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THE RELATIONSHIPS BETWEEN NATURE CONNECTEDNESS, PSYCHOLOGICAL RESILIENCE, AND LIFE SATISFACTION

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ABSTRACT

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Nature connectedness and psychological resilience have been both found to be associated with human wellbeing. Yet the relationship between nature connectedness and psychological resilience has not been much studied, nor their association with subjective wellbeing within the same sample. However, previous research regarding the stress relieving effects of nature gives reasons to believe that nature connectedness and psychological resilience may be related to each other. Additionally, previous studies that have separately investigated the wellbeing relations of nature connectedness and psychological resilience give reasons to believe that they could be both simultaneously positively associated with subjective wellbeing.

The aim of this study was to investigate the relationships between nature connectedness, psychological resilience, and life satisfaction, which is one aspect of subjective wellbeing. Specifically, this study investigated whether nature connectedness and psychological resilience are associated with each other and whether they are associated with life satisfaction within the same sample. This study also investigated if nature connectedness moderates the relationship between psychological resilience and life satisfaction. In addition, this study investigated whether either nature connectedness or psychological resilience mediates the other's relationship with life satisfaction.

The sample of this study ($N = 667$) was collected from Finnish municipalities by random sampling as a part of a larger Act With Nature -research project. Participants completed an online survey where individual experience of nature connectedness, psychological resilience, and life satisfaction were asked. Nature connectedness was assessed with CNS-7-scale, psychological resilience with RS-14-scale and life satisfaction with SWLS-scale. Research questions were analyzed with Pearson correlations, hierarchical multiple regression, and mediation analyses.

A significant positive association was found between nature connectedness and psychological resilience. When examined separately, both nature connectedness and psychological resilience were significantly positively associated with life satisfaction. When examined together, only psychological resilience had a significant positive association with life satisfaction. Nature connectedness did not moderate or mediate the relationship between psychological resilience and life satisfaction. Psychological resilience instead mediated fully the relationship between nature connectedness and life satisfaction.

This study brought new knowledge and complemented existing findings regarding the relationships between nature connectedness, psychological resilience, and life satisfaction, one dimension of subjective wellbeing. Based this study's results, it is suggested that psychological resilience is likely an important factor enhancing subjective wellbeing and that the effect of nature connectedness on subjective wellbeing may occur through psychological resilience. It is suggested that the feelings of connectedness to nature may enhance at least some aspects of psychological resilience or processes linked to resilience (e.g., stress coping, perspective taking) which in turn would lead to greater subjective wellbeing. Given the result regarding positive association between nature connectedness and psychological resilience it is further suggested that incorporating nature in future's resilience-building interventions might be beneficial. Additional research is recommended in order to gain a more comprehensive understanding about these phenomena and to confirm the findings and suggestions of this study.

Key words: nature connectedness, psychological resilience, life satisfaction, subjective wellbeing

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INTRODUCTION

Nature connectedness, defined for example as feelings of oneness and connectedness with nature (Mayer & Franz, 2004), and psychological resilience, defined for example as an ability to recover from adversities (Sisto et al., 2019), are both phenomena that have been indicated to be associated with different aspects of human wellbeing (Capaldi et al., 2014; Capaldi et al., 2017; Bajaj & Bande, 2016; Di Fabio & Palazzeschi, 2015; Fan et al., 2023; Hu et al., 2015; Kong et al., 2015; Liu et al., 2014; Martin et al., 2020; Nisbet et al., 2019; Nisbet et al., 2020; Pritchard et al., 2020; Wagnild & Young, 1993). However, nature connectedness and psychological resilience have rarely been studied together. Only a few studies (Brown, 2017; Ingulli & Lindbloom, 2013) have investigated the relationship between nature connectedness and psychological resilience. To the author's best knowledge, their relationship with wellbeing has not been studied in the same study before. The lack of previous studies opens opportunities for new research.

