER Adaptive ⇒ PRS ⇒ PANAS 4 – NA; Path n: ER Maladaptive ⇒ PRS ⇒ PANAS 4 – NA.

Figure C.2. *Conceptual parallel mediation model of Alternative Model 2 tested in Study 5, with standardized coefficients, linking experimental conditions to negative emotions post-intervention with mediation through ER strategies and PRS in parallel*



Note. Solid line: direct effects; dashed line: indirect effects; green lines: statistically significant effects; red lines: non-significant effects; *: significant effects ($p < .050$).

Table C.6. *Parameter estimates for the direct effects of the Alternative Model 2 (parallel mediation model) tested in Study 5*

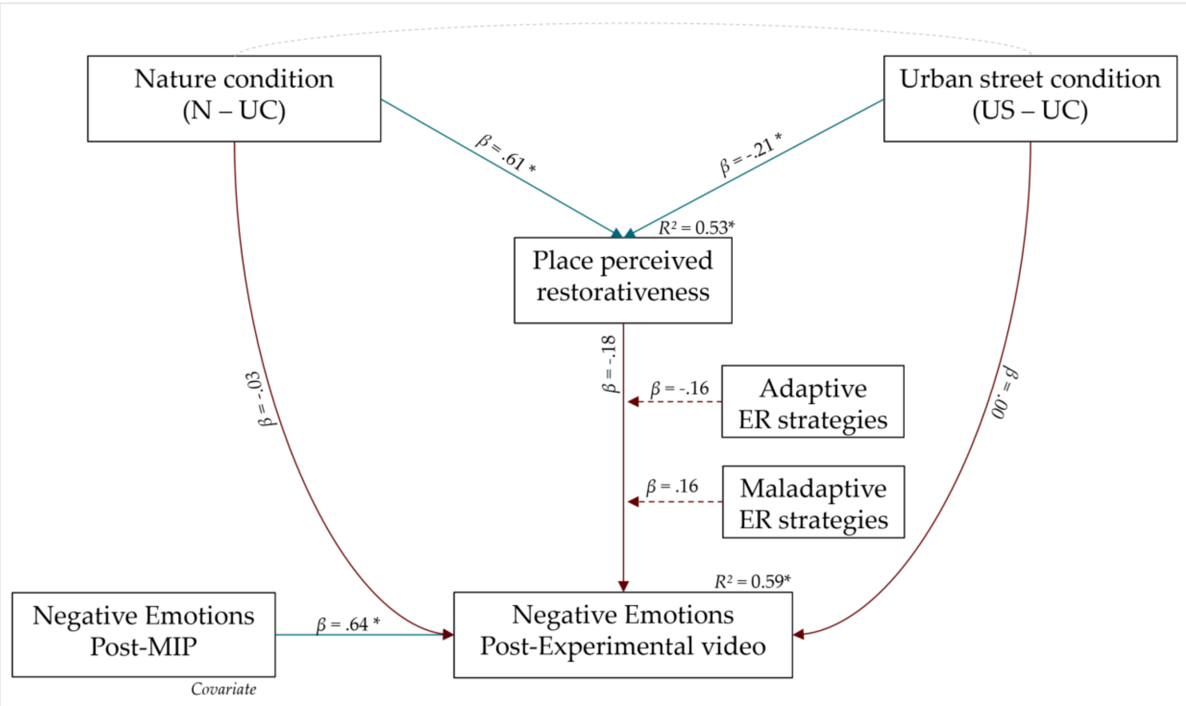
				95 % Confidence Intervals				
Dependent	**Predictor**	***Estimate***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
PANAS 4	ER Adaptive	-0.007	0.002	-0.011	-0.003	-0.204	-3.509	< .001
PANAS 4	ER Maladaptive	0.005	0.002	0.001	0.010	0.144	2.336	0.019
PANAS 4	PRS	-0.044	0.023	-0.090	0.001	-0.163	-1.921	0.055
PANAS 4	Nature	-0.021	0.127	-0.272	0.220	-0.012	-0.165	0.869
PANAS 4	Urban street	-0.025	0.122	-0.273	0.199	-0.015	-0.206	0.837
PANAS 4	PANAS 3	0.620	0.068	0.483	0.751	0.651	9.134	< .001
ER Adaptive	Nature	3.846	4.428	-5.067	12.317	0.075	0.868	0.385
ER Adaptive	Urban street	3.176	4.776	-6.493	12.336	0.062	0.665	0.506
ER Maladaptive	Nature	3.937	3.891	-3.835	11.646	0.087	1.012	0.312
ER Maladaptive	Urban street	-0.152	3.826	-7.774	7.031	-0.003	-0.040	0.968
PRS	Nature	3.807	0.378	3.059	4.561	0.605	10.084	< .001
PRS	Urban street	-1.296	0.444	-2.158	-0.370	-0.206	-2.922	0.003

Table C.7. *Parameter estimates for the indirect effects of the Alternative Model 2 (parallel mediation model) tested in Study 5*

Indirect paths	*Estimate*	*SE*	*95 % Confidence Intervals*		*β*	*z*	*p*
			Lower	*Upper*			
Path a	-0.026	0.033	-0.100	0.036	-0.015	-0.796	0.426
Path b	0.021	0.026	-0.023	0.079	0.013	0.835	0.403
Path c	-0.169	0.089	-0.346	0.004	-0.099	-1.907	0.056
Path d	-0.022	0.035	-0.093	0.046	-0.013	-0.615	0.538
Path e	-0.001	0.021	-0.047	0.042	-0.000	-0.039	0.969
Path f	0.058	0.039	-0.002	0.153	0.034	1.460	0.144

Note. Path a: Nature ⇒ ER Adaptive ⇒ PANAS 4 – NA; Path b: Nature ⇒ ER Maladaptive ⇒ PANAS 4 – NA; Path c: Nature ⇒ PRS ⇒ PANAS 4 – NA; Path d: Urban street ⇒ ER Adaptive ⇒ PANAS 4 – NA; Path e: Urban street ⇒ ER Maladaptive ⇒ PANAS 4 – NA; Path f: Urban street ⇒ PRS ⇒ PANAS 4 – NA

Figure C.3. *Conceptual moderated mediation model of Alternative Model 3 tested in Study 5, with standardized coefficients, linking experimental conditions to negative emotions post-intervention with mediation through PRS, moderated by ER strategies*



Note. Solid line: direct effects; dashed line: moderated effects; green lines: statistically significant effects; red lines: non-significant effects; *: significant effects ($p < .050$).

Table C.8. *Parameter estimates for the direct effects of the Alternative Model 3 (moderated mediation by ER strategies model) tested in Study 5*

				95% CI				
Dependent	Predictor	*B*	*SE*	*Lower*	*Upper*	*β*	*z*	*p*
PANAS 4	PANAS 3	0.641	0.065	0.515	0.768	0.643	9.831	< .001
PANAS 4	Nature	-0.053	0.124	-0.298	0.185	-0.029	-0.427	0.670
PANAS 4	Urban Street	0.007	0.116	-0.239	0.239	0.004	0.060	0.952
PANAS 4	ER Adaptive:PRS	-0.001	0.000	-0.001	0.000	-0.163	-1.857	0.063
PANAS 4	ER Maladaptive:PRS	0.001	0.000	-0.000	0.002	0.157	1.900	0.057
PANAS 4	PRS	-0.053	0.033	-0.119	0.012	-0.184	-1.585	0.113
PRS	Nature	3.807	0.364	3.124	4.543	0.605	10.448	< .001
PRS	Urban Street	-1.296	0.415	-2.131	-0.470	-0.206	-3.124	0.002

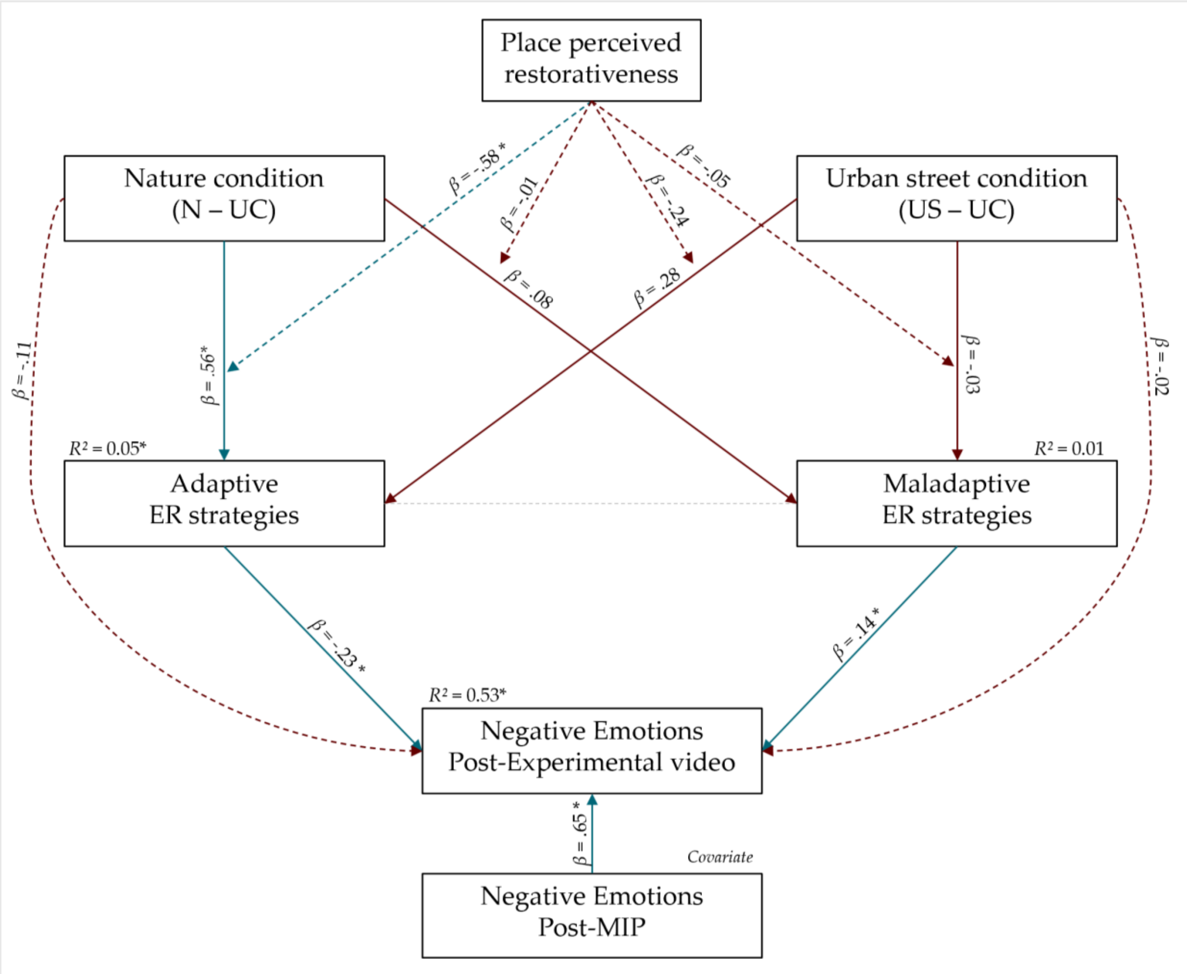
Table C.9. *Parameter estimates for the conditional mediation effects of the Alternative Model 3 (moderated mediation by ER strategies model) tested in Study 5*

Moderator levels						95% C.I. (a)				
ER Maladaptive	ER Adaptive	Type	Effect	*B*	*SE*	*Lower*	*Upper*	*β*	*z*	*p*
Mean-1·SD	Mean-1·SD	Indirect	N ⇒ PRS ⇒ PANAS	-0.430	0.117	-0.660	-0.200	-0.229	-3.668	< .001
Mean-1·SD	Mean-1·SD		US ⇒ PRS ⇒ PANAS	0.157	0.059	0.042	0.272	0.083	2.679	0.007
Mean-1·SD	Mean-1·SD	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001
Mean-1·SD	Mean-1·SD		PRS ⇒ PANAS	-0.115	0.029	-0.173	-0.058	-0.386	-3.945	< .001
Mean-1·SD	Mean-1·SD		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean-1·SD	Mean-1·SD	Direct	N ⇒ PANAS	-0.049	0.194	-0.429	0.331	-0.026	-0.252	0.801
Mean-1·SD	Mean-1·SD		US ⇒ PANAS	-0.131	0.151	-0.427	0.165	-0.070	-0.869	0.385
Mean-1·SD	Mean-1·SD	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean-1·SD	Mean-1·SD		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668
Mean-1·SD	Mean	Indirect	N ⇒ PRS ⇒ PANAS	-0.301	0.113	-0.523	-0.079	-0.164	-2.660	0.008
Mean-1·SD	Mean		US ⇒ PRS ⇒ PANAS	0.110	0.050	0.012	0.207	0.060	2.201	0.028
Mean-1·SD	Mean	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001
Mean-1·SD	Mean		PRS ⇒ PANAS	-0.081	0.029	-0.138	-0.023	-0.277	-2.760	0.006
Mean-1·SD	Mean		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean-1·SD	Mean	Direct	N ⇒ PANAS	-0.049	0.189	-0.419	0.322	-0.027	-0.259	0.796
Mean-1·SD	Mean		US ⇒ PANAS	-0.131	0.149	-0.424	0.162	-0.071	-0.878	0.380
Mean-1·SD	Mean	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean-1·SD	Mean		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668
Mean-1·SD	Mean+1·SD	Indirect	N ⇒ PRS ⇒ PANAS	-0.172	0.110	-0.388	0.045	-0.095	-1.554	0.120
Mean-1·SD	Mean+1·SD		US ⇒ PRS ⇒ PANAS	0.063	0.043	-0.022	0.147	0.035	1.445	0.148
Mean-1·SD	Mean+1·SD	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001
Mean-1·SD	Mean+1·SD		PRS ⇒ PANAS	-0.046	0.029	-0.103	0.011	-0.160	-1.574	0.116
Mean-1·SD	Mean+1·SD		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean-1·SD	Mean+1·SD	Direct	N ⇒ PANAS	-0.049	0.195	-0.430	0.333	-0.027	-0.251	0.802
Mean-1·SD	Mean+1·SD		US ⇒ PANAS	-0.131	0.149	-0.423	0.161	-0.072	-0.880	0.379
Mean-1·SD	Mean+1·SD	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean-1·SD	Mean+1·SD		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668
Mean	Mean-1·SD	Indirect	N ⇒ PRS ⇒ PANAS	-0.365	0.115	-0.591	-0.140	-0.197	-3.173	0.002
Mean	Mean-1·SD		US ⇒ PRS ⇒ PANAS	0.133	0.054	0.027	0.239	0.072	2.466	0.014
Mean	Mean-1·SD	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001

Mean	Mean-1·SD		PRS ⇒ PANAS	-0.098	0.029	-0.155	-0.041	-0.332	-3.347	< .001
Mean	Mean-1·SD		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean	Mean-1·SD	Direct	N ⇒ PANAS	-0.049	0.187	-0.415	0.317	-0.026	-0.262	0.794
Mean	Mean-1·SD		US ⇒ PANAS	-0.131	0.150	-0.424	0.162	-0.071	-0.875	0.382
Mean	Mean-1·SD	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean	Mean-1·SD		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668
Mean	Mean	Indirect	N ⇒ PRS ⇒ PANAS	-0.236	0.112	-0.455	-0.017	-0.129	-2.112	0.035
Mean	Mean		US ⇒ PRS ⇒ PANAS	0.086	0.046	-0.005	0.176	0.047	1.859	0.063
Mean	Mean	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001
Mean	Mean		PRS ⇒ PANAS	-0.063	0.029	-0.120	-0.006	-0.218	-2.161	0.031
Mean	Mean		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean	Mean	Direct	N ⇒ PANAS	-0.049	0.179	-0.400	0.302	-0.027	-0.273	0.785
Mean	Mean		US ⇒ PANAS	-0.131	0.147	-0.419	0.157	-0.072	-0.891	0.373
Mean	Mean	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean	Mean		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668
Mean	Mean+1·SD	Indirect	N ⇒ PRS ⇒ PANAS	-0.106	0.110	-0.321	0.108	-0.059	-0.971	0.332
Mean	Mean+1·SD		US ⇒ PRS ⇒ PANAS	0.039	0.041	-0.042	0.119	0.021	0.942	0.346
Mean	Mean+1·SD	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001
Mean	Mean+1·SD		PRS ⇒ PANAS	-0.029	0.029	-0.086	0.029	-0.099	-0.975	0.329
Mean	Mean+1·SD		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean	Mean+1·SD	Direct	N ⇒ PANAS	-0.049	0.193	-0.427	0.329	-0.027	-0.254	0.800
Mean	Mean+1·SD		US ⇒ PANAS	-0.131	0.148	-0.420	0.158	-0.072	-0.888	0.375
Mean	Mean+1·SD	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean	Mean+1·SD		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668
Mean+1·SD	Mean-1·SD	Indirect	N ⇒ PRS ⇒ PANAS	-0.300	0.113	-0.522	-0.078	-0.163	-2.650	0.008
Mean+1·SD	Mean-1·SD		US ⇒ PRS ⇒ PANAS	0.109	0.050	0.012	0.207	0.060	2.195	0.028
Mean+1·SD	Mean-1·SD	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001
Mean+1·SD	Mean-1·SD		PRS ⇒ PANAS	-0.080	0.029	-0.138	-0.023	-0.276	-2.749	0.006
Mean+1·SD	Mean-1·SD		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean+1·SD	Mean-1·SD	Direct	N ⇒ PANAS	-0.049	0.191	-0.423	0.325	-0.027	-0.256	0.798
Mean+1·SD	Mean-1·SD		US ⇒ PANAS	-0.131	0.150	-0.424	0.162	-0.071	-0.875	0.381
Mean+1·SD	Mean-1·SD	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean+1·SD	Mean-1·SD		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668
Mean+1·SD	Mean	Indirect	N ⇒ PRS ⇒ PANAS	-0.170	0.110	-0.387	0.046	-0.094	-1.544	0.123
Mean+1·SD	Mean		US ⇒ PRS ⇒ PANAS	0.062	0.043	-0.023	0.147	0.034	1.437	0.151
Mean+1·SD	Mean	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001
Mean+1·SD	Mean		PRS ⇒ PANAS	-0.046	0.029	-0.103	0.012	-0.159	-1.563	0.118
Mean+1·SD	Mean		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean+1·SD	Mean	Direct	N ⇒ PANAS	-0.049	0.190	-0.422	0.324	-0.027	-0.257	0.797
Mean+1·SD	Mean		US ⇒ PANAS	-0.131	0.148	-0.421	0.159	-0.072	-0.885	0.376
Mean+1·SD	Mean	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean+1·SD	Mean		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668
Mean+1·SD	Mean+1·SD	Indirect	N ⇒ PRS ⇒ PANAS	-0.041	0.109	-0.255	0.173	-0.023	-0.377	0.706
Mean+1·SD	Mean+1·SD		US ⇒ PRS ⇒ PANAS	0.015	0.040	-0.063	0.093	0.008	0.375	0.708
Mean+1·SD	Mean+1·SD	Component	N ⇒ PRS	3.732	0.374	2.998	4.465	0.593	9.968	< .001
Mean+1·SD	Mean+1·SD		PRS ⇒ PANAS	-0.011	0.029	-0.068	0.046	-0.038	-0.377	0.706
Mean+1·SD	Mean+1·SD		US ⇒ PRS	-1.360	0.373	-2.090	-0.629	-0.216	-3.648	< .001
Mean+1·SD	Mean+1·SD	Direct	N ⇒ PANAS	-0.049	0.199	-0.439	0.341	-0.027	-0.246	0.806
Mean+1·SD	Mean+1·SD		US ⇒ PANAS	-0.131	0.149	-0.422	0.160	-0.072	-0.882	0.378
Mean+1·SD	Mean+1·SD	Total	N ⇒ PANAS	-0.301	0.145	-0.586	-0.016	-0.165	-2.070	0.038
Mean+1·SD	Mean+1·SD		US ⇒ PANAS	-0.062	0.145	-0.346	0.222	-0.034	-0.429	0.668

Note. N: Nature Condition; US: Urban Street Condition; PANAS: post-intervention negative emotions.

Figure C.4. *Conceptual moderated mediation model of Alternative Model 3 tested in Study 5, with standardized coefficients, linking experimental conditions to negative emotions post-intervention with mediation through PRS, moderated by ER strategies*



Note. Solid line: direct effects; dashed line: moderated effects; green lines: statistically significant effects; red lines: non-significant effects; *: significant effects ($p < .050$).

Table C.10. *Parameter estimates for the direct effects of the Alternative Model 4 (moderated mediation by PRS model) tested in Study 5*

Dependent	Predictor	*B*	*SE*	95% C.I.		*β*	*z*	*p*
				Lower	*Upper*			
PANAS 4	ER Maladaptive	0.005	0.002	0.001	0.010	0.141	2.400	0.016
PANAS 4	ER Adaptive	-0.008	0.002	-0.012	-0.004	-0.226	-3.965	< .001
PANAS 4	PANAS 3	0.627	0.068	0.491	0.760	0.650	9.197	< .001
PANAS 4	Urban Street	0.036	0.116	-0.183	0.266	0.021	0.314	0.753
PANAS 4	Nature	-0.185	0.106	-0.406	0.028	-0.107	-1.753	0.080
ER Adaptive	Nature	28.605	11.581	4.498	51.475	0.559	2.470	0.014
ER Adaptive	Urban Street	14.498	8.188	-2.469	30.414	0.283	1.771	0.077
ER Adaptive	PRS:Nature	-4.809	1.739	-8.439	-1.428	-0.579	-2.766	0.006
ER Adaptive	PRS:Urban Street	-2.331	1.785	-6.042	1.185	-0.238	-1.306	0.192
ER Maladaptive	Nature	3.475	9.899	-18.011	22.028	0.077	0.351	0.726
ER Maladaptive	Urban Street	1.410	6.217	-10.665	13.828	0.031	0.227	0.821
ER Maladaptive	PRS:Nature	-0.060	1.376	-2.651	2.722	-0.008	-0.043	0.965
ER Maladaptive	PRS:Urban Street	-0.433	1.402	-3.310	2.265	-0.050	-0.309	0.758

Table C.11. *Parameter estimates for the indirect effects of the Alternative Model 4 (moderated mediation by PRS model) tested in Study 5*

Indirect paths	*B*	*SE*	95% C.I.		*β*	*z*	*p*
			Lower	*Upper*			
Path a	-0.112	0.072	-0.269	0.016	-0.064	-1.544	0.123
Path b	0.008	0.036	-0.063	0.085	0.004	0.210	0.834
Path c	-0.220	0.117	-0.495	-0.028	-0.127	-1.876	0.061
Path d	0.019	0.057	-0.105	0.132	0.011	0.326	0.744
Path e	0.037	0.018	0.008	0.081	0.131	2.028	0.043
Path f	-0.000	0.008	-0.016	0.017	-0.001	-0.041	0.968
Path g	0.018	0.015	-0.008	0.053	0.054	1.190	0.234
Path h	-0.002	0.008	-0.021	0.012	-0.007	-0.286	0.775

Note. Path a: Urban Street ⇒ ER Adaptive ⇒ PANAS 4; Path b: Urban Street ⇒ ER Maladaptive ⇒ PANAS 4; Path c: Nature ⇒ ER Adaptive ⇒ PANAS 4; Path d: Nature ⇒ ER Maladaptive ⇒ PANAS 4; Path e: PRS:Nature ⇒ ER Adaptive ⇒ PANAS 4; Path f: PRS:Nature ⇒ ER Maladaptive ⇒ PANAS 4; Path g: PRS:Urban Street ⇒ ER Adaptive ⇒ PANAS 4; Path h: PRS:Urban Street ⇒ ER Maladaptive ⇒ PANAS 4

Table C.12. *Parameter estimates for the conditional mediation effects of the Alternative Model 4 (moderated mediation model) tested in Study 5*