Despite nature connectedness and psychological resilience have not been studied much together, it has been documented that interaction with nature is beneficially related to recovery from stress and to the ability to cope with stress and life challenges (Gaekwad et al., 2023; Hatala et al., 2020; Korpela et al., 2001; Møller et al., 2023; Yao et al., 2021; White et al., 2023). Since spending time in nature has been found to be associated with nature connectedness (Mayer & Franz, 2004), and because coping with stress and overcoming adversities are important parts of psychological resilience phenomenon (Aburn et al., 2016; Hiebel et al., 2021; Sisto et al., 2019), studies that have found an association between nature interaction and stress give an additional reason to believe that nature connectedness and psychological resilience might be related to each other.

Previous research suggests that both nature connectedness and psychological resilience are independently associated similarly with subjective wellbeing. For example, both nature connectedness and psychological resilience have been observed to be positively associated with life satisfaction, one aspect of subjective wellbeing, in many studies (Capaldi et al., 2014; Bajaj & Bande, 2016; Di Fabio & Palazzeschi, 2015; Fan et al., 2023; Hu et al., 2015; Kong et al., 2015; Liu et al., 2014; Pritchard et al., 2020; Wagnild and Young, 1993). Since subjective wellbeing has been associated with positive outcomes such as good social relationships, health, and longevity (Diener et al., 2018), it is important to examine possible factors contributing to it. In addition, the observation that nature connectedness and psychological resilience have had similar associations with subjective wellbeing gives an additional reason to expect that nature connectedness and psychological resilience might be interrelated.

The aim of this study is to examine the relationships between nature connectedness, psychological resilience, and subjective wellbeing. First, because previous knowledge regarding the association between nature connectedness and psychological resilience is limited, this study investigates whether they are associated with each other. Second, to gain knowledge on how nature connectedness and psychological resilience are associated with subjective wellbeing within the same sample, this study investigates how nature connectedness and psychological resilience are associated with life satisfaction, one aspect of subjective wellbeing (see Pavot & Diener, 1993).

Definitions of nature connectedness

Wilson's (1984) description of biophilia can be seen as one onset for the research of human-nature connection. Wilson (1984) defined biophilia as "the innate tendency to focus on life and lifelike processes" and described that this tendency to relate with the natural world might be a biologically based need for humans. Since the introduction of biophilia, the research of human-nature connection has expanded vastly in environmental psychology. Different definitions and measurements for assessing human-nature connection have emerged during the past decades. For example, concepts suggested to describe the human-nature relationship include inclusion with nature (Schultz, 2002), emotional affinity towards nature (Kals et al., 1999), connectedness to nature (Mayer & Franz, 2004), love and care for nature (Perkins, 2010) and nature relatedness (Nisbet et al., 2009). Different approaches to nature connectedness differ from each other in whether cognitive, emotional, or more multidimensional perspective is emphasized.

Other researchers have emphasized a **cognitive perspective** when defining human connection with nature. For example, Schultz (2002) introduced the concept of inclusion with nature to describe one's connection with nature. According to Schultz (2002), in the core of inclusion is connectedness that refers to the extent to which one includes nature within the cognitive representation of oneself. Beliefs that one is a part of nature are required for caring and commitment, other dimensions of inclusion, to emerge. The Inclusion of Nature in Self scale (INS) and its extended version (EINS) were designed to assess the concept of inclusion with nature (Martin & Czellar, 2016; Schultz, 2001). In addition, Schultz et al. (2004) argued that connection with nature is implicit and presented a modified Implicit Associations Test (IAT) to assess the implicit connectedness with nature.

Other researchers have emphasized an **emotional perspective** when defining human connection to nature. For example, Kals and colleagues (1999) presented the construct of emotional affinity toward nature and a scale to measure it. According to the researchers, the emotional affinity toward

nature refers to a category of emotions that cannot be easily explained by cognitive attributions. These emotions include the love of nature and the feelings of safety, freedom, and oneness with nature.

Mayer and Franz (2004) also emphasized the role of emotional experience when defining connection with nature. According to Mayer and Franz (2004), one's connection with nature can be seen as an affective sense of oneness with the natural world. They developed the Connectedness to Nature Scale (CNS) to measure this affective and experiential sense of connectedness to nature, i.e. how emotionally connected one feels with nature. Some researchers have however suggested that CNS measures rather cognitive beliefs regarding connection to nature than emotional connection to nature (Perrin & Benassi, 2009).

Newer approaches emphasizing an emotional perspective to nature connectedness include for example the construct of love and care for nature (Perkins, 2010). Perkins (2010) created a scale called the Love and Care for Nature to assess one's personal and emotional relationship with nature. According to Perkins (2010), the construct of love and care for nature includes recognition of nature's intrinsic value and a feeling of responsibility to protect it. According to Perkins (2010), nature evokes feelings of awe, wonder and interest that in turn evoke feelings of deep love and interconnectedness with nature.

Human connection to nature has also been approached from a more **multidimensional perspective**. For example, according to Nisbet and colleagues (2009) one's connection with nature should be assessed by evaluating cognitive, affective, and experiential dimensions of connectedness. They developed the Nature Relatedness Scale for this purpose. More specifically, Nature Relatedness Scale assesses people's external nature-related perspectives and attitudes, internalized identification with nature, and physical familiarity with nature in terms of ease with nature and the attraction to spend time in nature.

As described above, the literature regarding conceptualizing and assessing human connectedness to nature has expanded vastly since Wilson's (1984) description of biophilia. However, remarkable similarities can be found between these different conceptualizations of nature connectedness. For example, Tam (2013) noted that there are overlaps between different definitions, concept labels and scale items. Furthermore, based on a comprehensive analysis on above-mentioned measures, Tam (2013) suggested that these different measurements scales of nature connectedness are similar at least in terms of their relations with certain outcomes such as personality traits, subjective happiness, and life satisfaction.

In this study, human connection to nature is defined according to Mayer and Franz (2004) as an emotional and experiential connection to the natural world. Despite some critic has been presented (e.g., Perrin & Benassi, 2009), their definition is still widely used and the Connectedness to Nature Scale and its short version have been observed to be valid research tools in many studies (e.g.,

Cervinka et al., 2012; Navarro et al., 2017; Navarro et al. 2022; Mayer et al., 2009; Pasca et al., 2017; Zhang et al., 2014). Furthermore, the CNS scale has been found to have a positive association with several other measurement scales of nature connectedness (Restall & Conrad, 2015; Tam, 2013).

Definitions of psychological resilience

It is noteworthy that the term resilience is widely used in different sciences. Resilience is investigated in various purposes for example in psychology, ecology, business administration and political sciences (Martin-Breen & Anderies, 2011). In this study, resilience is investigated from a psychological point of view. In the literature, **psychological resilience** has been understood, for example, as an ability to recover or bounce back from adversities, as a dynamic adaptation process evolving over time and as adaptive personal characteristics or attitudes that help one to stay psychologically healthy after exposure to stressful life events (Sisto et al., 2019). However, despite several decades of research, multiple theories and conceptualizations regarding psychological resilience exist as exemplified by many literature reviews (e.g., Aburn et al., 2016; Fletcher & Sarkar, 2013; Hiebel et al., 2021; IJntema et al., 2019; Sisto et al., 2019).

The beginning of the research of psychological resilience can be dated back to early studies on individuals who displayed adaptation despite adversities. Early research on resilience aimed to understand why some individuals can turn adversity into personal growth and adaptation (Fletcher & Sarkar, 2013). Most of the early studies focused on children or young people overcoming adversities and avoiding psychiatric disorders (Fletcher & Sarkar, 2013; Wagnild & Young, 1993). Early pioneering studies included, for example, the studies of Garmezy in 1991, Rutter in 1990 and Werner and Smith in 1992, where the focus was on young people who succeeded despite living in adverse circumstances, such as parental mental illness or poverty (Fletcher & Sarkar, 2013).