Moderator levels					**95% C.I.**				
PRS	**Type**	**Effect**	***B***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
Mean-1·SD	Indirect	N ⇒ ER Adaptive ⇒ PANAS	-0.036	0.117	-0.266	0.194	-0.020	-0.304	0.761
Mean-1·SD		N ⇒ ER Maladaptive ⇒ PANAS	0.119	0.139	-0.154	0.392	0.065	0.854	0.393
Mean-1·SD		US ⇒ ER Adaptive ⇒ PANAS	-0.078	0.054	-0.185	0.028	-0.043	-1.446	0.148
Mean-1·SD		US ⇒ ER Maladaptive ⇒ PANAS	0.013	0.058	-0.101	0.127	0.007	0.225	0.822
Mean-1·SD	Component	N ⇒ ER Adaptive	3.853	12.644	-20.929	28.634	0.075	0.305	0.761
Mean-1·SD		ER Adaptive ⇒ PANAS	-0.009	0.003	-0.014	-0.004	-0.260	-3.689	< .001
Mean-1·SD		N ⇒ ER Maladaptive	10.042	11.524	-12.545	32.629	0.222	0.871	0.384
Mean-1·SD		ER Maladaptive ⇒ PANAS	0.012	0.003	0.006	0.017	0.295	4.279	< .001
Mean-1·SD		US ⇒ ER Adaptive	8.477	5.393	-2.094	19.048	0.166	1.572	0.116
Mean-1·SD		US ⇒ ER Maladaptive	1.108	4.916	-8.527	10.743	0.024	0.225	0.822
Mean-1·SD	Direct	N ⇒ PANAS	-0.502	0.290	-1.069	0.066	-0.276	-1.733	0.083
Mean-1·SD		US ⇒ PANAS	-0.239	0.175	-0.582	0.103	-0.132	-1.370	0.171
Mean-1·SD	Total	N ⇒ PANAS	-0.636	0.316	-1.256	-0.016	-0.350	-2.011	0.044
Mean-1·SD		US ⇒ PANAS	-0.323	0.192	-0.699	0.052	-0.178	-1.686	0.092
Mean	Indirect	N ⇒ ER Adaptive ⇒ PANAS	0.027	0.068	-0.106	0.161	0.015	0.401	0.689
Mean		N ⇒ ER Maladaptive ⇒ PANAS	0.077	0.081	-0.082	0.236	0.042	0.952	0.341
Mean		US ⇒ ER Adaptive ⇒ PANAS	-0.056	0.054	-0.162	0.049	-0.031	-1.051	0.293
Mean		US ⇒ ER Maladaptive ⇒ PANAS	-0.026	0.060	-0.145	0.092	-0.014	-0.434	0.664
Mean	Component	N ⇒ ER Adaptive	-2.953	7.326	-17.311	11.405	-0.058	-0.403	0.687
Mean		ER Adaptive ⇒ PANAS	-0.009	0.003	-0.014	-0.004	-0.260	-3.689	< .001
Mean		N ⇒ ER Maladaptive	6.518	6.677	-6.569	19.604	0.144	0.976	0.329
Mean		ER Maladaptive ⇒ PANAS	0.012	0.003	0.006	0.017	0.295	4.279	< .001
Mean		US ⇒ ER Adaptive	6.102	5.567	-4.808	17.013	0.119	1.096	0.273
Mean		US ⇒ ER Maladaptive	-2.215	5.074	-12.159	7.730	-0.049	-0.436	0.662
Mean	Direct	N ⇒ PANAS	-0.246	0.187	-0.613	0.121	-0.135	-1.316	0.188
Mean		US ⇒ PANAS	-0.003	0.169	-0.334	0.328	-0.002	-0.018	0.986
Mean	Total	N ⇒ PANAS	-0.250	0.207	-0.656	0.155	-0.138	-1.211	0.226
Mean		US ⇒ PANAS	-0.038	0.187	-0.405	0.328	-0.021	-0.204	0.838
Mean+1·SD	Indirect	N ⇒ ER Adaptive ⇒ PANAS	0.090	0.067	-0.041	0.221	0.050	1.352	0.176
Mean+1·SD		N ⇒ ER Maladaptive ⇒ PANAS	0.035	0.073	-0.108	0.178	0.019	0.486	0.627
Mean+1·SD		US ⇒ ER Adaptive ⇒ PANAS	-0.034	0.095	-0.221	0.152	-0.019	-0.363	0.717
Mean+1·SD		US ⇒ ER Maladaptive ⇒ PANAS	-0.066	0.111	-0.284	0.153	-0.036	-0.589	0.556
Mean+1·SD	Component	N ⇒ ER Adaptive	-9.758	6.714	-22.918	3.402	-0.191	-1.453	0.146
Mean+1·SD		ER Adaptive ⇒ PANAS	-0.009	0.003	-0.014	-0.004	-0.260	-3.689	< .001
Mean+1·SD		N ⇒ ER Maladaptive	2.994	6.120	-9.001	14.988	0.066	0.489	0.625
Mean+1·SD		ER Maladaptive ⇒ PANAS	0.012	0.003	0.006	0.017	0.295	4.279	< .001
Mean+1·SD		US ⇒ ER Adaptive	3.728	10.223	-16.309	23.765	0.073	0.365	0.715
Mean+1·SD		US ⇒ ER Maladaptive	-5.537	9.318	-23.800	12.725	-0.122	-0.594	0.552
Mean+1·SD	Direct	N ⇒ PANAS	0.009	0.219	-0.420	0.439	0.005	0.043	0.966
Mean+1·SD		US ⇒ PANAS	0.233	0.294	-0.342	0.809	0.128	0.794	0.427
Mean+1·SD	Total	N ⇒ PANAS	0.135	0.241	-0.338	0.608	0.074	0.561	0.575
Mean+1·SD		US ⇒ PANAS	0.247	0.325	-0.391	0.885	0.136	0.759	0.448

Appendix C.9.

State Emotion Regulation Inventory (Study 6)

(SERI; Katz et al., 2017)

Instructions: Ricorda la situazione negativa che hai descritto nella prima parte della sperimentazione. Di seguito è riportato un elenco di affermazioni. Valuta il tuo grado di accordo con ciascuna delle seguenti affermazioni rispetto a quel pensiero negativo e al modo in cui l'hai affrontato <u>durante l'esplorazione dello scenario virtuale</u>. Per le tue valutazioni, tieni conto che *1 = Totalmente in disaccordo* e *7 = Totalmente d'accordo*.

Response options: 1 = Totalmente in disaccordo – 7 = Totalmente d'accordo

CODE	**ITEM**	
Distraction_1	Ho cercato di pensare ad altre cose	1 2 3 4 5 6 7
Reappraisal_1	Ho cercato di rivalutare la situazione in modo più positivo	1 2 3 4 5 6 7
Brooding_1	Ho analizzato criticamente le possibili implicazioni del mio pensiero	1 2 3 4 5 6 7
Acceptance_1	Quando il pensiero mi è venuto in mente, l'ho semplicemente accettato così com'era	1 2 3 4 5 6 7
Distraction_2	Ho cercato di pensare ad altri argomenti non correlati al pensiero	1 2 3 4 5 6 7
Reappraisal_2	Ho cercato di trovare aspetti positivi della situazione	1 2 3 4 5 6 7
Brooding_2	Ho affrontato criticamente il significato del mio pensiero e come si riflette su di me	1 2 3 4 5 6 7
Acceptance_2	Ho permesso al pensiero di entrare nella mia mente così com'era	1 2 3 4 5 6 7
Distraction_3	Ho cercato di pensare ad altro invece di affrontare il pensiero	1 2 3 4 5 6 7
Reappraisal_3	Ho cercato di cambiare il modo in cui penso alla situazione	1 2 3 4 5 6 7
Brooding_3	Ho considerato come il mio pensiero evidenzia aspetti problematici della mia situazione attuale	1 2 3 4 5 6 7

Acceptance_3	Ho permesso al pensiero di emergere senza analizzarlo o evitarlo	1 2 3 4 5 6 7
Distraction_4	Ho cercato di preoccuparmi di altre cose	1 2 3 4 5 6 7
Reappraisal_4	Ho cercato di vedere la situazione sotto una luce più positiva	1 2 3 4 5 6 7
Brooding_4	Ho analizzato criticamente le possibili ragioni del mio pensiero	1 2 3 4 5 6 7
Acceptance_4	Ho permesso al pensiero di emergere senza fare grandi sforzi per cambiarlo	1 2 3 4 5 6 7

Appendix C.10.

Difficulties in Emotion Regulation Scale (Study 6)

(DERS; Gratz & Roemer, 2004; Italian version: Sighinolfi et al., 2010)

Instructions: Questo questionario contiene una serie di atteggiamenti relativi a come le persone sono in relazione con i loro sentimenti e/o emozioni di cui possono fare esperienza. In riferimento alla situazione negativa che hai descritto, indica quanto senti che ciascun atteggiamento rispecchia il modo in cui, durante l'esplorazione dello scenario virtuale, hai affrontato quel pensiero. Per le tue valutazioni, tieni conto che *1 = Per niente* e *5 = Completamente*.

Response options: 1 = Per niente – 5 = Completamente

CODE	ITEM	
Awareness_1	Ho prestato attenzione a come mi sentivo	1 2 3 4 5
Clarity_1	Ho avuto difficoltà a dare un senso a ciò che provavo	1 2 3 4 5
Awareness_2	Ho riconosciuto le mie emozioni	1 2 3 4 5
Modulate_1	Ho avuto difficoltà nel controllare i miei comportamenti	1 2 3 4 5
Modulate_2	Ho creduto che sarei rimasto in quello stato per molto tempo	1 2 3 4 5
Nonacceptance_1	Mi sono sentito in colpa per essermi sentito in quel modo	1 2 3 4 5
Modulate_3	Le mie emozioni sembravano fuori controllo	1 2 3 4 5
Nonacceptance_2	Ho provato vergogna per essermi sentito in quel modo	1 2 3 4 5
Clarity_2	Non avevo idea di come mi sentissi	1 2 3 4 5
Awareness_3	Mi interessava ciò che stavo provando	1 2 3 4 5
Nonacceptance_3	Ho provato imbarazzo per essermi sentito in quel modo	1 2 3 4 5
Clarity_3	Ero confuso riguardo a ciò che provavo	1 2 3 4 5

Appendix C.11.

Virtual Reality Sickness Questionnaire (Study 6)

(VRSQ, Kim et al., 2018; Italian version used by Latini et al., 2021)

Instructions: Indica se in questo momento o durante l'esperienza nella realtà virtuale hai percepito uno o più dei seguenti sintomi, utilizzando la scala di risposta fornita che va da 0 a 4.

Response options: 0 = per niente; 1 = leggermente; 2 = moderatamente; 3 = molto; 4 = moltissimo

CODE	ITEM					
Oculomotor_1	Generale disagio	1	2	3	4	5
Oculomotor_2	Fatica	1	2	3	4	5
Oculomotor_3	Bruciore agli occhi	1	2	3	4	5
Oculomotor_4	Difficoltà di concentrazione	1	2	3	4	5
Disorientation_1	Mal di testa	1	2	3	4	5
Disorientation_2	Intontimento	1	2	3	4	5
Disorientation_3	Visione offuscata	1	2	3	4	5
Disorientation_4	Capogiro (occhi chiusi)	1	2	3	4	5
Disorientation_5	Vertigini	1	2	3	4	5

Appendix C.12.

Ingroup Presence Questionnaire (Study 6)

(Schubert et al., 2001)

Instructions: Sulla base della tua esperienza negli scenari, ti chiediamo di esprimere il tuo grado di accordo o disaccordo con le seguenti affermazioni, tenendo conto della scala di risposta fornita di seguito.

Response options: 0 = Completamente in disaccordo; 3 = Né in accordo né in disaccordo; 6 = Completamente d'accordo.

CODE	ITEM							
IPQ_1	L'esperienza negli scenari mi è sembrata più realistica del mondo reale	0	1	2	3	4	5	6
IPQ_2	L'esperienza negli scenari mi è sembrata coerente con quella del mondo reale	0	1	2	3	4	5	6
IPQ_3	Ho percepito gli scenari come se fossero reali	0	1	2	3	4	5	6
IPQ_4	Non mi sono sentito/a presente negli scenari	0	1	2	3	4	5	6
IPQ_5	Mentre navigavo negli scenari, ero consapevole del mondo reale che mi circondava (suoni, temperatura della stanza, altre persone, ecc.)	0	1	2	3	4	5	6
IPQ_6	Avevo la sensazione di agire all'interno degli scenari, piuttosto che gestire qualcosa dall'esterno	0	1	2	3	4	5	6
IPQ_7	Mi sono sentito/a completamente coinvolto/a negli scenari	0	1	2	3	4	5	6
IPQ_8	Mentre esploravo gli scenari, ho comunque prestato attenzione all'ambiente reale	0	1	2	3	4	5	6
IPQ_9	Ho percepito gli scenari come immagini piuttosto che come luoghi realmente visitati	0	1	2	3	4	5	6
IPQ_10	Durante l'esperienza negli scenari, non ero consapevole del mondo reale circostante	0	1	2	3	4	5	6
IPQ_11	Mi sono sentito/a presente negli scenari	0	1	2	3	4	5	6
IPQ_12	Per qualche motivo, ho avuto la sensazione che gli scenari che ho esplorato mi circondassero	0	1	2	3	4	5	6

Appendix C.13.

Reliability Analyses – Study 6

Table C.13. *Summary of reliability analyses for the experimental condition in Study 6*

Measures	*Cronbach's α*
PANAS 1	
Positive affect	0.871
Negative affect	0.851
PANAS 2	
Positive affect	0.908
Negative affect	0.907
PANAS 3	
Positive affect	0.914
Negative affect	0.872
Environmental Characteristics	
Urban elements	0.953
Natural elements	0.791
VRSQ	
Oculo-motor	0.629
Disorientation	0.732
IPQ	
Sense of presence	0.666
Realism	0.742
Total	0.879

Table C.14. *Summary of reliability analyses for emotion regulation strategies scales across trait and experimental condition in Study 6*

Measures	*Cronbach's α*	
	Experimental condition	*Trait*
Emotion regulation strategies – Adaptive	0.767	0.533
Emotion regulation strategies – Maladaptive	0.760	0.516
SERI – Distraction	0.898	0.731
SERI – Reappraisal	0.845	0.858
SERI – Brooding	0.814	0.541
SERI – Acceptance	0.860	0.625
DERS – Awareness	0.784	0.665
DERS – Clarity	0.788	0.854
DERS – Modulate	0.768	0.790
DERS – Non-acceptance	0.894	0.876

Table C.15. *Reliability Analyses for PRS and Location Selection across experimental scenarios in Study 6*

Measures	Cronbach's α					
	Exp. condition	*Arctic*	*Forest*	*Island*	*Flowery field*	*Urban*
PRS	0.888	0.826	0.811	0.865	0.827	0.759
Location Selection Scale						
Total mean	0.876	0.931	0.909	0.925	0.933	0.937
Up-regulation factor	0.752	0.901	0.885	0.885	0.920	0.920
Down-regulation factor	0.929	0.932	0.891	0.931	0.930	0.909

Appendix C.14.

Content Analysis – Study 6

This Appendix presents the content analysis of participants' comments in the MIP recall procedure in Study 6.

Comments made by participants during the recall and description of a negative event procedure were analysed to identify recurring themes and assess their alignment with the intended task of the emotional manipulation procedure. Participants' comment submission times averaged 6.42 minutes, ranging from 3.06 to 15.2 minutes with a median time of 5.43 minutes.

The content analysis revealed that the comments were generally consistent across different experimental conditions, reflecting several primary themes:

- *Loss and grief*: Participants frequently described experiences related to the death of loved ones, including family members, close friends, and pets. Emotions associated with these events included deep sadness, a sense of emptiness, and, in some cases, guilt. Some participants noted that grief is a persistent feeling that affects long-term emotional well-being.
- *Interpersonal relationships*: Significant sources of emotional stress included romantic breakups, arguments with friends, and family conflicts. Dominant emotions in this category were anger, frustration, betrayal, and a loss of identity and self-esteem. Participants also reported feelings of guilt for not managing these situations better.
- *Health issues*: Personal and family health problems were described as highly stressful and distressing events. These included chronic illness diagnoses, surgeries, and severe conditions. Associated emotions were intense fear, anxiety, and sadness, often leading to feelings of vulnerability and uncertainty about the future.

- *Educational and work-related experiences*: Negative experiences in educational and professional contexts, such as academic failures, workplace bullying, and performance stress, were significant. Predominant emotions included inadequacy, fear of failure, and constant pressure. However, some participants expressed pride in overcoming these difficulties, highlighting resilience and personal growth.
- *Loneliness and isolation*: Feelings of loneliness and isolation were particularly noted in contexts involving relocations and adaptation to new environments. Participants described challenges in forming new social connections and feeling understood, leading to sadness, anxiety, and disconnection.

Although sadness was the main target emotion of the negative mood induction procedure, the analysis of comments revealed a broader emotional complexity. In particular, participants experienced and reported a range of other emotions:

- *Sadness*: As expected, sadness was the primary emotion reported, deeply connected to experiences of loss, personal setbacks, and relational difficulties. It was described as a profound, often enduring feeling of emptiness and pain, with significant effects on daily well-being. Many participants noted that while sadness is challenging, it also provided an opportunity for personal reflection and emotional growth.
- *Anger*: Anger emerged as a relevant emotional response, especially in contexts of perceived injustice and conflict. Participants reported feelings of anger related to romantic breakups, family disputes, and experiences of bullying. This emotion was often accompanied by a sense of helplessness and frustration, intensifying the emotional experience.
- *Fear*: Fear was a significant reaction, particularly linked to health issues and future uncertainties. Participants described intense anxiety about medical diagnoses and the health of loved ones. This fear was characterized by a

sense of vulnerability and ongoing worry, often exacerbated by the inability to control future events. Some participants also reported confusion due to the difficulty in fully understanding their emotions and situations.

- *Guilt*: Guilt was a recurring emotion in response to loss and problematic interpersonal relationships. Participants felt guilty about not doing enough to prevent or manage negative situations, such as in cases of grief and conflicts. This emotion was associated with a high degree of self-reflection and, in some cases, negatively impacted participants' self-efficacy and self-esteem.
- *Pride*: Conversely, pride emerged in some comments. Participants expressed pride in their ability to cope with and overcome difficulties. This sense of self-recognition and satisfaction was often linked to recovery from negative experiences, demonstrating how resilience can lead to positive growth even in the face of adversity.

The content analysis demonstrated that while sadness was the primary target emotion of the MIP, participants' personal experiences revealed a broader spectrum of emotional responses.

Appendix C.15.

Alternative Models Testing (Study 6)

This Appendix presents details about the alternative models tested in Study 6.

Table C.16. *Parameter estimates for the direct effects of the Alternative Model 1 (serial-parallel mediation model) tested in Study 6*

				95% CI				
Dependent	**Predictor**	***B***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
PANAS 3	Island	0.041	0.133	-0.220	0.302	0.035	0.310	0.757
PANAS 3	Flowery field	-0.096	0.122	-0.335	0.142	-0.081	-0.792	0.429
PANAS 3	Forest	0.034	0.134	-0.229	0.297	0.029	0.253	0.800
PANAS 3	Arctic	-0.020	0.130	-0.274	0.234	-0.016	-0.152	0.879
PANAS 3	PANAS 2	0.413	0.044	0.327	0.499	0.696	9.457	< .001
PANAS 3	ER Adaptive	-0.001	0.002	-0.004	0.003	-0.027	-0.361	0.718
PANAS 3	ER Maladaptive	0.003	0.001	0.000	0.006	0.163	2.239	0.025
PANAS 3	PRS	-0.049	0.017	-0.083	-0.016	-0.274	-2.914	0.004
ER Adaptive	Island	2.448	7.624	-12.494	17.390	0.045	0.321	0.748
ER Adaptive	Flowery field	6.385	7.624	-8.556	21.327	0.116	0.838	0.402
ER Adaptive	Forest	13.312	7.624	-1.629	28.254	0.243	1.746	0.081
ER Adaptive	Arctic	5.796	7.750	-9.393	20.985	0.103	0.748	0.455
ER Maladaptive	Island	-0.938	8.389	-17.379	15.504	-0.016	-0.112	0.911
ER Maladaptive	Flowery field	-3.266	8.389	-19.707	13.176	-0.055	-0.389	0.697
ER Maladaptive	Forest	6.578	8.389	-9.863	23.020	0.110	0.784	0.433
ER Maladaptive	Arctic	-0.449	8.527	-17.162	16.264	-0.007	-0.053	0.958
PRS	Island	4.562	0.718	3.156	5.969	0.694	6.358	< .001
PRS	Flowery field	3.225	0.718	1.819	4.631	0.491	4.494	< .001
PRS	Forest	4.425	0.718	3.019	5.831	0.673	6.166	< .001
PRS	Arctic	3.943	0.729	2.513	5.372	0.585	5.405	< .001

Table C.17. *Parameter estimates for the indirect effects of the Alternative Model 1 (serial-parallel mediation model) tested in Study 6*

			95% CI				
Description	***B***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
Island ⇒ ER Adaptive ⇒ PANAS 3	-0.001	0.006	-0.013	0.010	-0.001	-0.240	0.810
Island ⇒ ER Maladaptive ⇒ PANAS 3	-0.003	0.027	-0.057	0.050	-0.003	-0.112	0.911
Island ⇒ PRS ⇒ PANAS 3	-0.225	0.085	-0.392	-0.059	-0.190	-2.649	0.008
Flowery field ⇒ ER Adaptive ⇒ PANAS 3	-0.004	0.011	-0.025	0.018	-0.003	-0.331	0.740
Flowery field ⇒ ER Maladaptive ⇒ PANAS 3	-0.011	0.028	-0.065	0.044	-0.009	-0.384	0.701
Flowery field ⇒ PRS ⇒ PANAS 3	-0.159	0.065	-0.287	-0.032	-0.134	-2.445	0.014
Forest ⇒ ER Adaptive ⇒ PANAS 3	-0.008	0.022	-0.050	0.035	-0.006	-0.353	0.724
Forest ⇒ ER Maladaptive ⇒ PANAS 3	0.021	0.029	-0.035	0.078	0.018	0.740	0.459
Forest ⇒ PRS ⇒ PANAS 3	-0.219	0.083	-0.381	-0.056	-0.184	-2.635	0.008
Arctic ⇒ ER Adaptive ⇒ PANAS 3	-0.003	0.010	-0.023	0.017	-0.003	-0.325	0.745
Arctic ⇒ ER Maladaptive ⇒ PANAS 3	-0.001	0.028	-0.056	0.053	-0.001	-0.053	0.958
Arctic ⇒ PRS ⇒ PANAS 3	-0.195	0.076	-0.344	-0.046	-0.160	-2.565	0.010

Table C.18. *Parameter estimates for the direct effects of the Alternative Model 2 (parallel mediation model) tested in Study 6*

				95% CI				
Dependent	**Predictor**	***B***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
PANAS 3	Arctic	-0.020	0.130	-0.274	0.234	-0.016	-0.152	0.879
PANAS 3	Forest	0.034	0.134	-0.229	0.297	0.029	0.253	0.800
PANAS 3	Flowery field	-0.096	0.122	-0.335	0.142	-0.081	-0.792	0.429
PANAS 3	Island	0.041	0.133	-0.220	0.302	0.035	0.310	0.757
PANAS 3	PANAS 2	0.413	0.044	0.327	0.499	0.696	9.457	< .001
PANAS 3	ER Adaptive	-0.001	0.002	-0.004	0.003	-0.027	-0.361	0.718
PANAS 3	ER Maladaptive	0.003	0.001	0.000	0.006	0.163	2.239	0.025
PANAS 3	PRS	-0.049	0.017	-0.083	-0.016	-0.274	-2.914	0.004
ER Adaptive	Island	2.448	7.624	-12.494	17.390	0.045	0.321	0.748
ER Adaptive	Flowery field	6.385	7.624	-8.556	21.327	0.116	0.838	0.402
ER Adaptive	Forest	13.312	7.624	-1.629	28.254	0.243	1.746	0.081
ER Adaptive	Arctic	5.796	7.750	-9.393	20.985	0.103	0.748	0.455
ER Maladaptive	Island	-0.938	8.389	-17.379	15.504	-0.016	-0.112	0.911
ER Maladaptive	Flowery field	-3.266	8.389	-19.707	13.176	-0.055	-0.389	0.697
ER Maladaptive	Forest	6.578	8.389	-9.863	23.020	0.110	0.784	0.433
ER Maladaptive	Arctic	-0.449	8.527	-17.162	16.264	-0.007	-0.053	0.958
PRS	Island	4.562	0.718	3.156	5.969	0.694	6.358	< .001
PRS	Flowery field	3.225	0.718	1.819	4.631	0.491	4.494	< .001
PRS	Forest	4.425	0.718	3.019	5.831	0.673	6.166	< .001
PRS	Arctic	3.943	0.729	2.513	5.372	0.585	5.405	< .001

Table C.19. *Parameter estimates for the indirect effects of the Alternative Model 2 (parallel mediation model) tested in Study 6*

			95% CI				
Description	***B***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
Arctic ⇒ ER Adaptive ⇒ PANAS 3	-0.003	0.010	-0.023	0.017	-0.003	-0.325	0.745
Arctic ⇒ ER Maladaptive ⇒ PANAS 3	-0.001	0.028	-0.056	0.053	-0.001	-0.053	0.958
Arctic ⇒ PRS ⇒ PANAS 3	-0.195	0.076	-0.344	-0.046	-0.160	-2.565	0.010
Forest ⇒ ER Adaptive ⇒ PANAS 3	-0.008	0.022	-0.050	0.035	-0.006	-0.353	0.724
Forest ⇒ ER Maladaptive ⇒ PANAS 3	0.021	0.029	-0.035	0.078	0.018	0.740	0.459
Forest ⇒ PRS ⇒ PANAS 3	-0.219	0.083	-0.381	-0.056	-0.184	-2.635	0.008
Flowery field ⇒ ER Adaptive ⇒ PANAS 3	-0.004	0.011	-0.025	0.018	-0.003	-0.331	0.740
Flowery field ⇒ ER Maladaptive ⇒ PANAS 3	-0.011	0.028	-0.065	0.044	-0.009	-0.384	0.701
Flowery field ⇒ PRS ⇒ PANAS 3	-0.159	0.065	-0.287	-0.032	-0.134	-2.445	0.014
Island ⇒ ER Adaptive ⇒ PANAS 3	-0.001	0.006	-0.013	0.010	-0.001	-0.240	0.810
Island ⇒ ER Maladaptive ⇒ PANAS 3	-0.003	0.027	-0.057	0.050	-0.003	-0.112	0.911
Island ⇒ PRS ⇒ PANAS 3	-0.225	0.085	-0.392	-0.059	-0.190	-2.649	0.008

Table C.20. *Parameter estimates for the direct effects of the Alternative Model 3 (moderated mediation by ER strategies model) tested in Study 6*