Wagnild and Young (1993) were among the first researchers to develop a measurement scale for psychological resilience. According to Wagnild and Young (1993), psychological resilience is a positive personality characteristic that moderates the negative effects of adversity and promotes individual adaptation. In addition, they proposed that resilience consists of five subcategories that are equanimity, perseverance, self-reliance, meaningfulness, and existential aloneness. Based on their studies on older adults, who had successfully adapted to a major life event, Wagnild and Young (1993) developed The Resilience Scale (RS) to assess psychological resilience. The items of the RS were initially selected to reflect the mentioned subcategories of resilience. However, instead of a five-

factor structure one could expect, they found two factors in RS, which were named as personal competence and as acceptance of self and life.

Other researchers also became interested in assessing psychological resilience after Wagnild and Young's (1993) views. For example, Luthar and colleagues (2000) noted that the exposure to significant adversity and positive adaptation are core components in defining resilience. However, they understood resilience rather as a dynamic adaptation process despite adversities (Luthar et al., 2000; Luthar & Cicchetti, 2000) than as a personality characteristic (e.g., Wagnild and Young, 1993). Whether psychological resilience is seen more like a relatively stable trait-like-construct or more like a dynamic process, has remained one of the main controversies between resilience theories to this day (Fletcher & Sarkar, 2013; Hiebel et al., 2021; Sisto et al., 2019).

Since above-mentioned early work in defining resilience, the research of psychological resilience has expanded vastly as exemplified by many literature reviews (e.g., Aburn et al., 2016; Fletcher & Sarkar, 2013; Hiebel et al., 2021; IJntema et al., 2019; Sisto et al., 2019; Troy et al., 2023). These reviews have identified that multiple conceptualizations of resilience exist but that certain ideas often emerge when defining resilience. These include recovery from adversities or stressful situations (Aburn et al., 2016; Hiebel et al., 2021; Sisto et al., 2019), successful or positive adaptation (Aburn et al., 2016; Fletcher & Sarkar, 2013; Hiebel et al., 2021; IJntema et al., 2019; Sisto et al., 2019), ability or capacity to overcome adversities and bounce back from them (Aburn et al., 2016; Hiebel et al., 2021; Sisto et al., 2019) and personal growth (Hiebel et al., 2021; Sisto et al., 2019).

The reviews however also suggest that psychological resilience is a complex multifaceted phenomenon and that there are conceptual unclarities and controversies between resilience theories (Aburn et al., 2016; Hiebel et al., 2021; IJntema et al., 2019; Sisto et al., 2019; Troy et al., 2023). These controversies include for example whether resilience is seen as a trait-like-construct or as a dynamic process (Fletcher & Sarkar, 2013; Hiebel et al., 2021; Sisto et al., 2019), how adversity is considered (IJntema et al., 2019; Troy et al., 2023) and what factors (i.e. social support, personality, psychological processes) explain the development of resilience (Fletcher & Sarkar, 2013; Troy et al., 2023). In summary, there is no one way to conceptualize psychological resilience in literature. However, it also seems that the early ideas of stress, adversity, and positive adaptation, introduced already by the early researchers (e.g., Luthar et al., 2000; Wagnild & Young, 1993), are still important when defining resilience.

In this study, psychological resilience is understood as a positive personality characteristic similarly to Wagnild and Young (1993) because the trait approach to resilience is still used (e.g., Hu et al., 2015) despite some reviews suggest that resilience is nowadays more often defined as a dynamic process (e.g., IJntema et al., 2019; Sisto et al., 2019). In addition, despite having defined resilience rather as a relatively stable personality trait than as a dynamic process, Wagnild (2003) acknowledged

that also change is possible. According to her, life circumstances can either decrease or enhance the amount of resilience one has. She emphasized that how one develops more resilience is a process but that the characteristic of resilience itself is not a process. Furthermore, the Resilience scale (RS) and its short version (RS-14) have been observed to be adequately valid and reliable tools for measuring psychological resilience in many study populations (e.g., Ahern et al., 2006; Mirošević et al., 2019; Wagnild, 2009; Windle et al., 2011).

Relationship between nature connectedness and psychological resilience

There is limited research literature related to the relationship between **nature connectedness and psychological resilience**. To the best of the author's knowledge, only two studies have investigated the relationship between nature connectedness and psychological resilience with conflicting findings (Brown, 2017; Ingulli & Lindbloom, 2013). Ingulli and Lindbloom (2013) found a positive association between one's perceived connectedness to nature and psychological resilience in a sample of 150 individuals from a major metropolitan area of the northwestern United States. On the other hand, Brown (2017) did not find a significant association between psychological resilience and nature connectedness in a sample of tornado survivors. However, Brown (2017) noted that different measures of resilience and nature connectedness, compared to the measures of Ingulli and Lindbloom's (2013) study, could have impacted the results. Also, the sample (tornado survivors) in Brown's (2017) study was clearly different from Ingulli and Lindbloom's (2013) study, where the participants did not reportedly have experiences of nature disaster. It is possible that experiencing a shocking nature disaster could weaken one's feelings of connectedness with nature or one's sense of resilience.

The literature related directly to the relationship between nature connectedness and psychological resilience is limited. However, there may be other commonalities. For example, an association between **nature connectedness and the ability to cope with stress** has been found at least in one study: Bakir-Demir et al. (2021) found that nature connectedness was associated with lower levels of perceived stress via adaptive emotion regulation strategies in a sample of college students. The ability to cope with and overcome stress and adversities are in turn linked to psychological resilience (Aburn et al., 2016; Hiebel et al., 2021; Sisto et al., 2019).

Furthermore, a few qualitative studies have identified that **interaction with nature can promote the ability to cope with stressful situations and life challenges** (Hatala et al., 2020; Korpela et al., 2001; Møller et al., 2023). For example, Hatala and colleagues (2020) found that nature was important

for Indigenous young people to cope with stress, anger, fear, and other day-to-day-difficulties. Analyses of young people's stories about their own photos revealed that the youth used nature as the metaphors of resilience and gained feelings of calm and hope from nature. Also, Møller et al. (2023) found that going into nature helped people to cope with their worst life experience (Møller et al., 2023). The majority of those who had spent time in nature during their worst life experience reported a greater sense of wellbeing and relief. Some participants also reported that they were able to gain a clearer perspective on their life. In Korpela et al.'s (2001) study, university students frequently reported in open-ended accounts the experiences of relaxation, forgetting worries, and reflection of personal matters when being in their favorite nature place.

In addition, when examining the results of recent meta-analyses, it seems quite clear that **interaction with nature and recovery from stress** are associated with each other (Gaekwad et al. 2023; Yao et al., 2021). Yao et al. (2021) found in their meta-analysis on empirical studies that exposure to natural environment was associated with decreased self-reported and physiological measures (e.g., salivary cortisol) of stress. Gaekwad et al. (2023) also found in their meta-analysis that different nature exposures (immersion, laboratory exposure, virtual reality) had a small to medium effect on decreasing physiological stress.

The restorative effects of natural environments on stress have usually been explained through two complementary theories. The Stress reduction theory (SRT) emphasizes an affective-physiological processing of attractive landscapes as a central to recovery (Ulrich, 1983), and the Attention restoration theory (ART) emphasizes cognitive processing and proposes that recovery occurs through cognitive mechanism called fascination in addition to other qualities such as psychological and physical distancing from daily concerns (Kaplan & Kaplan, 1989). In addition to explaining stress recovery, these theories have also been utilized to explain how nature can promote individual resilience as has been done in nature-based biopsychosocial resilience theory (NBRT) recently proposed by White et al. (2023). According to the developers of the NBRT theory, individuals have biological, psychological, and social resources that can reduce the effect of life stressors on their biological, psychological, and social health, and wellbeing (i.e., biopsychosocial resilience). NBRT theory further proposes that biopsychological resilience works in three ways: by preventing or decreasing the risk or potency of a stressor (preventive resilience), by reducing the effect of a stressor (response resilience) and by providing recovery towards a new state of equilibrium (recovery resilience). Based on wide amount of supporting evidence regarding the stress relieving and wellbeing promoting effects of nature, the NBRT theory further suggests that nature contact can support individuals to build and maintain biopsychosocial resilience resources.