				95% CI				
Dependent	**Predictor**	***B***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
PANAS 3	Arctic	-0.017	0.136	-0.283	0.250	-0.013	-0.122	0.903
PANAS 3	Forest	0.033	0.145	-0.251	0.317	0.027	0.228	0.819
PANAS 3	Flowery field	-0.102	0.128	-0.352	0.148	-0.084	-0.799	0.424
PANAS 3	Island	0.037	0.140	-0.238	0.313	0.031	0.266	0.791
PANAS 3	PANAS 2	0.418	0.045	0.331	0.505	0.691	9.387	< .001
PANAS 3	PRS	-0.061	0.017	-0.095	-0.028	-0.332	-3.570	< .001
PANAS 3	ER Adaptive:PRS	-0.000	0.000	-0.000	0.000	-0.010	-0.105	0.916
PANAS 3	ER Maladaptive:PRS	0.000	0.000	-0.000	0.001	0.139	1.609	0.108
PRS	Island	4.562	0.718	3.156	5.969	0.694	6.358	< .001
PRS	Flowery field	3.225	0.718	1.819	4.631	0.491	4.494	< .001
PRS	Forest	4.425	0.718	3.019	5.831	0.673	6.166	< .001
PRS	Arctic	3.943	0.729	2.513	5.372	0.585	5.405	< .001

Table C.21. *Parameter estimates for the indirect effects of the Alternative Model 3 (moderated mediation by ER strategies model) tested in Study 6*

Description	*B*	*SE*	95% CI Lower	95% CI Upper	*β*	*z*	*p*
Arctic ⇒ PRS ⇒ PANAS 3	-0.241	0.081	-0.400	-0.083	-0.195	-2.979	0.003
Forest ⇒ PRS ⇒ PANAS 3	-0.271	0.088	-0.443	-0.099	-0.224	-3.089	0.002
Flowery field ⇒ PRS ⇒ PANAS 3	-0.197	0.071	-0.336	-0.059	-0.163	-2.795	0.005
Island ⇒ PRS ⇒ PANAS 3	-0.279	0.090	-0.455	-0.103	-0.231	-3.113	0.002

Table C.22. *Parameter estimates for the direct effects of the Alternative Model 4 (moderated mediation by PRS model) tested in Study 6*

Dependent	Predictor	*B*	*SE*	95% CI Lower	95% CI Upper	*β*	*z*	*p*
PANAS 3	Arctic	-0.207	0.116	-0.435	0.021	-0.171	-1.776	0.076
PANAS 3	Forest	-0.175	0.117	-0.403	0.054	-0.148	-1.500	0.134
PANAS 3	Flowery field	-0.248	0.114	-0.472	-0.024	-0.210	-2.170	0.030
PANAS 3	Island	-0.181	0.114	-0.404	0.042	-0.153	-1.589	0.112
PANAS 3	PANAS 2	0.408	0.046	0.318	0.498	0.693	8.885	< .001
PANAS 3	ER Adaptive	-0.002	0.002	-0.005	0.002	-0.077	-0.983	0.325
PANAS 3	ER Maladaptive	0.004	0.002	0.001	0.007	0.189	2.451	0.014
ER Adaptive	Island	8.707	20.220	-30.922	48.337	0.159	0.431	0.667
ER Adaptive	Flowery field	-0.218	15.725	-31.039	30.603	-0.004	-0.014	0.989
ER Adaptive	Forest	20.761	23.026	-24.369	65.891	0.379	0.902	0.367
ER Adaptive	Arctic	-2.123	21.154	-43.585	39.339	-0.038	-0.100	0.920
ER Adaptive	Arctic:PRS	0.062	2.783	-5.392	5.516	0.008	0.022	0.982
ER Adaptive	Forest:PRS	-2.040	2.827	-7.580	3.501	-0.287	-0.721	0.471
ER Adaptive	Flowery field:PRS	0.075	2.425	-4.677	4.828	0.010	0.031	0.975
ER Adaptive	Island:PRS	-1.886	2.595	-6.972	3.199	-0.266	-0.727	0.467
ER Maladaptive	Arctic	36.096	23.033	-9.047	81.239	0.591	1.567	0.117
ER Maladaptive	Forest	1.667	25.070	-47.470	50.804	0.028	0.066	0.947
ER Maladaptive	Flowery field	-11.701	17.121	-45.259	21.856	-0.196	-0.683	0.494
ER Maladaptive	Island	-23.434	22.015	-66.582	19.714	-0.393	-1.064	0.287
ER Maladaptive	Arctic:PRS	-4.257	3.030	-10.196	1.681	-0.530	-1.405	0.160
ER Maladaptive	Forest:PRS	1.435	3.078	-4.598	7.468	0.185	0.466	0.641
ER Maladaptive	Flowery field:PRS	1.977	2.640	-3.197	7.152	0.243	0.749	0.454
ER Maladaptive	Island:PRS	3.661	2.825	-1.876	9.198	0.475	1.296	0.195

Table C.23. *Parameter estimates for the indirect effects of the Alternative Model 4 (moderated mediation by PRS model) tested in Study 6*

			95% CI				
Description	***B***	***SE***	***Lower***	***Upper***	***β***	***z***	***p***
Arctic ⇒ ER Adaptive ⇒ PANAS 3	0.003	0.035	-0.065	0.072	0.003	0.100	0.920
Arctic ⇒ ER Maladaptive ⇒ PANAS 3	0.135	0.102	-0.065	0.335	0.112	1.320	0.187
Forest ⇒ ER Adaptive ⇒ PANAS 3	-0.034	0.051	-0.135	0.067	-0.029	-0.665	0.506
Forest ⇒ ER Maladaptive ⇒ PANAS 3	0.006	0.094	-0.177	0.190	0.005	0.066	0.947
Flowery field ⇒ ER Adaptive ⇒ PANAS 3	0.000	0.026	-0.050	0.051	0.000	0.014	0.989
Flowery field ⇒ ER Maladaptive ⇒ PANAS 3	-0.044	0.066	-0.174	0.086	-0.037	-0.658	0.510
Island ⇒ ER Adaptive ⇒ PANAS 3	-0.014	0.036	-0.086	0.057	-0.012	-0.394	0.693
Island ⇒ ER Maladaptive ⇒ PANAS 3	-0.088	0.090	-0.263	0.088	-0.074	-0.976	0.329
Arctic:PRS ⇒ ER Adaptive ⇒ PANAS 3	-0.000	0.005	-0.009	0.009	-0.001	-0.022	0.982
Arctic:PRS ⇒ ER Maladaptive ⇒ PANAS 3	-0.016	0.013	-0.041	0.010	-0.100	-1.219	0.223
Forest:PRS ⇒ ER Adaptive ⇒ PANAS 3	0.003	0.006	-0.008	0.015	0.022	0.582	0.561
Forest:PRS ⇒ ER Maladaptive ⇒ PANAS 3	0.005	0.012	-0.018	0.028	0.035	0.458	0.647
Flowery field:PRS ⇒ ER Adaptive ⇒ PANAS 3	-0.000	0.004	-0.008	0.008	-0.001	-0.031	0.975
Flowery field:PRS ⇒ ER Maladaptive ⇒ PANAS 3	0.007	0.010	-0.013	0.028	0.046	0.716	0.474
Island:PRS ⇒ ER Adaptive ⇒ PANAS 3	0.003	0.005	-0.007	0.014	0.020	0.585	0.559
Island:PRS ⇒ ER Maladaptive ⇒ PANAS 3	0.014	0.012	-0.010	0.037	0.090	1.146	0.252

REFERENCES

Aalto, A.-M., Aro, S., Aro, A. R., & Mähönen, M. (1995). *RAND 36-item health survey 1.0. Suomenkielinen versio terveyteen liittyvän elämänlaadun kyselystä*. Stakes: Aiheita 2/1995, Helsinki, 1995.

Abbott, A. (2012). Stress and the city: Urban decay. *Nature*, *490*(7419).

Aghabozorgi, K., van der Jagt, A., Bell, S., & Smith, H. (2024). How University Blue and Green Space affect Students' Mental Health: A Scoping Review. *Urban Forestry & Urban Greening*, 128394.

Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control*, *19*(6), 716-723.

Albert, C., Hack, J., Schmidt, S., & Schröter, B. (2021). Planning and governing nature-based solutions in river landscapes: Concepts, cases, and insights. *Ambio*, *50*(8), 1405-1413.

Aldao, A. (2013). The future of emotion regulation research: Capturing context. *Perspectives on Psychological Science*, *8*(2), 155-172.

Aldao, A., & Nolen-Hoeksema, S. (2012). The influence of context on the implementation of adaptive emotion regulation strategies. *Behaviour Research and Therapy, 50*(7-8), 493-501.

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, *30*(2), 217-237.

Aldao, A., Sheppes, G., & Gross, J. J. (2015). Emotion regulation flexibility. *Cognitive Therapy and Research*, *39*(3), 263-278.

Aldous, D. E. Conference paper, UK, Richmond, Building a sustainable future: the role of botanic gardens. Proceedings of the 3rd Global Botanic Gardens Congress, Wuhan, China, 16-20 April, 2007, (1–5), *Botanic Gardens Conservation International*, Social, environmental, economic and health benefits of botanic gardens. (2007)

Aletta, F., Guattari, C., Evangelisti, L., Asdrubali, F., Oberman, T., & Kang, J. (2019). Exploring the compatibility of "Method A" and "Method B" data collection protocols reported in the ISO/TS 12913-2: 2018 for urban soundscape via a soundwalk. *Applied Acoustics*, *155*, 190-203.

Alves, S., Gulwadi, G. B., & Nilsson, P. (2021). An Exploration of How Biophilic Attributes on Campuses Might Support Student Connectedness to Nature, Others, and Self. *Frontiers in Psychology*, *12*.

Amicone, G., Collado, S., Perucchini, P., Petruccelli, I., Ariccio, S., & Bonaiuto, M. (2024). Green versus grey break: children's place experience of recess-time in primary schools' natural and built area. *Children's Geographies*, *22*(1), 15-29.

Amicone, G., Petruccelli, I., De Dominicis, S., Gherardini, A., Costantino, V., Perucchini, P., & Bonaiuto, M. (2018). Green breaks: The restorative effect of the school environment's green areas on children's cognitive performance. *Frontiers in Psychology*, *9*, 1579.

Amireault, S., Godin, G., Lacombe, J., & Sabiston, C. M. (2015). Validation of the Godin-Shephard Leisure-Time Physical Activity Questionnaire classification coding system using accelerometer assessment among breast cancer survivors. *Journal of Cancer Survivorship*, *9*, 532-540.

Anderson, A. P., Mayer, M. D., Fellows, A. M., Cowan, D. R., Hegel, M. T., & Buckey, J. C. (2017). Relaxation with immersive natural scenes presented using virtual reality. *Aerospace Medicine and Human Performance*, 88(6), 520-526.

Annerstedt, M., Jönsson, P., Wallergård, M., Johansson, G., Karlson, B., Grahn, P., Hansen, A. M., & Währborg, P. (2013). Inducing physiological stress recovery with sounds of nature in a virtual reality forest--results from a pilot study. *Physiology & Behavior*, 118, 240–250.

Arrindell, W.A. & Ettema, J.H.M. (2003) *Symptom Checklist SCL-90. Handleiding Bij Een Multidimensionele Psychopathologie-Indicator*. Lisse: Swets Test Publishers.

Assoverde[a]. (2023, February 13). *Parchi della Salute: criteri per la certificazione*. Assoverde. https://www.assoverde.it/22-febbraio-2023-convegno-e-webinar-milano-myplantgarden-parchi-della-salute-criteri-per-la-certificazione/.

Assoverde[b]. (2023, September 5). *Il progetto Waterfront di Pavia. Un'occasione di rigenerazione urbana, sostenibile e sociale*. Assoverde. https://www.assoverde.it/il-progetto-waterfront-unoccasione-di-rigenerazione-urbana-sostenibile-e-sociale/

Astell-Burt, T., & Feng, X. (2021). Time for 'green'during COVID-19? Inequities in green and blue space access, visitation and felt benefits. *International Journal of Environmental Research and Public Health*, 18(5), 2757.

Astell-Burt, T., Feng, X., & Kolt, G. S. (2013). Mental health benefits of neighbourhood green space are stronger among physically active adults in middle-to-older age: evidence from 260,061 Australians. *Preventive Medicine, 57*(5), 601-606.

Astell-Burt, T., Kondo, M., Pritchard, T., Olcon, K., Hipp, J. A., Adlakha, D., Pappas, E., & Feng, X. (2024). Contact with nature, nature prescriptions, and loneliness: Evidence from an international survey of adults in Australia, India, Singapore, the United Kingdom, and the United States. *Health & Place*, *90*, 103331.

Astell-Burt, T., Mitchell, R., & Hartig, T. (2014). The association between green space and mental health varies across the lifecourse. A longitudinal study. *J Epidemiol Community Health*, 68(6), 578-583.

Averill, J. R. (1983). Studies on anger and aggression: Implications for theories of emotion. *American Psychologist, 38*(11), 1145–1160.

Ayala-Azcárraga, C., Diaz, D., & Zambrano, L. (2019). Characteristics of urban parks and their relation to user well-being. *Landscape and Urban Planning*, *189*, 27-35.

Bakir-Demir, T., Berument, S. K., & Akkaya, S. (2021). Nature connectedness boosts the bright side of emotion regulation, which in turn reduces stress. *Journal of Environmental Psychology*, *76*, 101642.

Bakir-Demir, T., Berument, S. K., & Sahin-Acar, B. (2019). The relationship between greenery and self-regulation of children: The mediation role of nature connectedness. *Journal of Environmental Psychology*, *65*, 101327.

Balzarotti, S. (2021). The emotion regulation questionnaire: Factor structure and measurement invariance in an Italian sample of community dwelling adults. *Current Psychology*, *40*(10), 4918-4929.

Bandalos, D. L., & Finney, S. J. (2010). Factor analysis: Exploratory and confirmatory. In G. R. Hancock & R. O. Mueller (Eds.), *The reviewer's guide to quantitative methods in the social sciences* (pp. 93-114). New York, NY: Routledge.

Barnes, M. R., Donahue, M. L., Keeler, B. L., Shorb, C. M., Mohtadi, T. Z., & Shelby, L. J. (2019). Characterizing nature and participant experience in studies of nature exposure for positive mental health: An integrative review. *Frontiers in Psychology, 9*, 2617.

Barrable, A., Booth, D., Adams, D., & Beauchamp, G. (2021). Enhancing Nature Connection and Positive Affect in Children through Mindful Engagement with Natural Environments. *International Journal of Environmental Research and Public Health, 18*(9), 4785.

Barragan-Jason, G., Loreau, M., de Mazancourt, C., Singer, M. C., & Parmesan, C. (2023). Psychological and physical connections with nature improve both human well-being and nature conservation: A systematic review of meta-analyses. *Biological Conservation*, *277*, 109842.

Barrera-Hernández, L. F., Sotelo-Castillo, M. A., Echeverría-Castro, S. B., & Tapia-Fonllem, C. O. (2020). Connectedness to nature: Its impact on sustainable behaviors and happiness in children. *Frontiers in Psychology*, *11*, 276.

Barrett, L. F. (2006). Are emotions natural kinds?. *Perspectives on Psychological Science*, *1*(1), 28-58.

Barrett, L. F. (2017). The theory of constructed emotion: an active inference account of interoception and categorization. *Social Cognitive and Affective Neuroscience*, *12*(1), 1-23.

Bartlett, M. S. (1950). Periodogram analysis and continuous spectra. *Biometrika*, *37*(1/2), 1-16.

Bauer, T. (2011). *Tourism in the Antarctic: Opportunities, Constraints, and Future Prospects*. Routledge, New York and London.

Baumann, N., Kaschel, R., & Kuhl, J. (2005). Striving for unwanted goals: stress-dependent discrepancies between explicit and implicit achievement motives reduce subjective well-being and increase psychosomatic symptoms. *Journal of Personality and Social Psychology*, *89*(5), 781.

Baumeister, R. F. (2013). Writing a literature review. The Portable Mentor: Expert Guide to a Successful Career, in *Psychology*, 119-132.

Baumeister, R. F., & Leary, M. R. (1997). Writing narrative literature reviews. *Review of General Psychology*, 1(3), 311-320.

Baxter, D. E., & Pelletier, L. G. (2019). Is nature relatedness a basic human psychological need? A critical examination of the extant literature. *Canadian Psychology/Psychologie Canadienne*, *60*(1), 21.

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, *25*(24), 3186-3191.

Beck, A.T., Steer, R.A., & Brown, G.K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Corporation.

Belaire, J. A., Westphal, L. M., Whelan, C. J., & Minor, E. S. (2015). Urban residents' perceptions of birds in the neighborhood: Biodiversity, cultural ecosystem services, and disservices. *The Condor: Ornithological Applications*, *117*(2), 192-202.

Bell, S., Fleming, L. E., Grellier, J., Kuhlmann, F., Nieuwenhuijsen, M. J., & White, M. P. (Eds.). (2021). *Urban blue spaces: Planning and design for water, health and well-being*. Routledge.

Bennett, L. W., Cardone, S., & Jarczyk, J. (1998). Effects of a therapeutic camping program on addiction recovery: The Algonquin Haymarket relapse prevention program. *Journal of Substance Abuse Treatment*, *15*(5), 469-474.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*(3), 588.

Bentler, P. M., & Mooijaart, A. B. (1989). Choice of structural model via parsimony: a rationale based on precision. *Psychological Bulletin*, *106*(2), 315.

Bergeman, C. S., Blaxton, J., & Joiner, R. (2021). Dynamic Systems, Contextual Influences, and Multiple Timescales: Emotion Regulation as a Resilience Resource. *The Gerontologist, 61*(3), 304-311.

Berman, M. G., Cardenas-Iniguez, C., & Meidenbauer, K. L. (2021). An Environmental Neuroscience Perspective on the Benefits of Nature. *Nature and Psychology*, 61-88.

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, 19(12), 1207-1212.

Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., Kaplan, S., Sherdell, L., Gotlib, I. H., & Jonides, J. (2012). Interacting with nature improves cognition and affect for individuals with depression. *Journal of Affective Disorders*, *140*(3), 300–305.

Berry, M. S., Repke, M. A., Nickerson, N. P., Conway III, L. G., Odum, A. L., & Jordan, K. E. (2015). Making time for nature: Visual exposure to natural environments lengthens subjective time perception and reduces impulsivity. *PLoS One*, 10(11), e0141030.

Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology*, *25*(3), 249-259.

Berto, R. (2014). The role of nature in coping with psycho-physiological stress: a literature review on restorativeness. *Behavioral Sciences*, *4*(4), 394-409.

Beute, F., & de Kort, Y. A. (2014). Salutogenic effects of the environment: Review of health protective effects of nature and daylight. *Applied Psychology: Health and Well-being*, *6*(1), 67-95.

Beute, F., & de Kort, Y. A. (2018). Stopping the train of thought: A pilot study using an ecological momentary intervention with twice-daily exposure to natural versus urban scenes to lower stress and rumination. *Applied Psychology: Health and Well-Being*, *10*(2), 236-253.

Beute, F., & De Kort, Y. A. W. (2014). Natural resistance: Exposure to nature and self-regulation, mood, and physiology after ego-depletion. *Journal of Environmental Psychology*, *40*, 167-178.

Beute, F., De Kort, Y., & IJsselsteijn, W. (2016). Restoration in its natural context: How ecological momentary assessment can advance restoration research. *International Journal of Environmental Research and Public Health*, *13*(4), 420.

Bikos, L. H. (2022). "Chapter 12 invariance testing," in *ReCentering Psych Stats: Psychometrics*.

Birch, J., Rishbeth, C., & Payne, S. R. (2020). Nature doesn't judge you–how urban nature supports young people's mental health and wellbeing in a diverse UK city. *Health & Place, 62*, 102296.

Bjelland, I., Dahl, A. A., Haug, T. T., & Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale: an updated literature review. *Journal of Psychosomatic Research*, *52*(2), 69-77.

Bjureberg, J., Ljótsson, B., Tull, M. T., Hedman, E., Sahlin, H., Lundh, L. G., Bjärehed, J., DiLillo, D., Messman-Moore, T., Gumpert, C. H., & Gratz, K. L. (2016). Development and Validation of a Brief Version of the Difficulties in Emotion Regulation Scale: The DERS-16. *Journal of Psychopathology and Behavioral Assessment*, *38*(2), 284–296.

Blalock, D. V., Kashdan, T. B., & Farmer, A. S. (2016). Trait and daily emotion regulation in social anxiety disorder. *Cognitive Therapy and Research*, *40*, 416-425.

Blanchard-Fields, F., Mienaltowski, A., & Seay, R. B. (2007). Age differences in everyday problem-solving effectiveness: Older adults select more effective strategies for interpersonal problems. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *62*(1), 61-64.

Blanchard-Fields, F., Stein, R., & Watson, T. L. (2004). Age differences in emotion-regulation strategies in handling everyday problems. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *59*(6), 261-269.

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: a primer. *Frontiers in Public Health*, *6*, 149.

Bodin, M., & Hartig, T. (2003). Does the outdoor environment matter for psychological restoration gained through running?. *Psychology of Sport and Exercise*, *4*(2), 141-153.

Boemo, T., Nieto, I., Vazquez, C., & Sanchez-Lopez, A. (2022). Relations between emotion regulation strategies and affect in daily life: A systematic review and meta-analysis of studies using ecological momentary assessments. *Neuroscience & Biobehavioral Reviews*, 104747.

Bollen, K. A. (1989). A new incremental fit index for general structural equation models. *Sociological Methods & Research*, *17*(3), 303-316.

Bolouki, A. (2024). The impact of virtual reality natural and built environments on affective responses: A systematic review and meta-analysis. *International Journal of Environmental Health Research*, *34*(1), 73-89.

Bonaiuto, M., Albers, T. (2022). Water Based Solutions and health in urban areas: a threefold pathway according to environmental psychology. In G. Wiedman, T. Freitas, C. Herzog (Eds.), *Nature-based Solutions and the water challenge* (EN) / *Soluções baseadas na natureza e os desafios da água : acelerando a transição para cidades mais sustentáveis* (PT, pp. 179-191). Bruxelles/Luxembourg: European Commission, Directorate-General for Research and Innovation.

Bonaiuto, M., Alves, S. (2024). Nature-Based Solutions contribute to quality of life: Protecting, restoring, and building human capacities. In R.W. Marans, R.J. Stimson & N.J. Webster (Eds.), *Handbook of Quality of Life Research: Place and Space Perspectives* (pp. 45-59). Cheltenham, UK: Edward Elgar Publishing.

Bonanno, G. A. (2004). Loss, trauma, and human resilience: have we underestimated the human capacity to thrive after extremely aversive events?. *American Psychologist*, *59*(1), 20.

Bonanno, G. A., & Burton, C. L. (2013). Regulatory flexibility: An individual differences perspective on coping and emotion regulation. *Perspectives on Psychological Science*, *8*(6), 591-612.

Booij, S. H., Bos, E. H., de Jonge, P., & Oldehinkel, A. J. (2016). The temporal dynamics of cortisol and affective states in depressed and non-depressed individuals. *Psychoneuroendocrinology, 69*, 16-25.

Borkovec, T. D., Alcaine, O., & Behar, E. (2004). *Avoidance Theory of Worry and Generalized Anxiety Disorder*. In R. G. Heimberg, C. L. Turk, & D. S. Mennin (Eds.), *Generalized Anxiety Disorder: Advances in Research and Practice* (pp. 77-108). New York: Guilford Press.

Bos, E. H., Van der Meulen, L., Wichers, M., & Jeronimus, B. F. (2016). A primrose path? Moderating effects of age and gender in the association between green space and mental health. *International Journal of Environmental Research and Public Health*, *13*(5), 492.

Bower, G. H. (1981). Mood and memory. *American psychologist*, *36*(2), 129.

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25, 49–59.

Bragg, R., & Atkins, G. (2016). A review of nature-based interventions for mental health care. *Natural England Commissioned Reports*, *204*, 18.

Brans, K., Koval, P., Verduyn, P., Lim, Y. L., & Kuppens, P. (2013). The regulation of negative and positive affect in daily life. *Emotion*, *13*(5), 926.

Bratman, G. N. (2016). *Psychological Ecosystem Services: the Impacts of Nature Experience on Affect, Emotion Regulation, and Cognitive Function*. Stanford University.

Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., de Vries, S., Flanders, J., Folke, C., Frumkin, H., Gross, J. J., Hartig, T., Kahn, P. H., Jr, Kuo, M., Lawler, J. J., Levin, P. S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., Scarlett, L., … Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. *Science Advances*, *5*(7), eaax0903.

Bratman, G. N., Daily, G. C., Levy, B. J., & Gross, J. J. (2015). The benefits of nature experience: Improved affect and cognition. *Landscape and Urban Planning*, *138*, 41-50.

Bratman, G. N., Hamilton, J. P., & Daily, G. C. (2012). The impacts of nature experience on human cognitive function and mental health. *Annals of the New York academy of sciences*, *1249*(1), 118-136.

Bratman, G. N., Hamilton, J. P., Hahn, K. S., Daily, G. C., & Gross, J. J. (2015). Nature experience reduces rumination and subgenual prefrontal cortex activation. *Proceedings of the National Academy of Sciences*, *112*(28), 8567-8572.

Bratman, G. N., Olvera-Alvarez, H. A., & Gross, J. J. (2021). The affective benefits of nature exposure. *Social and Personality Psychology Compass,* e12630.

Bratman, G. N., Young, G., Mehta, A., Lee Babineaux, I., Daily, G. C., & Gross, J. J. (2021). Affective Benefits of Nature Contact: The Role of Rumination. *Frontiers in Psychology*, *12*, 584.

Braunstein, L. M., Gross, J. J., & Ochsner, K. N. (2017). Explicit and implicit emotion regulation: a multi-level framework. *Social Cognitive and Affective Neuroscience*, *12*(10), 1545-1557.

Bray, I., Reece, R., Sinnett, D., Martin, F., & Hayward, R. (2022). Exploring the role of exposure to green and blue spaces in preventing anxiety and depression among young people aged 14–24 years living in urban settings: A systematic review and conceptual framework. *Environmental Research*, 114081.

Briggs, J. C. (1996). The promise of virtual reality. *The futurist*, 30(5), 13.

Bringslimark, T., Hartig, T., & Patil, G. G. (2007). Psychological benefits of indoor plants in workplaces: Putting experimental results into context. *HortScience*, *42*(3), 581-587.

Brockman, R., Ciarrochi, J., Parker, P., & Kashdan, T. (2017). Emotion regulation strategies in daily life: Mindfulness, cognitive reappraisal and emotion suppression. *Cognitive Behaviour Therapy*, *46*(2), 91-113.

Brooke, K., & Williams, A. (2021). Iceland as a therapeutic landscape: White wilderness spaces for well-being. *GeoJournal*, *86*(3), 1275-1285.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822–848.

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York: Guilford Press.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research*, *21*(2), 230-258.

Browning, M. H. E. M., Hanley, J. R., Bailey, C. R., Beatley, T., Gailey, S., Hipp, J. A., Larson, L. R., James, P., Jennings, V., Jimenez, M. P., Kahn, P. H., Jr, Li, D., Reuben, A., Rigolon, A., Sachs, N. A., Pearson, A. L., & Minson, C. T. (2024). Quantifying Nature: Introducing NatureScore™ and NatureDose™ as Health Analysis and Promotion Tools. *American Journal of Health Promotion: AJHP*, *38*(1), 126–134.

Browning, M. H. E. M., Shin, S., Drong, G., McAnirlin, O., Gagnon, R. J., Ranganathan, S., Sindelar, K., Hoptman, D., Bratman, G. N., Yuan, S., Prabhu, V. G., & Heller, W. (2023). Daily exposure to virtual nature reduces symptoms of anxiety in college students. *Scientific Reports*, *13*(1), 1239.

Browning, M. H., & Rigolon, A. (2019). School green space and its impact on academic performance: A systematic literature review. *International Journal of Environmental Research and Public Health*, *16*(3), 429.

Browning, M. H., Mimnaugh, K. J., Van Riper, C. J., Laurent, H. K., & LaValle, S. M. (2020). Can simulated nature support mental health? Comparing short, single-doses of 360-degree nature videos in virtual reality with the outdoors. *Frontiers in Psychology*, 10, 2667.

Brummer, L., Stopa, L., & Bucks, R. (2014). The influence of age on emotion regulation strategies and psychological distress. *Behavioural and Cognitive Psychotherapy*, *42*(6), 668-681.

Brymer, E., & Davids, K. (2014). Experiential learning as a constraint-led process: An ecological dynamics perspective. *Journal of Adventure Education & Outdoor Learning*, 14(2), 103-117.

Butler, E. A., Egloff, B., Wlhelm, F. H., Smith, N. C., Erickson, E. A., & Gross, J. J. (2003). The social consequences of expressive suppression. *Emotion*, *3*(1), 48.

Butler, E. A., Lee, T. L., & Gross, J. J. (2007). Emotion regulation and culture: Are the social consequences of emotion suppression culture-specific?. *Emotion*, *7*(1), 30.

Buttazzoni, A., Doherty, S., & Minaker, L. (2022). How do urban environments affect young people's mental health? A novel conceptual framework to bridge public health, planning, and neurourbanism. *Public Health Reports*, *137*(1), 48-61.

Büyüköztürk, Ş. (2002). Factor analysis: Basic concepts and using to development scale. *Educational Management*, *8*(4), 470-483.

Caccetta, P., Collings, S., Devereux, A., Hingee, K., Mcfarlane, D., Traylen, A., Wu, X., & Zhou, Z. (2012). *Urban Monitor: Enabling Effective Monitoring and Management of Urban and Coastal Environments Using Digital Aerial Photography*. Final Report–Transformation of Aerial Photography into Digital Raster Information Products.

Cackowski, J. M., & Nasar, J. L. (2003). The restorative effects of roadside vegetation: Implications for automobile driver anger and frustration. *Environment and Behavior*, *35*(6), 736-751.

Cameron R. W. F., Brindley, P., Mears, M., McEwan, K., Ferguson, F., Sheffield, D., Jorgensen, A., Riley, J., Goodrick, J., Ballard, L., & Richardson, M. (2020). Where the wild things are! Do urban green spaces with greater avian biodiversity promote more positive emotions in humans?. *Urban Ecosystems*, 23(2), 301-317.

Campbell-Sills, L., Barlow, D. H., Brown, T. A., & Hofmann, S. G. (2006). Effects of suppression and acceptance on emotional responses of individuals with anxiety and mood disorders. *Behaviour Research and Therapy*, *44*(9), 1251-1263.

Campos, J. J., Campos, R. G., & Barrett, K. C. (1989). Emergent themes in the study of emotional development and emotion regulation. *Developmental Psychology*, *25*(3), 394.

Campos, J. J., Frankel, C. B., & Camras, L. (2004). On the nature of emotion regulation. *Child Development*, *75*(2), 377-394.

Cannon, W. B. (1927). The James-Lange theory of emotions: A critical examination and an alternative theory. *The American Journal of Psychology*, *39*(1/4), 106-124.

Capaldi, C. A., Passmore, H. A., Nisbet, E. K., Zelenski, J. M., & Dopko, R. L. (2015). Flourishing in nature: A review of the benefits of connecting with nature and its application as a wellbeing intervention. *International Journal of Wellbeing*, *5*(4).

Cardaciotto, L., Herbert, J. D., Forman, E. M., Moitra, E., & Farrow, V. (2008). The assessment of present-moment awareness and acceptance: The Philadelphia Mindfulness Scale. *Assessment*, *15*(2), 204-223.

Carrus, G., Scopelliti, M., Lafortezza, R., Colangelo, G., Ferrini, F., Salbitano, F., Agrimi, M., Portoghesi, L., Semenzato, P., Sanesi, G. (2015). Go greener, feel better? The positive effects of biodiversity on the well-being of individuals visiting urban and peri-urban green areas. *Landscape and Urban Planning*, *134*, 221-228.

Cerny, B. A., & Kaiser, H. F. (1977). A study of a measure of sampling adequacy for factor-analytic correlation matrices. *Multivariate Behavioral Research*, *12*(1), 43-47.

Chan, S. H. M., Qiu, L., Esposito, G., Mai, K. P., Tam, K. P., & Cui, J. (2023). Nature in virtual reality improves mood and reduces stress: evidence from young adults and senior citizens. *Virtual Reality*, 27(4), 3285-3300.

Chang, C. Y., & Chen, P. K. (2005). Human response to window views and indoor plants in the workplace. *HortScience*, *40*(5), 1354-1359.

Chen, C. & Nakagawa, S. (2019). *Nature's Pathways on Human Health, in International Handbook of Forest Therapy*, eds. D. Kotte, Q. Li, W. S. Shin, A. Michalsen. Newcastle, UK: Cambridge Scholars Publishing.

Chen, F. F., & West, S. G. (2008). Measuring individualism and collectivism: The importance of considering differential components, reference groups, and measurement invariance. *Journal of Research in Personality*, *42*(2), 259-294.

Cheng, J. C. H., & Monroe, M. C. (2012). Connection to nature: Children's affective attitude toward nature. *Environment and Behavior*, *44*(1), 31-49.

Chhajer, R., & Hira, N. (2024). Exploring positive psychology intervention and mindfulness-based intervention in nature: impact on well-being of school students in India. *Frontiers in Public Health, 12*.

Christou-Champi, S., Farrow, T. F., & Webb, T. L. (2015). Automatic control of negative emotions: Evidence that structured practice increases the efficiency of emotion regulation. *Cognition and Emotion*, *29*(2), 319-331.

Cimprich, B., Visovatti, M., & Ronis, D. L. (2011). The Attentional Function Index—a self-report cognitive measure. *Psycho-Oncology*, *20*(2), 194-202.

Clayton, S. (2007). Domesticated nature: Motivations for gardening and perceptions of environmental impact. *Journal of Environmental Psychology*, *27*(3), 215-224.

Cohen, H., Philpott, S. M., Liere, H., Lin, B. B., & Jha, S. (2021). The relationship between pollinator community and pollination services is mediated by floral abundance in urban landscapes. *Urban Ecosystems, 24*, 275-290.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2 ed.). Mahwah, NJ: Lawrence Erlbaum.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 385-396.

Coley, R. L., Sullivan, W. C., & Kuo, F. E. (1997). Where does community grow? The social context created by nature in urban public housing. *Environment and Behavior*, *29*(4), 468-494.

Colombo, D., Fernández-Álvarez, J., Suso-Ribera, C., Cipresso, P., García-Palacios, A., Riva, G., & Botella, C. (2020). Biased affective forecasting: A potential mechanism that enhances resilience and well-being. *Frontiers in Psychology, 11*, 1333.

Comrey, A. L., & Lee, H. B. (1992). *A First Course in Factor Analysis*. Hillsdale, NJ: Lawrence Eribaum Associates.

Comrey, A. L., & Lee, H. B. (2013). *A first course in factor analysis*. Psychology Press.

Comrey, A. L., Backer, T. E., & Glaser, E. M. (1973). *A sourcebook for mental health measures.* Human Interaction Research Inst.

Costa, P. T., & McCrae, R. R. (1980). Influence of extraversion and neuroticism on subjective well-being: happy and unhappy people. *Journal of Personality and Social Psychology*, *38*(4), 668.

Costa-e-Silva, J. A. C., & Steffen, R. E. (2019). Urban environment and psychiatric disorders: a review of the neuroscience and biology. *Metabolism*, *100*, 153940.

Cracknell, A. P. (2017). UAVs: regulations and law enforcement. *International Journal of Remote Sensing*, *38*(8-10), 3054-3067.

Cracknell, D., White, M. P., Pahl, S., & Depledge, M. H. (2017). A preliminary investigation into the restorative potential of public aquaria exhibits: a UK student-based study. *Landscape Research*, *42*(1), 18-32.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297-334.

Cruchinho, P., López-Franco, M. D., Capelas, M. L., Almeida, S., Bennett, P. M., Miranda da Silva, M., Teixeira, G., Nunes, E., Lucas, P., Gaspar, F., & Handovers4SafeCare (2024). Translation, Cross-Cultural Adaptation, and Validation of Measurement Instruments: A Practical Guideline for Novice Researchers. *Journal of Multidisciplinary Healthcare*, 2701-2728.

Dadvand, P., Nieuwenhuijsen, M. J., Esnaola, M., Forns, J., Basagaña, X., Alvarez-Pedrerol, M., Rivas, I., López-Vicente, M., De Castro Pascual, M., Su, J., Jerrett, M., Querol, X., & Sunyer, J. (2015). Green spaces and cognitive development in primary schoolchildren. *Proceedings of the National Academy of Sciences of the United States of America*, *112*(26), 7937–7942.

Dadvand, P., Tischer, C., Estarlich, M., Llop, S., Dalmau-Bueno, A., López-Vicente, M., Valentín, A., de Keijzer, C., Fernández-Somoano, A., Lertxundi, N., Rodriguez-Dehli, C., Gascon, M., Guxens, M., Zugna, D., Basagaña, X., Nieuwenhuijsen, M. J., Ibarluzea, J., Ballester, F., & Sunyer, J. (2017). Lifelong Residential Exposure to Green Space and Attention: A Population-based Prospective Study. *Environmental Health Perspectives*, *125*(9), 097016.

Darwin, C. (1872). *The descent of man, and selection in relation to sex* (Vol. 2). D. Appleton.

Davidov, E., Meuleman, B., Cieciuch, J., Schmidt, P., & Billiet, J. (2014). Measurement equivalence in cross-national research. *Annual Review of Sociology*, *40*(1), 55-75.

Davies, K., & Cohen, M. J. (1995). *Reconnecting with Nature: Educational Self-Esteem Sensory Activities for Reducing Drug Use and Irresponsible Relationships in Students at Risk*. In M. J. Cohen, Reconnecting with Nature: A restoration of the missing link in Western thinking, Chapter 11. Friday Harbor, WA: University of Global Education.

de Almeida, T. (2020). Regulation of Affective States: benefits of contact with the Nature. *International Journal of Advanced Engineering Research and Science*, *7*(2), 309-313.

Deng, L., Luo, H., Ma, J., Huang, Z., Sun, L. X., Jiang, M. Y., Zhu, C., & Li, X. (2020). Effects of integration between visual stimuli and auditory stimuli on restorative potential and aesthetic preference in urban green spaces. *Urban Forestry & Urban Greening*, *53*, 126702.

DeSalvo, K. B., Fisher, W. P., Tran, K., Bloser, N., Merrill, W., & Peabody, J. (2006). Assessing measurement properties of two single-item general health measures. *Quality of Life Research*, *15*, 191-201.

Dettweiler, U., Gerchen, M., Mall, C., Simon, P., & Kirsch, P. (2023). Choice matters: Pupils' stress regulation, brain development and brain function in an outdoor education project. *British Journal of Educational Psychology*, *93*, 152-173.

DeVellis, R. F. (2012). *Scale Development: Theory and Applications*. Thousand Oaks, CA Sage.

Dewey, J. (1958). *Experience and Nature*. (Vol. 471). Courier Corporation.

Diener, E. D., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, *49*(1), 71-75.

Diener, E., Wirtz, D., Tov, W., Kim-Prieto, C., Choi, D.-w., Oishi, S., & Biswas-Diener, R. (2010). New well-being measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research*, 97 (2), 143-156.

Diessner, R., Solom, R. D., Frost, N. K., Parsons, L., & Davidson, J. (2008). Engagement with beauty: Appreciating natural, artistic, and moral beauty. *The Journal of Psychology*, *142*(3), 303-332.

Dimitrov-Discher, A., Wenzel, J., Kabisch, N., Hemmerling, J., Bunz, M., Schöndorf, J., Walter, H., Veer, I. M., & Adli, M. (2022). Residential green space and air pollution are associated with brain activation in a social-stress paradigm. *Scientific Reports*, *12*(1), 1-11.

Dixon-Gordon, K. L., Aldao, A., & De Los Reyes, A. (2015). Emotion regulation in context: Examining the spontaneous use of strategies across emotional intensity and type of emotion. *Personality and Individual Differences*, *86*, 271-276.

Djernis, D., Lerstrup, I., Poulsen, D., Stigsdotter, U., Dahlgaard, J., & O'Toole, M. (2019). A systematic review and meta-analysis of nature-based mindfulness: Effects of moving mindfulness training into an outdoor natural setting. *International Journal of Environmental Research and Public Health, 16*(17), 3202.

Duffy, R. D., & Dik, B. J. (2013). Research on calling: What have we learned and where are we going?. *Journal of Vocational Behavior*, *83*(3), 428-436.

Duijndam, S., Karreman, A., Denollet, J., & Kupper, N. (2021). Situation selection and modification in social inhibition: a person-centered approach. *Anxiety, Stress, & Coping*, *34*(6), 658-671.

Dzhambov, A. M., Browning, M. H., Markevych, I., Hartig, T., & Lercher, P. (2020). Analytical approaches to testing pathways linking greenspace to health: A scoping review of the empirical literature. *Environmental Research*, *186*, 109613.

Dzhambov, A. M., Hartig, T., Tilov, B., Atanasova, V., Makakova, D. R., & Dimitrova, D. D. (2019). Residential greenspace is associated with mental health via intertwined capacity-building and capacity-restoring pathways. *Environmental Research*, *178*, 108708.

Edwards, S. L., Rapee, R. M., & Franklin, J. (2003). Postevent rumination and recall bias for a social performance event in high and low socially anxious individuals. *Cognitive Therapy and Research*, *27*, 603-617.

Ehring, T., Zetsche, U., Weidacker, K., Wahl, K., Schönfeld, S., & Ehlers, A. (2011). The Perseverative Thinking Questionnaire (PTQ): Validation of a content-independent measure of repetitive negative thinking. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*(2), 225-232.

Ekman, P. (1993). Facial expression and emotion. *American Psychologist, 48*(4), 384.

Ekman, P. (1999). *Facial expressions*. In Dalgleish, T., & Power, M. (Eds.). *Handbook of Cognition and Emotion* (pp. 301-320). New York: John Wiley & Sons Ltd.

Ekman, P., & Oster, H. (1979) Facial Expressions of Emotion. *Annual Review of Psychology, 30*, 527-554.

Ekman, P., Friesen, W. V., & Ellsworth, P. (2013). *Emotion in the human face: Guidelines for research and an integration of findings* (Vol. 11). Elsevier.

Elliott, L. R., White, M. P., Grellier, J., Rees, S. E., Waters, R. D., & Fleming, L. E. (2018). Recreational visits to marine and coastal environments in England: Where, what, who, why, and when?. *Marine Policy*, *97*, 305-314.

Emami, E., Amini, R., & Motalebi, G. (2018). The effect of nature as positive distractibility on the Healing Process of Patients with cancer in therapeutic settings. *Complementary Therapies in Clinical Practice*, *32*, 70-73.

Emamjomeh, A., Zhu, Y., & Beck, M. (2020). The potential of applying immersive virtual environment to biophilic building design: A pilot study. *Journal of Building Engineering*, *32*, 101481.

Engemann, K., Svenning, J. C., Arge, L., Brandt, J., Erikstrup, C., Geels, C., Hertel, O., Mortensen, P. B., Plana-Ripoll, O., Tsirogiannis, C., Sabel, C. E., Sigsgaard, T., & Pedersen, C. B. (2020). Associations between growing up in natural environments and subsequent psychiatric disorders in Denmark. *Environmental Research*, *188*, 109788.

England, N. (2019). *Monitor of Engagement with the Natural Environment Children's Report* (MENE) 2018-2019.

Engvik, H., & Føllesdal, H. (2005). The Big Five Inventory in Norwegian. *Journal of the Norwegian Psychological Association*, *42*, 129-130.

Ensinger, K. (2016). Achtsamkeit, Naturerleben und die Erfahrung von Erholung. *Umweltpsychologie*, *20*(2), 95-111.

Evans, D. E., & Rothbart, M. K. (2007). Developing a model for adult temperament. *Journal of Research in Personality*, *41*(4), 868-888.

Fan, J., McCandliss, B. D., Fossella, J., Flombaum, J. I., & Posner, M. I. (2005). The activation of attentional networks. *Neuroimage*, *26*(2), 471-479.

Felsten, G. (2009). Where to take a study break on the college campus: An attention restoration theory perspective. *Journal of Environmental Psychology*, *29*(1), 160-167.

Fido, D., Rees, A., Wallace, L., & Mantzorou, L. (2020). Psychopathy moderates the relationship between nature connectedness and cognitive reappraisal. *Ecopsychology*, *12*(4), 301-308.

Finlay, J. M. (2018). 'Walk like a penguin': older Minnesotans' experiences of (non) therapeutic white space. *Social Science & Medicine*, 198, 77-84.

Fisher, J. C., Irvine, K. N., Bicknell, J. E., Hayes, W. M., Fernandes, D., Mistry, J., & Davies, Z. G. (2021). Perceived biodiversity, sound, naturalness and safety enhance the restorative quality and wellbeing benefits of green and blue space in a neotropical city. *Science of the Total Environment*, *755*, 143095.

Fjeld, T., Veiersted, B., Sandvik, L., Riise, G., & Levy, F. (1998). The effect of indoor foliage plants on health and discomfort symptoms among office workers. *Indoor and Built Environment*, *7*(4), 204-209.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, *48*(1), 150.

Fowler, F. J. (1995). *Improving survey questions: Design and evaluation*. Thousand Oaks, CA: Sage.

Franz, G. (2005). *An empirical approach to the experience of architectural space* (Doctoral dissertation, Bauhaus-Universität Weimar, Germany).

Frijda, N. H. (1986). *The emotions.* Cambridge University Press; Editions de la Maison des Sciences de l'Homme.

Frijda, N. H., & Mesquita, B. (1994). The social roles and functions of emotions. In S. Kitayama & H. R. Markus (Eds.), *Emotion and culture: Empirical studies of mutual influence* (pp. 51–87). American Psychological Association.

Frijda, N. H., Kuipers, P., & Ter Schure, E. (1989). Relations among emotion, appraisal, and emotional action readiness. *Journal of Personality and Social Psychology*, *57*(2), 212.

Fuller, R. J., Smith, K. W., Grice, P. V., Currie, F. A., & Quine, C. P. (2007). Habitat change and woodland birds in Britain: implications for management and future research. *Ibis*, *149*, 261-268.

Furman, E., Jasinevicius, T. R., Bissada, N. F., Victoroff, K. Z., Skillicorn, R., & Buchner, M. (2009). Virtual reality distraction for pain control during periodontal scaling and root planing procedures. *The Journal of the American Dental Association*, 140(12), 1508-1516.

Gable, P. A., & Harmon-Jones, E. (2011). Attentional consequences of pregoal and postgoal positive affects. *Emotion*, *11*(6), 1358.

Gaffikin, L. (2013). The environment as a strategic healthcare partner. *Current Opinion in Obstetrics and Gynecology, 25*(6), 494-499.

Gao, T., Zhang, T., Zhu, L., Gao, Y., & Qiu, L. (2019). Exploring psychophysiological restoration and individual preference in the different environments based on virtual reality. *International Journal of Environmental Research and Public Health*, 16(17), 3102.

Garnefski, N., & Kraaij, V. (2007). The Cognitive Emotion Regulation Questionnaire. *European Journal of Psychological Assessment*, *23*(3), 141-149.

Garnefski, N., Kraaij, V., & Spinhoven, P. (2001). Negative life events, cognitive emotion regulation and emotional problems. *Personality and Individual Differences*, *30*(8), 1311-1327.

Garnefski, N., Rieffe, C., Jellesma, F., Terwogt, M. M., & Kraaij, V. (2007). Cognitive emotion regulation strategies and emotional problems in 9–11-year-old children: the development of an instrument. *European Child & Adolescent Psychiatry*, *16*, 1-9.

Garritty, C., Gartlehner, G., Nussbaumer-Streit, B., King, V. J., Hamel, C., Kamel, C., Affengruber, L., & Stevens, A. (2021). Cochrane Rapid Reviews Methods Group offers evidence-informed guidance to conduct rapid reviews. *Journal of Clinical Epidemiology*, *130*, 13-22.

Garritty, C., Stevens, A., Gartlehner, G., King, V., & Kamel, C. (2016). Cochrane Rapid Reviews Methods Group to play a leading role in guiding the production of informed high-quality, timely research evidence syntheses. *Systematic Reviews*, *5*(1), 1-5.

Garside R., Orr N., Short R., Lovell B., Husk K., Mceachan R., Rashid R., Dickie I., Preston S., Ainsworth H. Therapeutic Nature: Nature-Based Social Prescribing for

Diagnosed Mental Health Conditions in the UK. European Centre for Environment and Human Health, University of Exeter Medical School; Truro, UK: 2020. *Final Report for Defra*.

Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Forns, J., Plasència, A., & Nieuwenhuijsen, M. J. (2015). Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review. *International Journal of Environmental Research and Public Health*, *12*(4), 4354-4379.

Gatersleben, B., & Andrews, M. (2013). When walking in nature is not restorative—The role of prospect and refuge. *Health & Place*, *20*, 91-101.

Gawrych, M. (2024). Associations between nature connectedness and mental health-mediating effects of coping strategies. *Archives of Psychiatry & Psychotherapy*, *26*(2).

Gerber, S. M., Jeitziner, M. M., Sänger, S. D., Knobel, S. E. J., Marchal-Crespo, L., Müri, R. M., Schefold, J. C., Jakob, S. M., & Nef, T. (2019). Comparing the Relaxing Effects of Different Virtual Reality Environments in the Intensive Care Unit: Observational

Gerolimatos, L. A., & Edelstein, B. A. (2012). Predictors of health anxiety among older and young adults. *International Psychogeriatrics*, *24*(12), 1998-2008.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Houghton, Mifflin and Company.

Gilbert P. (Ed.). (2005). *Compassion: Conceptualisations, research and use in psychotherapy*. London: Routledge.

Gilbert, P. (2014). The origins and nature of compassion focused therapy. *British Journal of Clinical Psychology*, *53*(1), 6-41.

Giusti, M., Svane, U., Raymond, C. M., & Beery, T. H. (2018). A framework to assess where and how children connect to nature. *Frontiers in Psychology*, 2283.

Gladwell, V. F., Brown, D. K., Barton, J. L., Tarvainen, M. P., Kuoppa, P., Pretty, J., Suddaby, J. M., & Sandercock, G. R. (2012). The effects of views of nature on autonomic control. *European Journal of Applied Physiology*, *112*(9), 3379–3386.

Glover, T. D. (2004). Social capital in the lived experiences of community gardeners. *Leisure Sciences*, *26*(2), 143-162.

Goldberg, D. P. (1972). *The detection of psychiatric illness by questionnaire*. Maudsley Monograph No 21. Oxford University Press, Oxford.

Golding, S. E., Gatersleben, B., & Cropley, M. (2018). An experimental exploration of the effects of exposure to images of nature on rumination. *International Journal of Environmental Research and Public Health, 15*(2), 300.

Gomez, E., Baur, J. W., Hill, E., & Georgiev, S. (2015). Urban parks and psychological sense of community. *Journal of Leisure Research*, *47*(3), 388-398.