Spending time in nature has been associated with experiencing a sensed connection with the natural world (Mayer & Franz, 2004). Given the findings that nature connectedness may mediate or

moderate the beneficial effects of nature exposure (Baceviciene & Jankauskiene, 2022; Liu et al., 2022; Mayer et al., 2009), the findings regarding stress relieving effects of nature and the SRT, ART and NBRT theories provide additional support for the assumption that nature connectedness and psychological resilience might be related to each other. This study aims to provide new knowledge about the association between nature connectedness and psychological resilience.

Nature connectedness, psychological resilience, and subjective wellbeing

Previous research has recognized two main dimensions of subjective wellbeing: a cognitive dimension, which is also known as life satisfaction, and an affective dimension, which is often further divided into negative and positive affect (Pavot & Diener, 1993). Sometimes also other measures (e.g., vitality, meaning in life) are used as indicators of wellbeing (e.g., Capaldi et al., 2014; Capaldi et al., 2017; Di Fabio & Palazzeschi, 2015; Nisbet et al., 2019; Pritchard et al., 2020). Both nature connectedness and psychological resilience have been separately observed to be associated with different aspects of subjective wellbeing in a similar way in many studies (Capaldi et al., 2014; Bajaj & Bande, 2016; Di Fabio & Palazzeschi, 2015; Fan et al., 2023; Hu et al., 2015; Kong et al., 2015; Liu et al., 2014; Martin et al., 2020; Nisbet et al., 2019; Nisbet et al., 2020; Pritchard et al., 2020; Wagnild & Young, 1993). Because subjective wellbeing has been associated with positive outcomes such as good social relationships, health, and longevity (Diener et al., 2018), it is important to investigate possible factors contributing to it.

Several studies have found that **nature connectedness has been in association with different aspects of subjective wellbeing** (Capaldi et al., 2014; Capaldi et al., 2017; Martin et al., 2020; Nisbet et al., 2019; Nisbet et al., 2020; Pritchard et al., 2020). For example, Capaldi and colleagues (2014) investigated in their meta-analysis of studies on adults (ages ranging from 19 to 63 years), associations between nature connectedness and different wellbeing measures. They found that nature connectedness was positively associated with life satisfaction, positive affect, and vitality. Also, Pritchard and colleagues (2020) conducted a meta-analysis with samples that consisted mostly of adults (ages ranging from 11 to 63 years). They got comparable results to Capaldi et al. (2014) by finding that nature connectedness was positively associated with life satisfaction, positive affect, and vitality as well as other wellbeing measures (i.e., personal growth and meaning in life). Capaldi and colleagues (2017) in turn found that nature connectedness was positively associated with meaning in life and greater emotional, social, and psychological wellbeing in Canadian, Japanese, and Russian undergraduate students. There seems to be less research regarding the association between nature

connectedness and negative affect. However, at least a few studies have found that in-the-moment experience of nature connectedness, also referred as state connectedness, has been in association with lesser amount of negative affect (Nisbet et al., 2019; Nisbet et al., 2020).