Gonçalves, P., Grilo, A. F., Mendes, R. C., Vierikko, K., Elands, B., Marques, T. A., & Santos-Reis, M. (2021). What's biodiversity got to do with it? Perceptions of biodiversity and restorativeness in urban parks. *Ecology and Society*, *26*(3).

Goodman, A., & Goodman, R. (2009). Strengths and difficulties questionnaire as a dimensional measure of child mental health. *Journal of the American Academy of Child & Adolescent Psychiatry*, *48*(4), 400-403.

Graf, L., Liszio, S., & Masuch, M. (2020). Playing in virtual nature: improving mood of elderly people using VR technology. *In Proceedings of Mensch und Computer 2020* (pp. 155-164).

Grahn, P., & Stigsdotter, U. A. (2003). Landscape planning and stress. *Urban Forestry & Urban Greening*, *2*(1), 1-18.

Grahn, P., & Stigsdotter, U. K. (2010). The relation between perceived sensory dimensions of urban green space and stress restoration. *Landscape and Urban Planning, 94*(3-4), 264-275.

Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment*, *26*, 41-54.

Green, B. N., Johnson, C. D., & Adams, A. (2006). Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. *Journal of Chiropractic Medicine*, 5(3), 101-117.

Grellier, J., White, M. P., Albin, M., Bell, S., Elliott, L. R., Gascón, M., Gualdi, S., Mancini, L., Nieuwenhuijsen, M. J., Sarigiannis, D. A., van den Bosch, M. A., Wolf, T., Wuijts, S., & Fleming, L. E. (2017). BlueHealth: a study programme protocol for mapping and quantifying the potential benefits to public health and well-being from Europe's blue spaces. *BMJ Open*, 7(6), e016188.

Grilli, G., Mohan, G., & Curtis, J. (2020). Public park attributes, park visits, and associated health status. *Landscape and Urban Planning*, *199*, 103814.

Grimm, M., Kroschel, K., Mower, E., & Narayanan, S. (2007). Primitives-based evaluation and estimation of emotions in speech. *Speech Communication*, *49*(10-11), 787-800.

Gross, J. J. (1998). Antecedent-and response-focused emotion regulation: divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology*, *74*(1), 224.

Gross, J. J. (2001). Emotion regulation in adulthood: Timing is everything. *Current Directions in Psychological Science*, *10*(6), 214-219.

Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology, 39*(3), 281-291.

Gross, J. J. (2008). Emotion regulation. *Handbook of Emotions*, *3*(3), 497-513.

Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, *26*(1), 1-26.

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, *85*(2), 348.

Gross, J. J., & Muñoz, R. F. (1995). Emotion regulation and mental health. *Clinical Psychology: Science and Practice, 2*(2), 151-164.

Gross, J. J., & Thompson, R. A. (2006). Emotion regulation: Conceptual foundations. *Handbook of Emotion Regulation*.

Gross, J. J., & Thompson, R. A. (2007). Emotion Regulation: Conceptual Foundations. In J. J. Gross (Ed.), *Handbook of Emotion Regulation* (pp. 3–24). The Guilford Press.

Gross, J. J., Carstensen, L. L., Pasupathi, M., Tsai, J., Götestam Skorpen, C., & Hsu, A. Y. (1997). Emotion and aging: experience, expression, and control. *Psychology and Aging*, *12*(4), 590.

Gross, J. J., Sheppes, G., & Urry, H. L. (2011). Taking one's lumps while doing the splits: A big tent perspective on emotion generation and emotion regulation. *Cognition & Emotion*, *25*(5), 789-793.

Guadagnoli, E., & Velicer, W. F. (1988). Relation of sample size to the stability of component patterns. *Psychological Bulletin*, *103*(2), 265.

Guido, G., Peluso, A. M., Capestro, M., & Miglietta, M. (2015). An Italian version of the 10-item Big Five Inventory: An application to hedonic and utilitarian shopping values. *Personality and Individual Differences, 76,* 135–140.

Gullone, E., & Taffe, J. (2012). The emotion regulation questionnaire for children and adolescents (ERQ–CA): a psychometric evaluation. *Psychological Assessment*, *24*(2), 409.

Guo, S., Wang, W., & Zhang, M. (2020). Exploring the impact of environmental regulations on happiness: new evidence from China. *Environmental Science and Pollution Research, 27*(16), 19484-19501.

Gyurak, A., Gross, J. J., & Etkin, A. (2011). Explicit and implicit emotion regulation: A dual-process framework. *Cognition and emotion*, *25*(3), 400-412.

Haga, S. M., Kraft, P., & Corby, E. K. (2009). Emotion regulation: Antecedents and well-being outcomes of cognitive reappraisal and expressive suppression in cross-cultural samples. *Journal of Happiness Studies*, *10*, 271-291.

Hajrasoulih, A., Del Rio, V., Francis, J., & Edmondson, J. (2018). Urban form and mental wellbeing: Scoping a theoretical framework for action. *Journal of Urban Design and Mental Health*, *5*(10).

Han, K. T. (2003). A reliable and valid self-rating measure of the restorative quality of natural environments. *Landscape and Urban Planning*, *64*(4), 209-232.

Han, K. T. (2009). Influence of limitedly visible leafy indoor plants on the psychology, behavior, and health of students at a junior high school in Taiwan. *Environment and Behavior*, *41*(5), 658-692.

Han, K. T. (2010). An exploration of relationships among the responses to natural scenes: Scenic beauty, preference, and restoration. *Environment and Behavior*, *42*(2), 243-270.

Han, Z., Kang, J., & Meng, Q. (2022). The effect of foreground and background of soundscape sequence on emotion in urban open spaces. *Applied Acoustics*, *199*, 109039.

Haney, A. M., Motschman, C. A., Warner, O. M., Wesley, R. L., Wycoff, A. M., Trull, T. J., & McCarthy, D. M. (2022). Comparing associations between mood and breath alcohol concentration in the laboratory and natural environment. *Psychology of Addictive Behaviors*. *36*(7), 885–894.

Hanley, A. W., Bettmann, J. E., Kendrick, C. E., Deringer, A., & Norton, C. L. (2020). Dispositional mindfulness is associated with greater nature connectedness and self-reported ecological behavior. *Ecopsychology*, *12*(1), 54-63.

Hanley, A. W., Derringer, S. A., & Hanley, R. T. (2017). Dispositional mindfulness may be associated with deeper connections with nature. *Ecopsychology*, *9*(4), 225-231.

Harper, N. J., Fernee, C. R., & Gabrielsen, L. E. (2021). Nature's role in outdoor therapies: an umbrella review. *International Journal of Environmental Research and Public Health*, *18*(10), 5117.

Harrison, N. R., & Clark, D. P. (2020). Mindful awareness, but not acceptance, predicts engagement with natural beauty. *Ecopsychology*, *12*(1), 36-43.

Hartig, T. (2007). Three steps to understanding restorative environments as health resources. *Open Space: People Space*, *2*.

Hartig, T. (2021). Restoration in nature: Beyond the conventional narrative. *Nature and Psychology*, 89-151.

Hartig, T., & Evans, G. W. (1993). Psychological foundations of nature experience. In *Advances in Psychology* (Vol. 96, pp. 427-457). North-Holland.

Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology*, 23(2), 109-123.

Hartig, T., Kaiser, F. G., & Strumse, E. (2007). Psychological restoration in nature as a source of motivation for ecological behaviour. *Environmental Conservation*, *34*(4), 291-299.

Hartig, T., Korpela, K. M., Evans, G. W., & Garling, T. (1996). Validation of a measure of perceived environmental restorativeness. *Göteborg Psychological Reports*, 26, 1-64. Göteborg, Sweden: Göteborg University, Department of Psychology.

Hartig, T., Mang, M., & Evans, G. W. (1991). Restorative effects of natural environment experiences. *Environment and Behavior*, *23*(1), 3-26.

Hartig, T., Mitchell, R., De Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health*, 35, 207-228.

Hartig, T., Van Den Berg, A. E., Hagerhall, C. M., Tomalak, M., Bauer, N., Hansmann, R., Ojala, A., Syngollitou, E., Carrus, G., Van Herzele, A., Bell, S., Podesta, M. T. C., & Waaseth, G. (2011). Health benefits of nature experience: Psychological, social and cultural processes. *In Forests, Trees and Human Health* (pp. 127-168). Springer, Dordrecht.

Hedblom, M., Gunnarsson, B., Iravani, B., Knez, I., Schaefer, M., Thorsson, P., & Lundström, J. N. (2019). Reduction of physiological stress by urban green space in a multisensory virtual experiment. *Scientific Reports*, 9(1), 10113.

Herzog, T. R. (1985). A cognitive analysis of preference for waterscapes. *Journal of Environmental Psychology*, *5*(3), 225-241.

Herzog, T. R., Black, A. M., Fountaine, K. A., & Knotts, D. J. (1997). Reflection and attentional recovery as distinctive benefits of restorative environments. *Journal of Environmental Psychology*, *17*(2), 165-170.

Herzog, T. R., Maguire, P., & Nebel, M. B. (2003). Assessing the restorative components of environments. *Journal of Environmental Psychology*, *23*(2), 159-170.

Hiekkaranta, A. P., Kirtley, O. J., Lafit, G., Decoster, J., Derom, C., de Hert, M., Gülöksüz, S., Jacobs, N., Menne-Lothmann, C., Rutten, B. P. F., Thiery, E., van Os, J., van Winkel, R., Wichers, M., & Myin-Germeys, I. (2021). Emotion regulation in response to daily negative and positive events in youth: The role of event intensity and psychopathology. *Behaviour Research and Therapy, 144,* 103916.

Hinkin, T. R. (1995). A review of scale development practices in the study of organizations. *Journal of Management*, *21*(5), 967-988.

Hipp, J. A., Gulwadi, G. B., Alves, S., & Sequeira, S. (2016). The relationship between perceived greenness and perceived restorativeness of university campuses and student-reported quality of life. *Environment and Behavior*, *48*(10), 1292-1308.

Ho, M. H., Wu, M. S., & Yen, H. Y. (2023). Effects of virtual reality natural experiences on factory workers' psychological and physiological stress. *Frontiers in Psychology*, 14, 993143.

Hofer, M., & Allemand, M. (2017). Dispositional and situational emotion regulation in younger and older adults. *GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry, 30*(3), 109–118.

Hofer, M., Burkhard, L., & Allemand, M. (2015). Age differences in emotion regulation during a distressing film scene. *Journal of Media Psychology: Theories, Methods, and Applications, 27*(2), 47–52.

Hoffman, C. J., Ersser, S. J., Hopkinson, J. B., Nicholls, P. G., Harrington, J. E., & Thomas, P. W. (2012). Effectiveness of mindfulness-based stress reduction in mood, breast-and endocrine-related quality of life, and well-being in stage 0 to III breast cancer: a randomized, controlled trial. *Journal of Clinical Oncology*, *30*(12), 1335-1342.

Hogg, M.A., Abrams, D., & Martin, G.N. (2010). *Social cognition and attitudes*. In: Martin, G.N., Carlson, N.R., Buskist, W., (Ed.), Psychology (pp 646-677). Harlow:Pearson Education Limited.

Holland, I., DeVille, N. V., Browning, M. H. E. M., Buehler, R. M., Hart, J. E., Hipp, J. A., Mitchell, R., Rakow, D. A., Schiff, J. E., White, M. P., Yin, J., & James, P. (2021). Measuring Nature Contact: A Narrative Review. *International Journal of Environmental Research and Public Health*, *18*(8), 4092.

Hong, S., Joung, D., Lee, J., Kim, D. Y., Kim, S., & Park, B. J. (2019). The effects of watching a virtual reality (VR) forest video on stress reduction in adults. *Journal of People, Plants, Environment*, 22(3), 309-319.

Hoogendoorn, G., Sütterlin, B., & Siegrist, M. (2021). Tampering with nature: A systematic review. *Risk Analysis*, *41*(1), 141-156.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural Equation Modelling: Guidelines for Determining Model Fit. *The Electronic Journal of Business Research Methods*, *6*, 53-60.

Horn, J. L., & McArdle, J. J. (1992). A practical and theoretical guide to measurement invariance in aging research. *Experimental Aging Research*, *18*(3), 117-144.

Horowitz, M., Adler, N., & Kegeles, S. (1988). A scale for measuring the occurrence of positive states of mind: a preliminary report. *Psychosomatic Medicine*, *50*(5), 477-483.

Hoyle, H., Hitchmough, J., & Jorgensen, A. (2017). All about the 'wow factor'? The relationships between aesthetics, restorative effect and perceived biodiversity in designed urban planting. *Landscape and Urban Planning*, *164*, 109-123.

Hoyle, H., Norton, B., Dunnett, N., Richards, J. P., Russell, J. M., & Warren, P. (2018). Plant species or flower colour diversity? Identifying the drivers of public and invertebrate response to designed annual meadows. *Landscape and Urban Planning*, *180*, 103-113.

Huang, Q., Yang, M., Jane, H. A., Li, S., & Bauer, N. (2020). Trees, grass, or concrete? The effects of different types of environments on stress reduction. *Landscape and Urban Planning*, *193*, 103654.

Hunter, R., Christian, H., Veitch, J., Astell-Burt, T., Hipp, J., & Schipperijn, J. (2015). The impact of interventions to promote physical activity in urban green space: a systematic review and recommendations for future research. *Social science & Medicine*, *124*, 246-56.

Huynh, T., & Torquati, J. C. (2019). Examining connection to nature and mindfulness at promoting psychological well-being. *Journal of Environmental Psychology*, *66*, 101370.

Ibes, D. C., & Forestell, C. A. (2022). The role of campus greenspace and meditation on college students' mood disturbance. *Journal of American College Health*, *70*(1), 99-106.

Ibrahim, F. A., Mehta, U. M., Thekkumkara, S. N., Rakesh, K. R., Swetha, G., Kumar, C. N., Kumar, K. J., Narayana, A., Ravisundar, S., Satyanarayana, P., & Thirthalli, J. (2023). Multivariate associations between cognition and neighborhood geospatial characteristics in schizophrenia. *Asian Journal of Psychiatry*, *84*, 103593.

Ishibashi, S., Akasaka, M., Koyanagi, T. F., Yoshida, K. T., & Soga, M. (2020). Recognition of local flora and fauna by urban park users: Who notices which species?. *Urban Forestry & Urban Greening*, *56*, 126867.

Ivaldi, A. (2023). Understanding and restoring the self in nature for well-being: A phenomenological analysis of walking coaching experiences. *The Humanistic Psychologist*.

Izard, C. E. (1993). Four systems for emotion activation: cognitive and noncognitive processes. *Psychological Review*, *100*(1), 68.

Jackson, D. L. (2003). Revisiting Sample Size and Number of Parameter Estimates: Some Support for the N:q Hypothesis. *Structural Equation Modeling*, 10, 128-141.

James, W. (1884). Che cos' è un'emozione. Trad. It.(1996) L. Anolli, W. Gerbino, P. Legrenzi & S. Roncato (Eds.). *Psicologia generale*. 18-42.

Jennings, V., & Bamkole, O. (2019). The relationship between social cohesion and urban green space: An avenue for health promotion. *International journal of Environmental Research and Public Health*, *16*(3), 452.

Jennings, V., Larson, L., & Yun, J. (2016). Advancing sustainability through urban green space: Cultural ecosystem services, equity, and social determinants of health. *International Journal of Environmental Research and Public Health, 13*(2), 196.

Jiang, B., Chang, C. Y., & Sullivan, W. C. (2014). A dose of nature: Tree cover, stress reduction, and gender differences. *Landscape and Urban Planning*, *132*, 26-36.

Jiang, B., Li, D., Larsen, L., & Sullivan, W. C. (2016). A Dose-Response Curve Describing the Relationship Between Urban Tree Cover Density and Self-Reported Stress Recovery. *Environment and Behavior*, *48*(4), 607–629.

Jiang, S. (2020). Positive distractions and play in the public spaces of pediatric healthcare environments: A literature review. *Health Environments Research & Design Journal, 13*(3), 171-197.

Jiang, Y., Zhang, J., Ming, H., Huang, S., & Lin, D. (2019). Stressful life events and well-being among rural-to-urban migrant adolescents: The moderating role of the stress mindset and differences between genders. *Journal of Adolescence, 74*, 24-32.

Jin, Y. L., Chen, E. C., & Li, T. Y. (2023, May). Study of Different Interaction Methods on the Healing Effect of Natural Environment in Virtual Reality. *In 2023 9th International Conference on Virtual Reality* (ICVR) (pp. 185-192). IEEE.

Jo, H. I., & Jeon, J. Y. (2021). Overall environmental assessment in urban parks: Modelling audio-visual interaction with a structural equation model based on soundscape and landscape indices. *Building and Environment*, *204*, 108166.

John, O. P. and Srivastava, S. (1999) *The Big Five Trait Taxonomy: History, Measurement, and Theoretical Perspectives*. In: Pervin, L.A. and John, O.P. Eds., Handbook of Personality: Theory and Research, Vol. 2, Guilford Press, New York, 102-138.

John, O. P., & Gross, J. J. (2004). Healthy and unhealthy emotion regulation: Personality processes, individual differences, and life span development. *Journal of Personality*, *72*(6), 1301-1334.

Johnsen, S. Å. K. (2011). The use of nature for emotion regulation: Toward a conceptual framework. *Ecopsychology*, *3*(3), 175-185.

Johnsen, S. Å. K. (2013). Exploring the use of nature for emotion regulation: associations with personality, perceived stress, and restorative outcomes. *Nordic Psychology*, *65*(4), 306-321.

Johnsen, S. Å. K. (2014). Using the Natural Environment for Emotion Regulation Conceptual and Empirical Explorations.

Johnsen, S. Å. K., & Rydstedt, L. W. (2013). Active use of the natural environment for emotion regulation. *Europe's Journal of Psychology*, *9*(4), 798-819.

Kabat-Zinn, J. (1994, September). Catalyzing movement towards a more contemplative/sacred-appreciating/non-dualistic society. *Meeting of the Working Group. The Contemplative Mind in Society*.

Kabisch, N., van den Bosch, M., & Lafortezza, R. (2017). The health benefits of nature-based solutions to urbanization challenges for children and the elderly–A systematic review. *Environmental Research*, *159*, 362-373.

Kahn Jr, P. H. (1997). Developmental psychology and the biophilia hypothesis: Children's affiliation with nature. *Developmental Review*, *17*(1), 1-61.

Kahn Jr, P. H., Ruckert, J. H., Severson, R. L., Reichert, A. L., & Fowler, E. (2010). A nature language: An agenda to catalog, save, and recover patterns of human–nature interaction. *Ecopsychology*, *2*(2), 59-66.

Kahn Jr, P. H., Severson, R. L., & Ruckert, J. H. (2009). The human relation with nature and technological nature. *Current Directions in Psychological Science*, *18*(1), 37-42.

Kahn Jr, P. H., Weiss, T., & Harrington, K. (2018). Modeling child–nature interaction in a nature preschool: A proof of concept. *Frontiers in Psychology*, 835.

Kamitsis, I., & Francis, A. J. (2013). Spirituality mediates the relationship between engagement with nature and psychological wellbeing. *Journal of Environmental Psychology*, *36*, 136-143.

Kaplan, D. M., Hughes, C. D., Schatten, H. T., Mehl, M. R., Armey, M. F., & Nugent, N. R. (2022). Emotional change in its "natural habitat": Measuring everyday emotion regulation with passive and active ambulatory assessment methods. *Journal of Psychotherapy Integration*. Advance online publication.

Kaplan, R. (2001). The nature of the view from home: Psychological benefits. *Environment and Behavior*, *33*(4), 507-542.

Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge University Press.

Kaplan, R., Kaplan, S., & Ryan, R. (1998). With People in Mind: Design and Management of Everyday Nature Island Press. *Washington DC*.

Kaplan, S. (1987). Aesthetics, affect, and cognition: Environmental preference from an evolutionary perspective. *Environment and Behavior, 19*(1), 3–32.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, *15*(3), 169-182.

Kaplan, S., & Berman, M. G. (2010). Directed attention as a common resource for executive functioning and self-regulation. *Perspectives on Psychological Science*, *5*(1), 43-57.

Karmanov, D., & Hamel, R. (2008). Assessing the restorative potential of contemporary urban environment (s): Beyond the nature versus urban dichotomy. *Landscape and Urban Planning*, *86*(2), 115-125.

Katz, B. A., Lustig, N., Assis, Y., & Yovel, I. (2017). Measuring regulation in the here and now: The development and validation of the State Emotion Regulation Inventory (SERI). *Psychological Assessment*, *29*(10), 1235.

Kellert, S. R. (2018). Three. The Practice of Biophilic Design. In *Nature by Design* (pp. 23-110). Yale University Press, New Haven.

Keniger, L. E., Gaston, K. J., Irvine, K. N., & Fuller, R. A. (2013). What are the benefits of interacting with nature?. *International Journal of Environmental Research and Public Health, 10*(3), 913-935.

Képos (2023). *Libro bianco del verde 22/23: Focus la salute è verde il verde è salute. Parchi della Salute per un neo-rinascimento del Verde e della sua Cura-Quaderno tecnico: Aziende e professionisti del settore protagonisti del cambiamento*. (Maccazzola, F. M. & Pisanti, S.). ISBN 9791221037432.

Khangura, S., Konnyu, K., Cushman, R., Grimshaw, J., & Moher, D. (2012). Evidence summaries: the evolution of a rapid review approach. *Systematic Reviews*, *1*(1), 1-9.

Kim, H. K., Park, J., Choi, Y., & Choe, M. (2018). Virtual reality sickness questionnaire (VRSQ): Motion sickness measurement index in a virtual reality environment. *Applied Ergonomics*, *69*, 66-73.

Kingsley, J., & Townsend, M. (2006). 'Dig in' to social capital: Community gardens as mechanisms for growing urban social connectedness. *Urban Policy and Research*, *24*(4), 525-537.

Kjellgren, A., & Buhrkall, H. (2010). A comparison of the restorative effect of a natural environment with that of a simulated natural environment. *Journal of Environmental Psychology*, 30(4), 464-472.

Kleespies, M. W., Braun, T., Dierkes, P. W., & Wenzel, V. (2021). Measuring connection to nature—a illustrated extension of the inclusion of nature in self scale. *Sustainability*, *13*(4), 1761.

Kline, R. (2013). Exploratory and confirmatory factor analysis. In *Applied quantitative analysis in education and the social sciences* (pp. 171-207). Routledge.

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). Guilford Press.

Knobel, P., Dadvand, P., & Maneja-Zaragoza, R. (2019). A systematic review of multi-dimensional quality assessment tools for urban green spaces. *Health & Place*, *59*, 102198.

Knopf, R. (1987). Human behavior, cognition, and affect in the natural environment. In D. Stokols and I. Altman (Eds.), *Handbook of Environmental Psychology* (pp. 783–826). NY: John Wiley and Sons.

Kobylińska, D., & Karwowska, D. (2015). How automatic activation of emotion regulation influences experiencing negative emotions. *Frontiers in Psychology*, *6*, 1628.

Kondo, M. C., Jacoby, S. F., & South, E. C. (2018). Does spending time outdoors reduce stress? A review of real-time stress response to outdoor environments. *Health & Place*, *51*, 136-150.

Koole, S. L. (2009). The psychology of emotion regulation: An integrative review. *Cognition and Emotion*, *23*(1), 4-41.

Koole, S. L., & Rothermund, K. (2011). "I feel better but I don't know why": The psychology of implicit emotion regulation. *Cognition and Emotion*, *25*(3), 389-399.

Koole, S. L., Webb, T. L., & Sheeran, P. L. (2015). Implicit emotion regulation: Feeling better without knowing why. *Current Opinion in Psychology*, *3*, 6-10.

Korpela, K. M. (2003). Negative mood and adult place preference. *Environment and Behavior*, *35*(3), 331-346.

Korpela, K. M., & Ylen, M. (2007). Perceived health is associated with visiting natural favourite places in the vicinity. *Health & Place*, *13*(1), 138-151.

Korpela, K. M., Hartig, T., Kaiser, F. G., & Fuhrer, U. (2001). Restorative experience and self-regulation in favorite places. *Environment and Behavior*, *33*(4), 572-589.

Korpela, K. M., Pasanen, T., Repo, V., Hartig, T., Staats, H., Mason, M., Alves, S., Fornara, F., Marks, T., Saini, S., Scopelliti, M., Soares, A. L., Stigsdotter, U. K., & Ward Thompson, C. (2018). Environmental strategies of affect regulation and their associations with subjective well-being. *Frontiers in Psychology*, *9*, 562.

Korpela, K. M., Ylén, M., Tyrväinen, L., & Silvennoinen, H. (2008). Determinants of restorative experiences in everyday favorite places. *Health & Place*, *14*(4), 636-652.

Korpela, K., & Hartig, T. (1996). Restorative qualities of favorite places. *Journal of Environmental Psychology*, *16*(3), 221-233.

Korpela, K., & Staats, H. (2021). Solitary and social aspects of restoration in nature. *The Handbook of Solitude: Psychological Perspectives on Social Isolation, Social Withdrawal, and Being Alone*, 325-339.

Korpela, K., Borodulin, K., Neuvonen, M., Paronen, O., & Tyrväinen, L. (2014). Analyzing the mediators between nature-based outdoor recreation and emotional well-being. *Journal of Environmental Psychology*, *37*, 1-7.

Korpela, K., De Bloom, J., Sianoja, M., Pasanen, T., & Kinnunen, U. (2017). Nature at home and at work: Naturally good? Links between window views, indoor plants, outdoor activities and employee well-being over one year. *Landscape and Urban planning*, *160*, 38-47.

Kotera, Y., Lyons, M., Vione, K. C., & Norton, B. (2021). Effect of nature walks on depression and anxiety: a systematic review. *Sustainability*, 13(7), 4015.

Krefis, A. C., Augustin, M., Schlünzen, K. H., Oßenbrügge, J., & Augustin, J. (2018). How does the urban environment affect health and well-being? A systematic review. *Urban Science, 2*(1), 21.

Krisantia, I., Faris, S., & Sazwani, S. (2021, April). Visual therapy through the application of plants and design elements in landscape. In *IOP Conference Series: Earth and Environmental Science* (Vol. 737, No. 1, p. 012008). IOP Publishing.

Kroenke, K., Spitzer, R. L., Williams, J. B., & Löwe, B. (2009). An ultra-brief screening scale for anxiety and depression: the PHQ–4. *Psychosomatics*, *50*(6), 613-621.

Kruize, H., van der Vliet, N., Staatsen, B., Bell, R., Chiabai, A., Muiños, G., Higgins, S., Quiroga, S., Martinez-Juarez, P., Aberg Yngwe, M., Tsichlas, F., Karnaki, P., Lima, M. L., García de Jalón, S., Khan, M., Morris, G., & Stegeman, I. (2019). Urban green space: creating a triple win for environmental sustainability, health, and health equity through behavior change. *International Journal of Environmental Research and Public Health*, *16*(22), 4403.

Kuhl, J. (2000). A functional-design approach to motivation and self-regulation: The dynamics of personality systems interactions. In *Handbook of Self-regulation* (pp. 111-169). Academic Press.

Kuo, F. E. (2013). Nature-deficit disorder: evidence, dosage, and treatment. *Journal of Policy Research in Tourism, Leisure and Events*, *5*(2), 172-186.

Kuo, F. E., & Sullivan, W. C. (2001). Aggression and violence in the inner city: Effects of environment via mental fatigue. *Environment and Behavior*, 33(4), 543-571.

Kuo, M. (2015). How might contact with nature promote human health? Promising mechanisms and a possible central pathway. *Frontiers in Psychology*, 1093.

Lämmle, L., von Lindern, E., Rummel, D., Michaeli, M., & Ziegler, M. (2022). Shedding Light onto the City Blues Myth—The Potential of Stimulating and Activating Effects of Urban Public Spaces and the Role of City Relatedness. *International Journal of Environmental Research and Public Health*, *19*(13), 7606.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1998). Emotion and motivation: measuring affective perception. *Journal of Clinical Neurophysiology*, 15(5), 397-408.

Lange, C. G. (1885). The mechanism of the emotions. *The Classical Psychologists*, 672-684.

Lanza, K., Alcazar, M., Chen, B., & Kohl III, H. W. (2023). Connection to nature is associated with social-emotional learning of children. *Current Research in Ecological and Social Psychology*, *4*, 100083.

Larsen, R. J. (2000). Toward a science of mood regulation. *Psychological Inquiry*, *11*(3), 129-141.

Larsen, R. J., & Prizmic, Z. (2004). Affect regulation. *Handbook of Self-Regulation: Research, Theory, and Applications*, 40-61.

Latini, A., Di Giuseppe, E., D'Orazio, M., & Di Perna, C. (2021). Exploring the use of immersive virtual reality to assess occupants' productivity and comfort in workplaces: An experimental study on the role of walls colour. *Energy and Buildings*, *253*, 111508.

Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., Shapiro, S., Carmody, J., Abbey, S., & Devins, G. (2006). The Toronto Mindfulness Scale: Development and Validation. *Journal of Clinical Psychology, 62*(12), 1445–1467.

Laumann, K., Gärling, T., & Stormark, K. M. (2001). Rating scale measures of restorative components of environments. *Journal of Environmental Psychology*, *21*(1), 31-44.

Laumann, K., Gärling, T., & Stormark, K. M. (2003). Selective attention and heart rate responses to natural and urban environments. *Journal of Environmental Psychology*, *23*(2), 125-134.

LaValle, S. M. (2023). *Virtual Reality.* Cambridge University Press.

Lazarus, R. S. (1984). *Stress, Appraisal, and Coping* (Vol. 464). New York: Springer.

Lazarus, R. S. (1991). *Emotion and Adaptation*. Oxford University Press.

Lederbogen, F., Kirsch, P., Haddad, L., Streit, F., Tost, H., Schuch, P., Wüst, S., Pruessner, J. C., Rietschel, M., Deuschle, M., & Meyer-Lindenberg, A. (2011). City living and urban upbringing affect neural social stress processing in humans. *Nature*, *474*(7352), 498–501.

LeDoux, J. E. (1995). Emotion: Clues from the brain. *Annual Review of Psychology*, *46*(1), 209-235.

LeDoux, J. E. (2012). Evolution of human emotion: a view through fear. In *Progress in Brain Research* (Vol. 195, pp. 431-442). Elsevier.

Lee, A. C., & Maheswaran, R. (2011). The health benefits of urban green spaces: a review of the evidence. *Journal of Public Health*, 33(2), 212-222.

Lee, J., Park, B. J., Tsunetsugu, Y., Kagawa, T., & Miyazaki, Y. (2009). Restorative effects of viewing real forest landscapes, based on a comparison with urban landscapes. *Scandinavian Journal of Forest Research*, *24*(3), 227-234.

Leipold, B., & Loepthien, T. (2015). Music reception and emotional regulation in adolescence and adulthood. *Musicae Scientiae*, *19*(1), 111-128.

Lengen, C. (2015). The effects of colours, shapes and boundaries of landscapes on perception, emotion and mentalising processes promoting health and well-being. *Health & Place*, *35*, 166-177.

Leung, T. M., Xu, J. M., Chau, C. K., Tang, S. K., & Pun-Cheng, L. S. C. (2017). The effects of neighborhood views containing multiple environmental features on road traffic noise perception at dwellings. *The Journal of the Acoustical Society of America*, *141*(4), 2399.

Li, D., Menotti, T., Ding, Y., & Wells, N. M. (2021). Life course nature exposure and mental health outcomes: A systematic review and future directions. *International Journal of Environmental Research and Public Health*, 18(10), 5146.

Li, H., Ding, Y., Zhao, B., Xu, Y., & Wei, W. (2023). Effects of immersion in a simulated natural environment on stress reduction and emotional arousal: A systematic review and meta-analysis. *Frontiers in Psychology*, *13*, 1058177.

Li, H., Zhang, X., Wang, H., Yang, Z., Liu, H., Cao, Y., & Zhang, G. (2021). Access to nature via virtual reality: A mini-review. *Frontiers in Psychology*, 12, 725288.

Li, Q. (2010). Effect of forest bathing trips on human immune function. *Environmental Health and Preventive Medicine*, *15*, 9-17.

Li, Z., Wang, Y., Liu, H., & Liu, H. (2022). Physiological and psychological effects of exposure to different types and numbers of biophilic vegetable walls in small spaces. *Building and Environment*, *225*, 109645.

Liang, J. H., Yang, R. Y., Liu, M. L., Pu, Y. Q., Bao, W. W., Zhao, Y., Hu, L. X., Zhang, Y. S., Huang, S., Jiang, N., Pu, X. Y., Huang, S. Y., Dong, G. H., & Chen, Y. J. (2024). Urban green, blue spaces and their joint effect are associated with lower risk of emotional and behavior problem in children and adolescents, a large population-based study in Guangzhou, China. *Environmental Research*, *240*, 117475.

Lindemann-Matthies, P., & Bose, E. (2007). Species richness, structural diversity and species composition in meadows created by visitors of a botanical garden in Switzerland. *Landscape and Urban Planning*, *79*(3-4), 298-307.

Lischetzke, T., & Eid, M. (2003). Is attention to feelings beneficial or detrimental to affective well-being? Mood regulation as a moderator variable. *Emotion*, *3*(4), 361.

Liu, C., Qi, T., & Ma, X. (2016). The research on the impact assessment of visual landscape of country parks in Beijing. *Journal of Environmental Engineering and Landscape Management*, *24*(1), 37-47.

Lloret, J., Gómez, S., Rocher, M., Carreño, A., San, J., & Inglés, E. (2021). The potential benefits of water sports for health and well-being in marine protected areas: A case study in the Mediterranean. *Annals of Leisure Research*, 1-27.

Lohr, V. I., & Pearson-Mims, C. H. (2005). Children's active and passive interactions with plants influence their attitudes and actions toward trees and gardening as adults. *HortTechnology*, *15*(3), 472-476.

Lopes, S., Lima, M., & Silva, K. (2020). Nature can get it out of your mind: the rumination reducing effects of contact with nature and the mediating role of awe and mood. *Journal of Environmental Psychology*, *71*, 101489.

Lovati, C., Manzi, F., Di Dio, C., Massaro, D., Gilli, G., & Marchetti, A. (2023). Feeling connected to nature: validation of the connectedness to nature scale in the Italian context. *Frontiers in Psychology*, *14*, 1242699.

Lovell R, Depledge M, Maxwell S. Health and the Natural Environment: A Review of Evidence, Policy, Practice and Opportunities for the Future (Defra Project Code BE0109) *Defra's Science and Research Projects Database*; 2018. p. 160.

Luck, S. J., & Vogel, E. K. (1997). The capacity of visual working memory for features and conjunctions. *Nature*, *390*(6657), 279-281.

Lumber, R., Richardson, M., & Sheffield, D. (2017). Beyond knowing nature: Contact, emotion, compassion, meaning, and beauty are pathways to nature connection. *PLoS One*, *12*(5), e0177186.

Luo, H., Deng, L., Song, C., Jiang, S., Huang, Y., Wang, W., ... & Li, X. (2023). Which characteristics and integrations between characteristics in blue–green spaces influence the nature experience?. *Journal of Environmental Planning and Management*, *66*(6), 1253-1279.

Luong, G., & Charles, S. T. (2014). Age differences in affective and cardiovascular responses to a negative social interaction: the role of goals, appraisals, and emotion regulation. *Developmental Psychology*, *50*(7), 1919.

Luteijn, E., Jackson, S., Volkmar, F. R., & Minderaa, R. B. (1998). Brief report: the development of the Children's Social Behavior Questionnaire: preliminary data. *Journal of Autism and Developmental Disorders*, *28*(6), 559–565.

Lymeus, F., Ahrling, M., Apelman, J., Florin, C. M., Nilsson, C., Vincenti, J., Zetterberg, A., Lindberg, P., & Hartig, T. (2020). Mindfulness-based restoration skills training (ReST) in a natural setting compared to conventional mindfulness training: Psychological functioning after a five-week course. *Frontiers in Psychology*, *11*, 1560.

Ma, J., Williams, J. M., Morris, P. G., & Chan, S. W. (2023). Effectiveness of a mindful nature walking intervention on sleep quality and mood in university students during Covid-19: A randomised control study. *Explore*, *19*(3), 405-416.

Maas, J., Van Dillen, S. M., Verheij, R. A., & Groenewegen, P. P. (2009). Social contacts as a possible mechanism behind the relation between green space and health. *Health & Place*, *15*(2), 586-595.

Maas, J., Verheij, R. A., Groenewegen, P. P., De Vries, S., & Spreeuwenberg, P. (2006). Green space, urbanity, and health: how strong is the relation?. *Journal of Epidemiology & Community Health, 60*(7), 587-592.

Macaulay, R., Johnson, K., Lee, K., & Williams, K. (2022). Comparing the effect of mindful and other engagement interventions in nature on attention restoration, nature connection, and mood. *Journal of Environmental Psychology*, *81*, 101813.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, *1*(2), 130.

MacIntyre, T. E., Calogiuri, G., Donnelly, A. A., Warrington, G., Beckmann, J., Lahart, I., & Brick, N. (2019). Societal challenges, methodological issues and transdisciplinary approaches. *Physical Activity in Natural Settings*, 15-35.

MacIntyre, T. E., Walkin, A., Calogiuri, G., Oliver, G., Donnelly, A. A., Gritzka, S., & Warrington, G. (2019). Immersion, watersports and Blueways and the blue mind: Case studies in blue exercise. *Physical Activity in Natural Settings*, 210-225.

Maffei, A., & Angrilli, A. (2019). E-MOVIE-Experimental MOVies for Induction of Emotions in neuroscience: An innovative film database with normative data and sex differences. *PLos One*, *14*(10), e0223124.

Malekinezhad, F. (2018). *Restoration experience through perceived open space qualities and perceived restorativeness of students in Malaysian Universities.* PhD thesis, Universiti Teknologi Malaysia, Faculty of Built Environment.

Malekinezhad, F., Courtney, P., bin Lamit, H., & Vigani, M. (2020). Investigating the mental health impacts of university campus green space through perceived sensory dimensions and the mediation effects of perceived restorativeness on restoration experience. *Frontiers in Public Health*, *8*, 578241.

Mantler, A., & Logan, A. C. (2015). Natural environments and mental health. *Advances in Integrative Medicine*, *2*(1), 5-12.

Marchand, W. R., Klinger, W., Block, K., VerMerris, S., Herrmann, T. S., Johnson, C., Paradiso, N., Scott, M., & Yabko, B. (2019). Mindfulness training plus nature exposure for veterans with psychiatric and substance use disorders: a model intervention. *International Journal of Environmental Research and Public Health, 16*(23), 4726.

Marchetti, I., Mor, N., Chiorri, C., & Koster, E. H. (2018). The brief state rumination inventory (BSRI): validation and psychometric evaluation. *Cognitive Therapy and Research*, *42*, 447-460.

Markevych, I., Schoierer, J., Hartig, T., Chudnovsky, A., Hystad, P., Dzhambov, A. M., de Vries, S., Triguero-Mas, M., Brauer, M., Nieuwenhuijsen, M. J., Lupp, G., Richardson, E. A., Astell-Burt, T., Dimitrova, D., Feng, X., Sadeh, M., Standl, M., Heinrich, J., & Fuertes, E. (2017). Exploring pathways linking greenspace to health: Theoretical and methodological guidance. *Environmental Research*, *158*, 301-317.

Marocco, S., & Talamo, A. (2022). The contribution of activity theory to modeling multi-actor decision-making: A focus on human capital investments. *Frontiers in Psychology*, *13*, 997062.

Marocco, S., Marini, M., & Talamo, A. (2024a). Enhancing organizational processes for service innovation: Strategic organizational counseling and organizational network analysis. *Frontiers in Research Metrics and Analytics*, 9, 1270501.

Marocco, S., Talamo, A., & Quintiliani, F. (2024b). Applying design thinking to develop AI-based multi-actor decision-support systems: A case study on human capital investments. *Applied Sciences*, 14, 5613.

Marocco, S., Talamo, A., & Quintiliani, F. (2024c). From service design thinking to the third generation of activity theory: A new model for designing AI-based decision-support systems. *Frontiers in Artificial Intelligence*, 7, 1303691.

Marselle, M. R., Hartig, T., Cox, D. T. C., de Bell, S., Knapp, S., Lindley, S., Triguero-Mas, M., Böhning-Gaese, K., Braubach, M., Cook, P. A., de Vries, S., Heintz-Buschart, A., Hofmann, M., Irvine, K. N., Kabisch, N., Kolek, F., Kraemer, R., Markevych, I., Martens, D., Müller, R., … Bonn, A. (2021). Pathways linking biodiversity to human health: A conceptual framework. *Environment International*, *150*, 106420.

Marteau, T. M., & Bekker, H. (1992). The development of a six-item short-form of the state scale of the Spielberger State—Trait Anxiety Inventory (STAI). *British Journal of Clinical Psychology*, *31*(3), 301-306.

Martin, L., White, M. P., Hunt, A., Richardson, M., Pahl, S., & Burt, J. (2020). Nature contact, nature connectedness and associations with health, wellbeing and pro-environmental behaviours. *Journal of Environmental Psychology*, *68*, 101389.

Martin, R. E., & Ochsner, K. N. (2016). The neuroscience of emotion regulation development: Implications for education. *Current Opinion in Behavioral Sciences*, *10,* 142-148.

Mason, M. J., & Korpela, K. (2009). Activity spaces and urban adolescent substance use and emotional health. *Journal of Adolescence*, *32*(4), 925-939.

Masters, R., Interrante, V., Watts, M., & Ortega, F. (2022, September). Virtual nature: Investigating the effect of biomass on immersive virtual reality forest bathing applications for stress reduction. *In ACM Symposium on Applied Perception 2022* (pp. 1-10).

Matsumoto, D. (2006). Are cultural differences in emotion regulation mediated by personality traits?. *Journal of Cross-cultural Psychology*, *37*(4), 421-437.

Matsumoto, D., Yoo, S. H., & Nakagawa, S. (2008). Culture, emotion regulation, and adjustment. *Journal of Personality and Social Psychology*, *94*(6), 925.

Matteson, K. C., Grace, J. B., & Minor, E. S. (2013). Direct and indirect effects of land use on floral resources and flower-visiting insects across an urban landscape. *Oikos*, *122*(5), 682-694.

Matthews, G., Jones, D. M., & Chamberlain, A. G. (1990). Refining the measurement of mood: The UWIST mood adjective checklist. *British Journal of Psychology*, *81*(1), 17-42.

Mattila, O., Korhonen, A., Pöyry, E., Hauru, K., Holopainen, J., & Parvinen, P. (2020). Restoration in a virtual reality forest environment. *Computers in Human Behavior*, 107, 106295.

Maund, P. R., Irvine, K. N., Reeves, J., Strong, E., Cromie, R., Dallimer, M., & Davies, Z. G. (2019). Wetlands for wellbeing: Piloting a nature-based health intervention for the management of anxiety and depression. *International Journal of Environmental Research and Public Health*, *16*(22), 4413.

Mauss, I. B., Bunge, S. A., & Gross, J. J. (2007). Automatic emotion regulation. *Social and Personality Psychology Compass*, *1*(1), 146-167.

Mauss, I. B., Bunge, S. A., & Gross, J. J. (2007). Automatic emotion regulation. *Social and Personality Psychology Compass*, *1*(1), 146-167.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, *24*(4), 503-515.

Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior*, *41*(5), 607-643.

McCoach, D. B., Gable, R. K., & Madura, J. P. (2013). *Instrument development in the affective domain* (Vol. 10, pp. 978-1). New York, NY: Springer.

McCormick, R. (2017). Does access to green space impact the mental well-being of children: A systematic review. *Journal of Pediatric Nursing*, *37*, 3-7.

McCrae, R. R., & Costa Jr, P. T. (1997). Personality trait structure as a human universal. *American Psychologist*, *52*(5), 509.

McCrae, R. R., & Costa, P. T. (2008). Empirical and theoretical status of the five-factor model of personality traits. *The SAGE Handbook of Personality Theory and Assessment*, *1*, 273-294.

McDougall, C. W., Quilliam, R. S., Hanley, N., & Oliver, D. M. (2020). Freshwater blue space and population health: An emerging research agenda. *Science of the Total Environment*, *737*, 140196.

McEwan, K., Ferguson, F. J., Richardson, M., & Cameron, R. (2020). The good things in urban nature: A thematic framework for optimising urban planning for nature connectedness. *Landscape and Urban Planning*, *194*, 103687.

McGee, M. D., Borstein, S. R., Meier, J. I., Marques, D. A., Mwaiko, S., Taabu, A Kishe, M. A., O'Meara, B., Bruggmann, R., Excoffier, L., & Seehausen, O. (2020). The ecological and genomic basis of explosive adaptive radiation. *Nature*, *586*(7827), 75-79.

McLaughlin, K. A., Hatzenbuehler, M. L., Mennin, D. S., & Nolen-Hoeksema, S. (2011). Emotion dysregulation and adolescent psychopathology: A prospective study. *Behaviour Research and Therapy*, *49*(9), 544-554.

McMahan, E. A., & Estes, D. (2015). The effect of contact with natural environments on positive and negative affect: A meta-analysis. *The Journal of Positive Psychology*, *10*(6), 507-519.

McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *Manual for the Profile of Mood States*. Educational and Industrial Testing Service.

McRae, K., Heller, S. M., John, O. P., & Gross, J. J. (2011). Context-dependent emotion regulation: Suppression and reappraisal at the Burning Man festival. *Basic and Applied Social Psychology*, *33*(4), 346-350.

McRae, K., Rhee, S. H., Gatt, J. M., Godinez, D., Williams, L. M., & Gross, J. J. (2017). Genetic and environmental influences on emotion regulation: A twin study of cognitive reappraisal and expressive suppression. *Emotion*, *17*(5), 772.

Mehrabian, A., & Russell, J. A. (1974). The basic emotional impact of environments. *Perceptual and Motor Skills*, *38*(1), 283-301.

Meidenbauer, K. L., Stenfors, C. U., Bratman, G. N., Gross, J. J., Schertz, K. E., Choe, K. W., & Berman, M. G. (2020). The affective benefits of nature exposure: What's nature got to do with it?. *Journal of Environmental Psychology*, *72*, 101498.

Menardo, E., Brondino, M., Hall, R., & Pasini, M. (2021). Restorativeness in Natural and Urban Environments: A Meta-Analysis. *Psychological Reports*, *124*(2), 417–437.

Menardo, E., Di Marco, D., Ramos, S., Brondino, M., Arenas, A., Costa, P., Vaz de Carvalho, C., & Pasini, M. (2022). Nature and mindfulness to cope with work-related stress: A narrative review. *International Journal of Environmental Research and Public Health*, *19*(10), 5948.

Meng, L., Li, S., & Zhang, X. (2024). Assessing biodiversity's impact on stress and affect from urban to conservation areas: A virtual reality study. *Ecological Indicators*, 158, 111532.

Meuwese, D., Dijkstra, K., Maas, J., & Koole, S. L. (2021). Beating the blues by viewing Green: Depressive symptoms predict greater restoration from stress and negative affect after viewing a nature video. *Journal of Environmental Psychology*, 75, 101594.

Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy*, *28*(6), 487-495.

Millsap, R. E. (2012). *Statistical approaches to measurement invariance*. Routledge.

Mitmansgruber, H., Beck, T. N., Höfer, S., & Schüßler, G. (2009). When you don't like what you feel: Experiential avoidance, mindfulness and meta-emotion in emotion regulation. *Personality and Individual Differences*, *46*(4), 448-453.

Mochizuki-Kawai, H., Matsuda, I., & Mochizuki, S. (2020). Viewing a flower image provides automatic recovery effects after psychological stress. *Journal of Environmental Psychology*, *70*, 101445.

Moore, S. A., Zoellner, L. A., & Mollenholt, N. (2008). Are expressive suppression and cognitive reappraisal associated with stress-related symptoms?. *Behaviour Research and Therapy*, *46*(9), 993-1000.

Moors, A. (2007). Can cognitive methods be used to study the unique aspect of emotion: An appraisal theorist's answer. *Cognition and Emotion*, *21*(6), 1238-1269.

Morgado, F. F., Meireles, J. F., Neves, C. M., Amaral, A. C., & Ferreira, M. E. (2017). Scale development: ten main limitations and recommendations to improve future research practices. *Psicologia: Reflexão e Crítica*, *30*(0), 3.

Morgan, E. (2011). *The aquatic ape hypothesis: the most credible theory of human evolution*. Souvenir Press.

Mosso, J. L., Gorini, A., De La Cerda, G., Obrador, T., Almazan, A., Mosso, D., Nieto, J. J., & Riva, G. (2009). Virtual reality on mobile phones to reduce anxiety in outpatient surgery. *Studies in Health Technology and Informatics*, *142*, 195–200.

Mostajeran, F., Krzikawski, J., Steinicke, F., & Kühn, S. (2021). Effects of exposure to immersive videos and photo slideshows of forest and urban environments. *Scientific Reports*, *11*(1), 3994.

Mueller, M. A., & Flouri, E. (2020). Neighbourhood greenspace and children's trajectories of self-regulation: Findings from the UK Millennium Cohort Study. *Journal of Environmental Psychology*, *71*, 101472.

Murray, C. V., Jacobs, J. I. L., Rock, A. J., & Clark, G. I. (2021). Attachment style, thought suppression, self-compassion and depression: Testing a serial mediation model. *PLoS One, 16*(1), e0245056.

Mygind, L., Elsborg, P., Schipperijn, J., Boruff, B., Lum, J. A. G., Bølling, M., Flensborg-Madsen, T., Bentsen, P., Enticott, P. G., & Christian, H. (2022). Is vegetation cover in key behaviour settings important for early childhood socioemotional function? A preregistered, cross-sectional study. *Developmental Science*, *25*(3), e13200.

Mytton, O., Townsend, N., Rutter, H., & Foster, C. (2012). Green space and physical activity: An observational study using Health Survey for England data. *Health & Place, 18*, 1034 - 1041.

Naragon-Gainey, K., McMahon, T. P., & Chacko, T. P. (2017). The structure of common emotion regulation strategies: A meta-analytic examination. *Psychological Bulletin*, *143*(4), 384.

Nasar, J. L. (2008). Assessing perceptions of environments for active living. *American Journal of Preventive Medicine*, *34*(4), 357-363.

Natural England. (2018). *Monitor of Engagement with the Natural Environment*. Technical Report, 2009 - 2018.

Nazif-Munoz, J. I., Cedeno Laurent, J. G., Browning, M., Spengler, J., & Olvera Álvarez, H. A. (2020). Green, brown, and gray: associations between different measurements of land patterns and depression among nursing students in El Paso, Texas. *International Journal of Environmental Research and Public Health*, 17(21), 8146.

Neale, C., Griffiths, A., Chalmin-Pui, L. S., Mendu, S., Boukhechba, M., & Roe, J. (2021). Color aesthetics: A transatlantic comparison of psychological and physiological impacts of warm and cool colors in garden landscapes. *Wellbeing, Space and Society*, *2*, 100038.

Neill, C., Gerard, J., & Arbuthnott, K. D. (2019). Nature contact and mood benefits: Contact duration and mood type. *The Journal of Positive Psychology*, *14*(6), 756-767.

Newman, M. A. R. K., Gatersleben, B., Wyles, K. J., & Ratcliffe, E. (2022). The use of virtual reality in environment experiences and the importance of realism. *Journal of Environmental Psychology*, *79*, 101733.

Ng, W., & Diener, E. (2009). Personality differences in emotions: Does emotion regulation play a role?. *Journal of Individual Differences*, *30*(2), 100-106.

Nghiem, T. P. L., Wong, K. L., Jeevanandam, L., Chang, C. C., Tan, L. Y. C., Goh, Y., & Carrasco, L. R. (2021). Biodiverse urban forests, happy people: Experimental evidence linking perceived biodiversity, restoration, and emotional wellbeing. *Urban Forestry & Urban Greening*, *59*, 127030.

Nicolaou, M. A., Gunes, H., & Pantic, M. (2011). Continuous prediction of spontaneous affect from multiple cues and modalities in valence-arousal space. *IEEE Transactions on Affective Computing*, *2*(2), 92-105.

Niedenthal, P. M., Barsalou, L. W., Winkielman, P., Krauth-Gruber, S., & Ric, F. (2005). Embodiment in attitudes, social perception, and emotion. *Personality and Social Psychology Review*, *9*(3), 184-211.

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature relatedness scale: Linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior*, *41*(5), 715-740.

Nolen-Hoeksema, S., & Aldao, A. (2011). Gender and age differences in emotion regulation strategies and their relationship to depressive symptoms. *Personality and Individual Differences*, *51*(6), 704-708.

Nolen-Hoeksema, S., Morrow, J., & Fredrickson, B. L. (1993). Response styles and the duration of episodes of depressed mood. *Journal of Abnormal Psychology*, *102*(1), 20.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*(5), 400-424.

Nordh, H., Hartig, T., Hagerhall, C. M., & Fry, G. (2009). Components of small urban parks that predict the possibility for restoration. *Urban Forestry & Urban Greening*, *8*(4), 225-235.

Norwood, M.F., Lakhani, A., Fullagar, S., Maujean, A., Downes, M.J., Byrne, J., Stewart, A., Barber, B.L., & Kendall, E. (2019). A narrative and systematic review of the behavioural, cognitive and emotional effects of passive nature exposure on young people: Evidence for prescribing change. *Landscape and Urban Planning*, *189*, 71-79.

Nukarinen, T., Rantala, J., Korpela, K., Browning, M. H., Istance, H. O., Surakka, V., & Raisamo, R. (2022). Measures and modalities in restorative virtual natural environments: An integrative narrative review. *Computers in Human Behavior*, 126, 107008.

Ochsner, K. N., & Gross, J. J. (2005). The cognitive control of emotion. *Trends in Cognitive Sciences*, *9*(5), 242-249.

Ochsner, K. N., & Gross, J. J. (2008). Cognitive emotion regulation: Insights from social cognitive and affective neuroscience. *Current Directions in Psychological Science*, *17*(2), 153-158.

Ochsner, K. N., & Gross, J. J. (2014). The neural bases of emotion and emotion regulation: A valuation perspective. In J. J. Gross (Ed.), *Handbook of Emotion Regulation* (pp. 23–42). The Guilford Press.

Ohly, H., White, M. P., Wheeler, B. W., Bethel, A., Ukoumunne, O. C., Nikolaou, V., & Garside, R. (2016). Attention Restoration Theory: A systematic review of the attention restoration potential of exposure to natural environments. *Journal of Toxicology and Environmental Health, Part B, 19*(7), 305-343.

Olderbak, S., Uusberg, A., MacCann, C., Pollak, K. M., & Gross, J. J. (2023). The process model of emotion regulation questionnaire: assessing individual differences in strategy stage and orientation. *Assessment*, *30*(7), 2090-2114.

Olvera-Alvarez, H. A., Browning, M. H., Neophytou, A. M., & Bratman, G. N. (2021). Associations of residential brownness and greenness with fasting glucose in young healthy adults living in the desert. *International Journal of Environmental Research and Public Health*, 18(2), 520.

Olwig, K. R. (2005). Liminality, seasonality and landscape. *Landscape Research*, 30(2), 259-271.

Oswald, T. K., Kohler, M., Rumbold, A. R., Kedzior, S. G., & Moore, V. M. (2023). The acute psychological effects of screen time and the restorative potential of nature immersion amongst adolescents: A randomised pre-post pilot study. *Journal of Environmental Psychology*, *92*, 102183.

Palanica, A., Lyons, A., Cooper, M., Lee, A., & Fossat, Y. (2019). A comparison of nature and urban environments on creative thinking across different levels of reality. *Journal of Environmental Psychology*, 63, 44-51.

Pálsdóttir, A. M., Stigsdotter, U. K., Persson, D., Thorpert, P., & Grahn, P. (2018). The qualities of natural environments that support the rehabilitation process of individuals with stress-related mental disorder in nature-based rehabilitation. *Urban Forestry & Urban Greening*, *29*, 312-321.

Pandey, R., & Choubey, A. K. (2010). Emotion and health: An overview. *SIS Journal of Projective Psychology & Mental Health*, *17*(2).

Panno, A., Theodorou, A., Carrus, G., Imperatori, C., Spano, G., & Sanesi, G. (2020). Nature reappraisers, benefits for the environment: a model linking cognitive reappraisal, the "being away" dimension of restorativeness and eco-friendly behavior. *Frontiers in Psychology*, *11*, 1986.

Park, B. J., Tsunetsugu, Y., Ishii, H., Furuhashi, S., Hirano, H., Kagawa, T., & Miyazaki, Y. (2008). Physiological effects of Shinrin-yoku (taking in the atmosphere of the forest) in a mixed forest in Shinano Town, Japan. *Scandinavian Journal of Forest Research*, *23*(3), 278-283.

Park, B. J., Tsunetsugu, Y., Kasetani, T., Kagawa, T., & Miyazaki, Y. (2010). The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan. *Environmental Health and Preventive Medicine*, *15*, 18-26.

Park, S. N., & Jo, H. J. (2016). Physiological and psychological effects of exposure to artificial waterfalls in green space planning. *International Journal of Environmental Science*, *25*(9), 1213-1222.

Parker, M. N., Tanofsky-Kraff, M., Crosby, R. D., Shank, L. M., Kwarteng, E. A., Loch, L. K., Faulkner, L. M., Haynes, H. E., Gupta, S., Fatima, S., Dzombak, J. W. P., Zenno, A., Engel, S. G., Brady, S. M., Yanovski, S. Z., & Yanovski, J. A. (2022). State negative affect in relation to loss-of-control eating among children and adolescents in the natural environment. *Appetite*, *178*, 106166.

Parkinson, B., & Totterdell, P. (1999). Classifying affect-regulation strategies. *Cognition & Emotion*, *13*(3), 277-303.

Pasini, M., Berto, R., Brondino, M., Hall, R., & Ortner, C. (2014). How to measure the restorative quality of environments: The PRS-11. *Procedia-Social and Behavioral Sciences*, *159*, 293-297.

Pasini, M., Berto, R., Scopelliti, M., & Carrus, G. (2009). Measuring the restorative value of the environment: Contribution to the validation of the Italian version of the Perceived Restorativeness Scale. *Giunti Organizzazioni Speciali*, *257*(56), 3–11.

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology*, *51*(6), 768-774.

Pazhouhanfar, M. (2018). Role of space qualities of urban parks on mood change. *Psychological Studies*, *63*(1), 25-31.

Pearson, D. G., & Craig, T. (2014). The great outdoors? Exploring the mental health benefits of natural environments. *Frontiers in psychology*, *5*, 93642.

Pearson, M., Gaines, K., Pati, D., Colwell, M., Motheral, L., & Adams, N. G. (2019). The physiological impact of window murals on pediatric patients. *HERD: Health Environments Research & Design Journal*, *12*(2), 116-129.

Perrin, J. L., & Benassi, V. A. (2009). The connectedness to nature scale: A measure of emotional connection to nature?. *Journal of Environmental Psychology*, *29*(4), 434-440.

Perugini, M., Bonnes, M., Aiello, A., & Ercolani, A. P. (2002). Il modello circonflesso delle qualità affettive dei luoghi: Sviluppo di uno strumento valutativo

Italiano [The affective quality of places' circumplex model: Development of an Italian valutative tool]. *Testing Psicometria Metodologia, 9*(4), 131–152.

Peschardt, K. K., & Stigsdotter, U. K. (2013). Associations between park characteristics and perceived restorativeness of small public urban green spaces. *Landscape and Urban Planning*, *112*, 26-39.

Peters, M., & Passchier, J. (2006). Translating instruments for cross-cultural studies in headache research. *Headache: The Journal of Head and Face Pain*, *46*(1), 82-91.

Philippot, P., Baeyens, C., Douilliez, C., & Francart, B. (2004). Cognitive regulation of emotion: Application to clinical disorders. *The Regulation of Emotion*, 71-97.

Phillips, M. L., Drevets, W. C., Rauch, S. L., & Lane, R. (2003). Neurobiology of emotion perception I: The neural basis of normal emotion perception. *Biological Psychiatry*, *54*(5), 504-514.

Pirgie, L., Schwab, M., Sudkamp, J., Höltge, J., & Cervinka, R. (2016). Recreation in the national park-Visiting restorative places in the National Park Thayatal, Austria fosters connectedness and mindfulness. *Zeitschrift für Umweltpsychologie*, *20*, 59-74.

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., & Duffy, S. (2006). Guidance on the conduct of narrative synthesis in systematic reviews. *A product from the ESRC Methods Programme Version*, *1*(1), b92.

Preiszner, B., Papp, S., Pipoly, I., Seress, G., Vincze, E., Liker, A., & Bókony, V. (2017). Problem-solving performance and reproductive success of great tits in urban and forest habitats. *Animal Cognition, 20*(1), 53-63.

Prescott, S. L., & Logan, A. C. (2016). Transforming life: a broad view of the developmental origins of health and disease concept from an ecological justice perspective. *International Journal of Environmental Research and Public Health*, *13*(11), 1075.

Pretty, J. (2004). How nature contributes to mental and physical health. *Spirituality and Health International*, *5*(2), 68-78.

Pretty, J., Peacock, J., Hine, R., Sellens, M., South, N., & Griffin, M. (2007). Green exercise in the UK countryside: Effects on health and psychological well-being, and implications for policy and planning. *Journal of Environmental Planning and Management*, *50*(2), 211-231.

Pretty, J., Peacock, J., Sellens, M., & Griffin, M. (2005). The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research*, *15*(5), 319-337.

Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review*, *41*, 71-90.

Quoidbach, J., Berry, E. V., Hansenne, M., & Mikolajczak, M. (2010). Positive emotion regulation and well-being: Comparing the impact of eight savoring and dampening strategies. *Personality and Individual Differences*, *49*(5), 368-373.

Rahnema, S., Sedaghathoor, S., Allahyari, M. S., Damalas, C. A., & El Bilali, H. (2019). Preferences and emotion perceptions of ornamental plant species for green space designing among urban park users in Iran. *Urban Forestry & Urban Greening*, *39*, 98-108.

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal of Research in Personality*, *41*(1), 203-212.

Rapuano, M., Ruotolo, F., Ruggiero, G., Masullo, M., Maffei, L., Galderisi, A., Palmieri, A., & Iachini, T. (2022). Spaces for relaxing, spaces for recharging: How parks affect people's emotions. *Journal of Environmental Psychology*, *81*, 101809.

Ray, T. N., Franz, S. A., Jarrett, N. L., & Pickett, S. M. (2021). Nature enhanced meditation: effects on mindfulness, connectedness to nature, and pro-environmental behavior. *Environment and Behavior*, *53*(8), 864-890.

Raykov, T. (2011). Evaluation of convergent and discriminant validity with multitrait–multimethod correlations. *British Journal of Mathematical and Statistical Psychology*, *64*(1), 38-52.

Reddon, J. R., & Durante, S. B. (2019). Prisoner exposure to nature: Benefits for wellbeing and citizenship. *Medical Hypotheses*, *123*, 13-18.

Reese, G., Stahlberg, J., & Menzel, C. (2022). Digital shinrin-yoku: Do nature experiences in virtual reality reduce stress and increase well-being as strongly as similar experiences in a physical forest?. *Virtual Reality*, 26(3), 1245-1255.

Richardson, E. A., & Mitchell, R. (2010). Gender differences in relationships between urban green space and health in the United Kingdom. *Social Science & Medicine*, *71*(3), 568-575.

Richardson, M. (2019). Beyond restoration: considering emotion regulation in natural well-being. *Ecopsychology*, *11*(2), 123-129.

Richardson, M., & McEwan, K. (2018). 30 days wild and the relationships between engagement with nature's beauty, nature connectedness and well-being. *Frontiers in Psychology, 9*, 1500.

Richardson, M., & Sheffield, D. (2015). Reflective self-attention: A more stable predictor of connection to nature than mindful attention. *Ecopsychology*, *7*(3), 166-175.

Richardson, M., McEwan, K., Maratos, F., & Sheffield, D. (2016). Joy and calm: How an evolutionary functional model of affect regulation informs positive emotions in nature. *Evolutionary Psychological Science*, *2*(4), 308-320.

Ríos-Rodríguez, M. L., Rosales, C., Hernández, B., & Lorenzo, M. (2024). Benefits for emotional regulation of contact with nature: a systematic review. *Frontiers in Psychology*, *15*, 1402885.

Roberts, A., Hinds, J., & Camic, P. M. (2020). Nature activities and wellbeing in children and young people: A systematic literature review. *Journal of Adventure Education and Outdoor Learning*, 20(4), 298-318.

Roe, J. (2008). *The restorative power of natural and built environments*. PhD Thesis. Heriot-Watt University.

Roe, J. J., & Aspinall, P. A. (2012). Adolescents' daily activities and the restorative niches that support them. *International Journal of Environmental Research and Public Health*, *9*(9), 3227-3244.

Roe, J. J., Aspinall, P. A., & Ward Thompson, C. (2017). Coping with stress in deprived urban neighborhoods: what is the role of green space according to life stage?. *Frontiers in Psychology*, *8*, 1760.

Roe, J., & Aspinall, P. (2011). The restorative benefits of walking in urban and rural settings in adults with good and poor mental health. *Health & Place*, *17*(1), 103-113.

Roelofs, J., Rood, L., Meesters, C., Te Dorsthorst, V., Bögels, S., Alloy, L. B., & Nolen-Hoeksema, S. (2009). The influence of rumination and distraction on depressed and anxious mood: A prospective examination of the response styles theory in children and adolescents. *European Child & Adolescent Psychiatry*, *18*(10), 635-642.

Rojas-Rueda, D., Nieuwenhuijsen, M. J., Gascon, M., Perez-Leon, D., & Mudu, P. (2019). Green spaces and mortality: a systematic review and meta-analysis of cohort studies. *The Lancet Planetary Health*, 3(11), e469-e477.

Rood, L., Roelofs, J., Bögels, S. M., Nolen-Hoeksema, S., & Schouten, E. (2009). The influence of emotion-focused rumination and distraction on depressive symptoms in non-clinical youth: A meta-analytic review. *Clinical Psychology Review*, *29*(7), 607-616.

Rosa, C. D., Collado, S., Profice, C. C., & Pires, P. P. (2022). The 7-items version of the connectedness to nature scale: A study of its validity and reliability with Brazilians. *Current Psychology*, *41*(8), 5105-5110.

Roseman, I. J. (1991). Appraisal determinants of discrete emotions. *Cognition & Emotion*, *5*(3), 161-200.

Rozario, K., Oh, R. R. Y., Marselle, M., Schröger, E., Gillerot, L., Ponette, Q., Godbold, D., Haluza, D., Kilpi, K., Müller, D., Roeber, U., Verheyen, K., Muys, B., Müller, S., Shaw, S., & Bonn, A. (2024). The more the merrier? Perceived forest biodiversity promotes short-term mental health and well-being—A multicentre study. *People and Nature*, *6*(1), 180-201.

Ruiz-Gil, T., Acuña, J. J., Fujiyoshi, S., Tanaka, D., Noda, J., Maruyama, F., & Jorquera, M. A. (2020). Airborne bacterial communities of outdoor environments and their associated influencing factors. *Environment International*, *145*, 106156.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*(6), 1161.

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, 110(1), 145.

Russell, J. A., & Barrett, L. F. (1999). Core affect, prototypical emotional episodes, and other things called emotion: dissecting the elephant. *Journal of Personality and Social Psychology*, 76(5), 805.

Russell, J. A., & Carroll, J. M. (1999). The phoenix of bipolarity: Reply to Watson and Tellegen (1999). *Psychological Bulletin, 125*(5), 611–617.

Russell, J. A., & Mehrabian, A. (1977). Evidence for a three-factor theory of emotions. *Journal of Research in Personality*, *11*(3), 273-294.

Russell, J. A., & Snodgrass, J. (1987). Emotion and the environment. In I. Altaian & D. Stokols (Eds.), *Handbook of Environmental Psychology* (pp. 245-280). New York: Wiley.

Ryan, R. M., & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality*, *65*(3), 529-565.

Rygal, N., & Swami, V. (2021). Simulated nature and positive body image: A comparison of the impact of exposure to images of blue and green spaces. *Body Image*, *39*, 151-155.

Saarni, C. (1984). An observational study of children's attempts to monitor their expressive behavior. *Child Development*, 1504-1513.

Sadowski, I., Böke, N., Mettler, J., Heath, N., & Khoury, B. (2020). Naturally mindful? The role of mindfulness facets in the relationship between nature relatedness and subjective well-being. *Current Psychology*, 1-16.

Sahni, P., & Kumar, J. (2021). Exploring the relationship of human–nature interaction and mindfulness: a cross-sectional study. *Mental Health, Religion & Culture*, *24*(5), 450-462.

Sallay, V., Martos, T., Rosta-Filep, O., Horváth, Z., & Korpela, K. (2023). Profiles of perceived physical features and emotional experiences in favorite places: Discovering ambivalent place preferences. *Journal of Environmental Psychology*, *90*, 102084.

Samus, A., Freeman, C., Van Heezik, Y., Krumme, K., & Dickinson, K. J. (2022). How do urban green spaces increase well-being? The role of perceived wildness and nature connectedness. *Journal of Environmental Psychology*, *82*, 101850.

Sands, M., Livingstone, K. M., & Isaacowitz, D. M. (2018). Characterizing age-related positivity effects in situation selection. *International Journal of Behavioral Development*, *42*(4), 396-404.

Sanyer, M. M., Bettmann, J. E., Anstadt, G., Ganesh, K., & Hanley, A. W. (2023). Decenter to reenter nature: Relationships between decentering, self-transcendence, and nature connectedness. *Psychology of Consciousness: Theory, Research, and Practice*, *10*(3), 205.

Saraceno, J. (2017). *CBT Eco-Art Therapy: Mood Regulation with Young Adults in Nature*. Notre Dame de Namur University.

Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review*, *69*(5), 379.

Schebella, M. F., Weber, D., Schultz, L., & Weinstein, P. (2020). The nature of reality: Human stress recovery during exposure to biodiverse, multisensory virtual environments. *International Journal of Environmental Research and Public Health*, 17(1), 56.

Scherer, K. R., Schorr, A., & Johnstone, T. (Eds.). (2001). *Appraisal processes in emotion: Theory, methods, research.* Oxford University Press.

Schirda, B., Valentine, T. R., Aldao, A., & Prakash, R. S. (2016). Age-related differences in emotion regulation strategies: Examining the role of contextual factors. *Developmental Psychology*, *52*(9), 1370.

Schubert, T. W., Friedmann, F., & Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. *Presence: Teleoperators and Virtual Environments, 10*, 266–281.

Schultz, P. W. (2002). Inclusion with nature: The psychology of human-nature relations. *Psychology of Sustainable Development*, 61-78.

Schumacker, R. E., & Lomax, R. G. (2010). *A Beginner's Guide to Structural Equation Modeling* (3rd Edition ed.). New York: Routledge Taylor and Francis Group, LLC

Schumacker, R. E., & Lomax, R. G. (2015). *A Beginner's Guide to Structural Equation Modeling* (4th ed.). New York, NY: Routledge.

Schutte, N. S., & Malouff, J. M. (2018). Mindfulness and connectedness to nature: A meta-analytic investigation. *Personality and Individual Differences*, *127*, 10-14.

Schutte, N. S., Bhullar, N., Stilinović, E. J., & Richardson, K. (2017). The impact of virtual environments on restorativeness and affect. *Ecopsychology*, 9(1), 1-7.

Schutte, N. S., Malouff, J. M., Price, I., Walter, S., Burke, G., & Wilkinson, C. (2008). Person–situation interaction in adaptive emotional functioning. *Current Psychology*, 27, 102-111.

Schwarz, G. (1978). Estimating the dimension of a model. *The Annals of Statistics*, 461-464.

Schwarz, N. (2012). Why researchers should think "real-time": A cognitive rationale. In M. R. Mehl & T. S. Conner (Eds.), *Handbook of Research Methods for Studying Daily Life* (pp. 22–42). The Guilford Press.

Schweitzer, J. P., & Gionfra, S. (2018). Nature-based education for resilient cities. *Lifelong Learning and Education in Healthy and Sustainable Cities*, 355-376.

Scopelliti, M., Carrus, G., & Bonaiuto, M. (2019). Is it really nature that restores people? A comparison with historical sites with high restorative potential. *Frontiers in Psychology*, *9*, 2742.

Severin, M. I., Raes, F., Notebaert, E., Lambrecht, L., Everaert, G., & Buysse, A. (2022). A qualitative study on emotions experienced at the coast and their influence on well-being. *Frontiers in Psychology*, *13*.

Shah, R. M. (2015). Public perceptions of Antarctic values: shaping future environmental protection policy. *Procedia-Social and Behavioral Sciences, 168*, 211-218.

Shanahan, D. F., Astell-Burt, T., Barber, E. A., Brymer, E., Cox, D. T. C., Dean, J., Depledge, M., Fuller, R. A., Hartig, T., Irvine, K. N., Jones, A., Kikillus, H., Lovell, R., Mitchell, R., Niemelä, J., Nieuwenhuijsen, M., Pretty, J., Townsend, M., van Heezik, Y., Warber, S., Gaston, K. J. (2019). Nature-Based Interventions for Improving Health and Wellbeing: The Purpose, the People and the Outcomes. *Sports (Basel, Switzerland)*, *7*(6), 141.

Shanahan, D. F., Bush, R., Gaston, K. J., Lin, B. B., Dean, J., Barber, E., & Fuller, R. A. (2016). Health benefits from nature experiences depend on dose. *Scientific Reports*, *6*(1), 1-10.

Shanahan, D. F., Fuller, R. A., Bush, R., Lin, B. B., & Gaston, K. J. (2015). The health benefits of urban nature: how much do we need?. *BioScience*, *65*(5), 476-485.

Sheppes, G., Scheibe, S., Suri, G., & Gross, J. J. (2011). Emotion-regulation choice. *Psychological Science, 22*(11), 1391–1396.

Shinew, K. J., Glover, T. D., & Parry, D. C. (2004). Leisure spaces as potential sites for interracial interaction: Community gardens in urban areas. *Journal of Leisure Research*, *36*(3), 336-355.

Shwartz, A., Turbé, A., Simon, L., & Julliard, R. (2014). Enhancing urban biodiversity and its influence on city-dwellers: An experiment. *Biological Conservation*, *171*, 82-90.

Siddaway, A. P., Wood, A. M., & Hedges, L. V. (2019). How to do a systematic review: a best practice guide for conducting and reporting narrative reviews, meta-analyses, and meta-syntheses. *Annual Review of Psychology*, 70(1), 747-770.

Sighinolfi, C., Pala, A. N., Chiri, L. R., Marchetti, I., & Sica, C. (2010). *Difficulties in Emotion Regulation Scale* (DERS): Traduzione e adattamento Italiano [Difficulties in Emotion Regulation Scale (DERS): The Italian translation and adaptation]. *Psicoterapia Cognitiva e Comportamentale, 16*(2), 141–170.

Simonds, J., & Rothbart, M. K. (2004, October). The Temperament in Middle Childhood Questionnaire (TMCQ): A computerized self-report instrument for ages 7–10. In *Poster session presented at the Occasional Temperament Conference,* Athens, GA.

Smith, K. E., Mason, T. B., Juarascio, A., Weinbach, N., Dvorak, R., Crosby, R. D., & Wonderlich, S. A. (2020). The momentary interplay of affect, attention bias, and expectancies as predictors of binge eating in the natural environment. *International Journal of Eating Disorders*, *53*(4), 586-594.

Smith, N. R., Lewis, D. J., Fahy, A., Eldridge, S., Taylor, S. J., Moore, D. G., Clark, C., Stansfeld, S. A., & Cummins, S. (2015). Individual socio-demographic factors and perceptions of the environment as determinants of inequalities in adolescent physical and psychological health: the Olympic Regeneration in East London (ORiEL) study. *BMC Public Health*, *15*(1), 1-18.

Snell, T. L., Lam, J. C. S., Lau, W. W.-Y., Lee, I., Maloney, E. M., Mulholland, N., Wilson, L., & Wynne, L. (2016). Contact with nature in childhood and adult depression. *Children, Youth and Environments*, *26*(1), 111-124.

Snell, T. L., Simmonds, J. G., & Klein, L. M. (2020). Exploring the impact of contact with nature in childhood on adult personality. *Urban Forestry & Urban Greening*, *55*, 126864.

Sousa, V. D., & Rojjanasrirat, W. (2011). Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline. *Journal of Evaluation in Clinical Practice*, *17*(2), 268-274.

Southon, G., Jorgensen, A., Dunnett, N., Hoyle, H., & Evans, K. (2018). Perceived species-richness in urban green spaces: Cues, accuracy and well-being impacts. *Landscape and Urban Planning*, 172, 1-10.

Spaapen, D. L., Waters, F., Brummer, L., Stopa, L., & Bucks, R. S. (2014). The emotion regulation questionnaire: validation of the ERQ-9 in two community samples. *Psychological Assessment*, *26*(1), 46.

Spano, G., Theodorou, A., Reese, G., Carrus, G., Sanesi, G., & Panno, A. (2023). Virtual nature, psychological and psychophysiological outcomes: A systematic review. *Journal of Environmental Psychology*, *89*, 102044.

Steel, P., Schmidt, J., & Shultz, J. (2008). Refining the relationship between personality and subjective well-being. *Psychological Bulletin*, *134*(1), 138.

Stewart, M., & Haaga, D. A. (2018). State mindfulness as a mediator of the effects of exposure to nature on affect and psychological well-being. *Ecopsychology*, *10*(1), 53-60.

Stickdorn M., Schneider J. (2011). *This Is Service Design Thinking: Basics, Tools, Cases*. Bis Publisher (English Edition).

Su, J. C., Park, I. J. K., Chang, J., Kim, S. Y., Dezutter, J., Seol, K. O., Lee, R. M., Soto, J. A., Zamboanga, B. L., Ham, L. S., Hurley, E. A., & Brown, E. (2015). Differential links between expressive suppression and well-being among chinese and Mexican American college students. *Asian American Journal of Psychology*, *6*(1), 15–24.

Sudimac, S., & Kühn, S. (2024). Can a nature walk change your brain? Investigating hippocampal brain plasticity after one hour in a forest. *Environmental Research, 262*, 119813.

Sukhera, J. (2022). Narrative reviews: flexible, rigorous, and practical. *Journal of Graduate Medical Mducation*, 14(4), 414-417.

Summerson, R., & Lieser, J. L. (2018). Opinion: wilderness and aesthetic values in the Antarctic sea-ice zone. *The Polar Journal*, *8*(1), 16-28.

Sun, Y., Li, F., He, T., Meng, Y., Yin, J., Yim, I. S., Xu, L., & Wu, J. (2023). Physiological and affective responses to green space virtual reality among pregnant women. *Environmental Research*, *216*, 114499.

Suri, G., Sheppes, G., Young, G., Abraham, D., McRae, K., & Gross, J. J. (2018). Emotion regulation choice: The role of environmental affordances. *Cognition and Emotion*, *32*(5), 963-971.

Swami, V., Barron, D., Todd, J., Horne, G., & Furnham, A. (2020). Nature exposure and positive body image:(Re-) examining the mediating roles of connectedness to nature and trait mindfulness. *Body Image*, *34*, 201-208.

Swami, V., Robinson, C., & Furnham, A. (2022). Positive Rational Acceptance of Body Image Threats Mediates the Association Between Nature Exposure and Body Appreciation. *Ecopsychology*, *14*(2), 118-125.

Swami, V., White, M. P., Voracek, M., Tran, U. S., Aavik, T., Ranjbar, H. A., ... & Lombardo, C. (2024). Exposure and connectedness to natural environments: An examination of the measurement invariance of the Nature Exposure Scale (NES) and Connectedness to Nature Scale (CNS) across 65 nations, 40 languages, gender identities, and age groups. *Journal of Environmental Psychology*, *99*, 102432.

Tabachnick, B. G., & Fidell, L. S. (2013). Using Multivariate Statistics (6th ed.). Boston, MA: Pearson.

Takeuchi, H., Taki, Y., Hashizume, H., Sassa, Y., Nagase, T., Nouchi, R., & Kawashima, R. (2011). Cerebral blood flow during rest associates with general intelligence and creativity. *PLoS One, 6*(9), e25532.

Talamo, A., Giorgi, S., and Mellini, B. (2011). "Designing technologies for ageing: is simplicity always a leading criterion?" in *Proceedings of the 9th ACM SIGCHI Italian Chapter International Conference on Computer-Human Interaction: Facing Complexity*, (New York, NY: ACM), 33–36.

Talamo, A., Marocco, S., & Tricol, C. (2021). "The flow in the funnel": Modeling organizational and individual decision-making for designing financial AI-based systems. *Frontiers in Psychology*, 12, 697101.

Tamir, M., John, O. P., Srivastava, S., & Gross, J. J. (2007). Implicit theories of emotion: affective and social outcomes across a major life transition. *Journal of Personality and Social Psychology*, *92*(4), 731.

Tamir, M., Mitchell, C., & Gross, J. J. (2008). Hedonic and instrumental motives in anger regulation. *Psychological Science*, *19*(4), 324-328.

Tamosiunas, A., Grazuleviciene, R., Luksiene, D., Dedele, A., Reklaitiene, R., Baceviciene, M., Vencloviene, J., Bernotiene, G., Radisauskas, R., Malinauskiene, V., Milinaviciene, E., Bobak, M., Peasey, A., & Nieuwenhuijsen, M. J. (2014). Accessibility and use of urban green spaces, and cardiovascular health: findings from a Kaunas cohort study. *Environmental Health: A Global Access Science Source*, *13*(1), 20.

Tamres, L. K., Janicki, D., & Helgeson, V. S. (2002). Sex differences in coping behavior: A meta-analytic review and an examination of relative coping. *Personality and Social Psychology Review*, *6*(1), 2-30.

Tanay, G., & Bernstein, A. (2013). State Mindfulness Scale (SMS): development and initial validation. *Psychological Assessment*, *25*(4), 1286.

Tang, I. C., Tsai, Y. P., Lin, Y. J., Chen, J. H., Hsieh, C. H., Hung, S. H., Sullivan, W. C., Tang, H. F., & Chang, C. Y. (2017). Using functional Magnetic Resonance Imaging (fMRI) to analyze brain region activity when viewing landscapes. *Landscape and Urban Planning*, *162*, 137-144.

Terraciano, A., McCrae, R. R., & Costa Jr, P. T. (2003). Factorial and construct validity of the Italian Positive and Negative Affect Schedule (PANAS). *European Journal of Psychological Assessment*, *19*(2), 131.

Thayer, R. L. (1989). The experience of sustainable landscapes. *Landscape Journal*, *8*(2), 101-110.

Theodorou, A., Spano, G., Bratman, G. N., Monneron, K., Sanesi, G., Carrus, G., Imperatori, C., & Panno, A. (2023). Emotion regulation and virtual nature:

cognitive reappraisal as an individual-level moderator for impacts on subjective vitality. *Scientific Reports*, *13*(1), 5028.

Thorell, L. B., & Nyberg, L. (2008). The Childhood Executive Functioning Inventory (CHEXI): A new rating instrument for parents and teachers. *Developmental Neuropsychology*, *33*(4), 536-552.

Thurstone, L. L. (1947). *Multiple-factor analysis; a development and expansion of The Vectors of Mind.* University of Chicago Press.

Thygesen, M., Engemann, K., Holst, G. J., Hansen, B., Geels, C., Brandt, J., Pedersen, C. B., & Dalsgaard, S. (2020). The Association between Residential Green Space in Childhood and Development of Attention Deficit Hyperactivity Disorder: A Population-Based Cohort Study. *Environmental Health Perspectives, 128*(12), 127011.

Tice, D. M., & Bratslavsky, E. (2000). Giving in to feel good: The place of emotion regulation in the context of general self-control. *Psychological Inquiry*, *11*(3), 149-159.

Tillmann, S., Tobin, D., Avison, W., & Gilliland, J. (2018). Mental health benefits of interactions with nature in children and teenagers: a systematic review. *Journal of Epidemiology and Community Health*, *72*(10), 958–966.

Todorova, A., Asakawa, S., & Aikoh, T. (2004). Preferences for and attitudes towards street flowers and trees in Sapporo, Japan. *Landscape and Urban Planning*, *69*(4), 403-416.

Tomasso, L. P., Yin, J., Cedeño Laurent, J. G., Chen, J. T., Catalano, P. J., & Spengler, J. D. (2021). The relationship between nature deprivation and individual wellbeing across urban gradients under COVID-19. *International Journal of Environmental Research and Public Health*, *18*(4), 1511.

Tomitaka, M., Uchihara, S., Goto, A., & Sasaki, T. (2021). Species richness and flower color diversity determine aesthetic preferences of natural-park and urban-park visitors for plant communities. *Environmental and Sustainability Indicators*, *11*, 100130.

Tost, H., Reichert, M., Braun, U., Reinhard, I., Peters, R., Lautenbach, S., Hoell, A., Schwarz, E., Ebner-Priemer, U., Zipf, A., & Meyer-Lindenberg, A. (2019). Neural correlates of individual differences in affective benefit of real-life urban green space exposure. *Nature Neuroscience*, *22*(9), 1389-1393.

Trapnell, P. D., & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. *Journal of Personality and Social Psychology*, *76*(2), 284.

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research*, *27*, 247-259.

Tricco, A. C., Antony, J., Zarin, W., Strifler, L., Ghassemi, M., Ivory, J., Perrier, L., Hutton, B., Moher, D., & Straus, S. E. (2015). A scoping review of rapid review methods. *BMC Medicine*, *13*(1), 1-15.

Tsai, J. L. (2007). Ideal affect: Cultural causes and behavioral consequences. *Perspectives on Psychological Science*, *2*(3), 242-259.

Tsunetsugu, Y., Park, B. J., Ishii, H., Hirano, H., Kagawa, T., & Miyazaki, Y. (2007). Physiological effects of Shinrin-yoku (taking in the atmosphere of the forest) in an old-growth broadleaf forest in Yamagata Prefecture, Japan. *Journal of Physiological Anthropology*, *26*(2), 135-142.

Turner, M. L., & Engle, R. W. (1989). Is working memory capacity task dependent?. *Journal of Memory and Language*, *28*(2), 127-154.

Twedt, E., Rainey, R. M., & Proffitt, D. R. (2016). Designed natural spaces: informal gardens are perceived to be more restorative than formal gardens. *Frontiers in Psychology*, *7*, 88.

Twohig-Bennett, C., & Jones, A. (2018). The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environmental Research*, 166, 628-637.

Tylka, T. L., & Wood-Barcalow, N. L. (2015). The Body Appreciation Scale-2: item refinement and psychometric evaluation. *Body Image*, *12*, 53-67.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., & James, P. (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. *Landscape and Urban Planning, 81*(3), 167-178.

Ulrich, R. S. (1983). *Aesthetic and affective response to natural environment*. In: Altman, I., Wohlwill, J.F. (eds) Behavior and the Natural Environment, 6, 85- 125. Springer, Boston, MA.

Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. *In Behavior and the Natural Environment* (pp. 85-125). Boston, MA: Springer US.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. S*cience*, *224*(4647), 420-421.

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology, 11*(3), 201–230.

Valtchanov, D., Barton, K. R., & Ellard, C. (2010). Restorative effects of virtual nature settings. *Cyberpsychology, Behavior, and Social Networking*, *13*(5), 503-512.

van Den Berg, A. E., & Custers, M. H. (2011). Gardening promotes neuroendocrine and affective restoration from stress. *Journal of Health Psychology*, *16*(1), 3-11.

van den Berg, A. E., Koole, S. L., & van der Wulp, N. Y. (2003). Environmental preference and restoration:(How) are they related?. *Journal of Environmental Psychology*, 23(2), 135-146.

van den Berg, M. M., Maas, J., Muller, R., Braun, A., Kaandorp, W., van Lien, R., van Poppel, M. N., van Mechelen, W., & van den Berg, A. E. (2015). Autonomic nervous system responses to viewing green and built settings: differentiating between sympathetic and parasympathetic activity. *International Journal of Environmental Research and Public Health*, *12*(12), 15860-15874.

Van Dillen, S. M., de Vries, S., Groenewegen, P. P., & Spreeuwenberg, P. (2012). Greenspace in urban neighbourhoods and residents' health: adding quality to quantity. *Journal of Epidemiology & Community Health*, *66*(6), e8-e8.

Van Dillen, S. M., de Vries, S., Groenewegen, P. P., & Spreeuwenberg, P. (2012). Greenspace in urban neighbourhoods and residents' health: adding quality to quantity. *J Epidemiol Community Health*, *66*(6), e8-e8.

van den Berg, A. E., Koole, S. L., & van der Wulp, N. Y. (2003). Environmental preference and restoration: (How) are they related? *Journal of Environmental Psychology*, *23*(2), 135–146.

Vanaken, G. J., & Danckaerts, M. (2018). Impact of green space exposure on children's and adolescents' mental health: A systematic review. *International Journal of Environmental Research and Public Health*, *15*(12), 2668.

Velarde, M. D., Fry, G., & Tveit, M. (2007). Health effects of viewing landscapes–Landscape types in environmental psychology. *Urban Forestry & Urban Greening*, *6*(4), 199-212.

Ventimiglia, I., & Seedat, S. (2019). Current evidence on urbanicity and the impact of neighbourhoods on anxiety and stress-related disorders. *Current Opinion in Psychiatry*, *32*(3), 248-253.

Ventriglio, A., Torales, J., Castaldelli-Maia, J. M., De Berardis, D., & Bhugra, D. (2021). Urbanization and emerging mental health issues. *CNS Spectrums*, *26*(1), 43-50.

Vincent, E., Battisto, D., & Grimes, L. (2010). The effects of presence and influence in nature images in a simulated hospital patient room. *HERD: Health Environments Research & Design Journal*, *3*(3), 56-69.

Vitale, V., & Bonaiuto, M. (2024). The role of nature in emotion regulation processes: An evidence-based rapid review. *Journal of Environmental Psychology*, 102325.

Vitale, V., Martin, L., White, M. P., Elliott, L. R., Wyles, K. J., Browning, M. H. E. M., Pahl, S., Stehl, P., Bell, S., Bratman, G. N., Gascon, M., Grellier, J., Lima, M. L., Lõhmus, M., Nieuwenhuijsen, M. J., Ojala, A., Taylor, J., van den Bosch, M., Weinstein, N., & Fleming, L. E. (2022). Mechanisms underlying childhood exposure to blue spaces and adult subjective well-being: An 18-country analysis. *Journal of Environmental Psychology*, 84, 101876.

Voelker, S., & Kistemann, T. (2013). Reprint of: "I'm always entirely happy when I'm here!" Urban blue enhancing human health and well-being in Cologne and Düsseldorf, Germany. *Social Science & Medicine*, *91*, 141-152.

Voigt-Antons, J. N., Spang, R., Kojić, T., Meier, L., Vergari, M., & Möller, S. (2021, March). Don't worry be happy-using virtual environments to induce emotional states measured by subjective scales and heart rate parameters. *In 2021 IEEE Virtual Reality and 3D User Interfaces (VR)* (pp. 679-686). IEEE.

Völker, S., & Kistemann, T. (2011). The impact of blue space on human health and well-being–Salutogenetic health effects of inland surface waters: A review. *International Journal of Hygiene and Environmental Health*, *214*(6), 449-460.

Völker, S., & Kistemann, T. (2015). Developing the urban blue: Comparative health responses to blue and green urban open spaces in Germany. *Health & Place*, *35*, 196-205.

Volokhov, R. N., & Demaree, H. A. (2010). Spontaneous emotion regulation to positive and negative stimuli. *Brain and Cognition*, *73*(1), 1-6.

Wang, X., Shi, Y., Zhang, B., & Chiang, Y. (2019). The influence of forest resting environments on stress using virtual reality. *International Journal of Environmental Research and Public Health*, 16(18), 3263.

Ward Thompson, C., & Aspinall, P. A. (2011). Natural environments and their impact on activity, health, and quality of life. *Applied Psychology: Health and Well-Being*, *3*(3), 230-260.

Warr, P., & Parker, S. (2010). IWP multi-affect Indicator. (*Unpublished instrument). Sheffield, UK: Institute of Work Psychology, University of Sheffield*.

Watson, D., & Clark, L. A. (1995). Depression and the melancholic temperament. *European Journal of Personality*, *9*(5), 351-366.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063.

Watson, D., Weber, K., Assenheimer, J. S., Clark, L. A., Strauss, M. E., & McCormick, R. A. (1995). Testing a tripartite model: I. Evaluating the convergent and discriminant validity of anxiety and depression symptom scales. *Journal of Abnormal Psychology*, *104*(1), 3.

Webb, T. L., Lindquist, K. A., Jones, K., Avishai, A., & Sheeran, P. (2018). Situation selection is a particularly effective emotion regulation strategy for people who need help regulating their emotions. *Cognition and Emotion*, *32*(2), 231-248.

Weeks, J. R. (2010). Defining urban areas. In T. Rashed, & C. Jürgens (Eds.), *Remote sensing and digital image processing* (pp. 33–45). Springer.

Weeland, J., Moens, M. A., Beute, F., Assink, M., Staaks, J. P., & Overbeek, G. (2019). A dose of nature: Two three-level meta-analyses of the beneficial effects of exposure to nature on children's self-regulation. *Journal of Environmental Psychology*, *65*, 101326.

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, *92*(4), 548.

Wells, N. M. (2000). At home with nature: Effects of "greenness" on children's cognitive functioning. *Environment and Behavior*, *32*(6), 775-795.

Wentura, D., Müller, P., & Rothermund, K. (2014). Attentional capture by evaluative stimuli: Gain-and loss-connoting colors boost the additional-singleton effect. *Psychonomic Bulletin & Review*, *21*, 701-707.

Wenzel, A., Grass, I., Belavadi, V. V., & Tscharntke, T. (2020). How urbanization is driving pollinator diversity and pollination–A systematic review. *Biological Conservation*, *241*, 108321.

Westen, D. (1994). Toward an integrative model of affect regulation: Applications to social-psychological research. *Journal of Personality*, *62*(4), 641-667.

Westphal, C., Steffan-Dewenter, I., & Tscharntke, T. (2003). Mass flowering crops enhance pollinator densities at a landscape scale. *Ecology Letters*, *6*(11), 961-965.

Wheaton, B. (1977). Assessing reliability and stability in panel models. *Sociological Methodology/Jossy-Bass*.

Wheeler, B. W., Lovell, R., Higgins, S. L., White, M. P., Alcock, I., Osborne, N. J., Husk, K., Sabel, C. E., & Depledge, M. H. (2015). Beyond greenspace: an ecological study of population general health and indicators of natural environment type and quality. *International Journal of Health Geographics*, 14(1), 1-17.

White, M. P., Alcock, I., Grellier, J., Wheeler, B. W., Hartig, T., Warber, S. L., Bone, A., Depledge, M. H., & Fleming, L. E. (2019). Spending at least 120 minutes a week in nature is associated with good health and wellbeing. *Scientific Reports*, *9*(1), 1-11.

White, M. P., Elliott, L. R., Gascon, M., Roberts, B., & Fleming, L. E. (2020). Blue space, health and well-being: A narrative overview and synthesis of potential benefits. *Environmental Research*, *191*, 110169.

White, M. P., Elliott, L. R., Grellier, J., Economou, T., Bell, S., Bratman, G. N., Cirach, M., Gascon, M., Lima, M. L., Lõhmus, M., Nieuwenhuijsen, M., Ojala, A., Roiko, A., Schultz, P. W., van den Bosch, M., & Fleming, L. E. (2021). Associations between green/blue spaces and mental health across 18 countries. *Scientific Reports*, *11*(1), 8903.

White, M. P., Pahl, S., Ashbullby, K., Herbert, S., & Depledge, M. H. (2013). Feelings of restoration from recent nature visits. *Journal of Environmental Psychology*, *35*, 40-51.

White, M. P., Pahl, S., Wheeler, B. W., Depledge, M. H., & Fleming, L. E. (2017). Natural environments and subjective wellbeing: Different types of exposure are associated with different aspects of wellbeing. *Health & Place*, *45*, 77-84.

White, M. P., Yeo, N. L., Vassiljev, P., Lundstedt, R., Wallergård, M., Albin, M., & Lõhmus, M. (2018). A prescription for "nature"–the potential of using virtual nature in therapeutics. *Neuropsychiatric Disease and Treatment*, 3001-3013.

White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology*, *30*(4), 482-493.

Wild, D., Grove, A., Martin, M., Eremenco, S., McElroy, S., Verjee-Lorenz, A., & Erikson, P. (2005). Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: report of the ISPOR task force for translation and cultural adaptation. *Value in Health*, *8*(2), 94-104.

Wolsko, C., & Lindberg, K. (2013). Experiencing connection with nature: The matrix of psychological well-being, mindfulness, and outdoor recreation. *Ecopsychology*, *5*(2), 80-91.

World Health Organization. (2010). *World Health Statistics 2010*. World Health Organization.

World Health Organization. (2012). Regional Office for Europe (WHO, 2012). *Environmental Health Inequalities in Europe. Copenhagen*.

World Health Organization. (2024). *Achieving well-being: a global framework for integrating well-being into public health utilizing a health promotion approach*. World Health Organization.

World Health Organization. (2015). *Health in 2015: from MDGs, Millennium Development Goals to SDGs, Sustainable Development Goals*. World Health Organization.

Wyles, K. J., White, M. P., Hattam, C., Pahl, S., King, H., & Austen, M. (2019). Are some natural environments more psychologically beneficial than others? The importance of type and quality on connectedness to nature and psychological restoration. *Environment and Behavior*, *51*(2), 111-143.

Xie, J., Liu, B., & Elsadek, M. (2021). How can flowers and their colors promote individuals' physiological and psychological states during the COVID-19 lockdown?. *International Journal of Environmental Research and Public Health*, *18*(19), 10258.

Xie, J., Sun, Q., Wang, S., Li, X., & Fan, F. (2020). Does environmental regulation affect export quality? theory and evidence from China. *International Journal of Environmental Research and Public Health, 17*(21), 8237.

Yamaguchi, M., Deguchi, M., & Miyazaki, Y. (2006). The effects of exercise in forest and urban environments on sympathetic nervous activity of normal young adults. *Journal of International Medical Research*, *34*(2), 152-159.

Yang, Y., Kim, H., Kang, M., Baik, H., Choi, Y., Jang, E. J., Chang, E. J., Yun, S., Park, M., Park, E., Yun, H., Lee, T. J., Kwon, Y. H., Hong, K. P., Lee, A. R., Jung, S., Ahn, T. H., Jin, H. Y., & Choi, K. H. (2023). The effectiveness of nature-based therapy for community psychological distress and well-being during COVID-19: a multi-site trial. *Scientific Reports*, *13*(1), 22370.

Yeung, D. Y., Fung, H. H., & Kam, C. (2012). Age differences in problem solving strategies: The mediating role of future time perspective. *Personality and Individual Differences*, *53*(1), 38-43.

Yeung, D. Y., Fung, H. H., & Kam, C. (2012). Age differences in problem solving strategies: The mediating role of future time perspective. *Personality and Individual Differences*, *53*(1), 38-43.

Yin, J., Bratman, G. N., Browning, M. H., Spengler, J. D., & Olvera-Alvarez, H. A. (2022). Stress recovery from virtual exposure to a brown (desert) environment versus a green environment. *Journal of Environmental Psychology*, 81, 101775.

Yli-Panula, E., Jeronen, E., Matikainen, E., & Persson, C. (2022). Conserve My Village—Finnish, Norwegian and Swedish Students' Valued Landscapes and Well-Being. *Sustainability*, 14(2), 671.

Yu, C. P., Lee, H. Y., & Luo, X. Y. (2018). The effect of virtual reality forest and urban environments on physiological and psychological responses. *Urban forestry & Urban Greening*, 35, 106-114.

Yu, C. P., Lee, H. Y., Lu, W. H., Huang, Y. C., & Browning, M. H. (2020). Restorative effects of virtual natural settings on middle-aged and elderly adults. *Urban Forestry & Urban Greening*, 56, 126863.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist*, *35*(2), 151.

Zajonc, R. B. (1998). Emotions. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The Handbook of Social Psychology* (4th ed., pp. 591–632). McGraw-Hill.

Zeier, P., Meine, L. E., & Wessa, M. (2022). It's worth the trouble: Stressor exposure is related to increased cognitive reappraisal ability. *Stress and Health*, *38*(3), 602-609.

Zelenski, J. M., & Nisbet, E. K. (2014). Happiness and feeling connected: The distinct role of nature relatedness. *Environment and Behavior*, *46*(1), 3-23.

Zeng, C., Lin, W., Li, N., Wen, Y., Wang, Y., Jiang, W., Zhang, J., Zhong , H., Chen, X., Luo, W., & Chen, Q. (2021). Electroencephalography (Eeg)-based neural emotional response to the vegetation density and integrated sound environment in a green space. *Forests, 12*(10), 1380.

Zeng, X., Luo, P., Wang, T., Wang, H., & Shen, X. (2023). Screening visual environment impact factors and the restorative effect of four visual environment components in large-space alternative care facilities. *Building and Environment*, *235*, 110221.

Zhang, L., Tan, P. Y., Gan, D. R. Y., & Samsudin, R. (2022). Assessment of mediators in the associations between urban green spaces and self-reported health. *Landscape and Urban Planning*, *226*, 104503.

Zhang, X., Zhang, Y., Zhai, J., Wu, Y., & Mao, A. (2021). Waterscapes for promoting mental health in the general population. *International Journal of Environmental Research and Public Health*, *18*(22), 11792.

Zuckerman, M. (1977). Development of a situation-specific trait-state test for the prediction and measurement of affective responses. *Journal of Consulting and Clinical Psychology*, *45*(4), 513.