Similar associations have been found between **psychological resilience and different aspects of subjective wellbeing** (Bajaj & Bande, 2016; Di Fabio & Palazzeschi, 2015; Fan et al., 2023; Hu et al., 2015; Kong et al., 2015; Liu et al., 2014; Wagnild and Young, 1993). For example, Hu and colleagues (2015) found in their meta-analysis that psychological resilience was positively associated with life satisfaction and positive affect and negatively with negative affect. Samples included in the meta-analysis consisted of children, adolescents, and adults (ages ranging from 6 to 60 years). Also, Bajaj and Pande (2016) found that psychological resilience was positively associated with life satisfaction and positive affect and negatively with negative affect in a sample of Indian undergraduate university students. In addition, they observed that psychological resilience partially mediated the relationship between mindfulness and life satisfaction and the relationship between mindfulness and affect components. Psychological resilience has also been observed to predict subjective wellbeing at least in one longitudinal study (Fan et al., 2023). Fan and colleagues (2023) conducted a study with a sample of university students and found that psychological resilience predicted three aspects of subjective wellbeing over five months: positively life satisfaction and positive affect and negatively negative affect.

Above presented previous research suggests that nature connectedness and psychological resilience are independently associated with different aspects of subjective wellbeing; those who feel connectedness to nature or have strong psychological resilience tend to experience for example more life satisfaction and positive affect. However, there is no research on how nature connectedness and psychological resilience are associated with subjective wellbeing within the same study and sample. This study aims to fill this gap by investigating the associations between nature connectedness, psychological resilience, and life satisfaction, which is one aspect of wellbeing (Pavot & Diener, 1993). Life satisfaction is chosen for the indicator of subjective wellbeing because assessing life satisfaction has been a commonly used way to operationalize subjective wellbeing in previous research (e.g., Bajaj & Bande, 2016; Capaldi et al., 2014; Di Fabio & Palazzeschi, 2015; Fan et al., 2023; Hu et al., 2015; Kong et al., 2015; Liu et al., 2014; Pritchard et al., 2020; Wagnild and Young, 1993). In addition, previous studies have found moderate to strong associations between life satisfaction and affect measures (Busseri, 2018; Diener et al., 2009; Kööts-Ausmees et al., 2013; Liang & Zhu, 2015; Berlin & Fors Connolly, 2019) and the life satisfaction and affect measures have been observed to predict each other at least in one longitudinal study (Joshanloo, 2023). Thus, it is assumed that the subjective experience of life satisfaction sufficiently describes the individual experience of subjective wellbeing.

Research questions and hypotheses

The aim of this study is to investigate the relationships between nature connectedness, psychological resilience, and life satisfaction, one aspect of subjective wellbeing (see Pavot & Diener, 1993). Specifically, the aim is to investigate whether nature connectedness and psychological resilience are related to each other and whether nature connectedness and psychological resilience are associated with life satisfaction in a Finnish sample. This study also investigates if the strength of nature connectedness moderates the relationship between psychological resilience and life satisfaction. Additionally, this study investigates whether nature connectedness mediates the relationship between psychological resilience and life satisfaction, or whether psychological resilience mediates the relationship between nature connectedness and life satisfaction.

There is limited research literature and contradictory findings regarding the relationship between nature connectedness and psychological resilience (see Brown, 2017; Ingulli & Lindbloom, 2013). Nevertheless, it is hypothesized that there is a positive relationship between nature connectedness and psychological resilience since the findings of one previous study support this idea (see Ingulli & Lindbloom, 2013). Furthermore, the other study, which did not find an association between nature connectedness and psychological resilience (see Brown, 2017), had a very specific sample (tornado survivors) and some methodological differences, which may explain the result. In addition, based on previous research, it can be concluded that nature exposure is likely to relieve stress and may even enhance individual coping (see Gaekwad et al., 2023; Hatala et al., 2020; Kaplan & Kaplan, 1989; Møller et al., 2023; Ulrich, 1983; Yao et al., 2021; White et al., 2023) and that nature connectedness is a potential mediator of the beneficial effects of nature exposure (see Baceviciene & Jankauskiene, 2022; Liu et al., 2022; Mayer et al., 2009). As recovery from stress and adversities and the ability to cope with them are phenomena linked to psychological resilience (Aburn et al., 2016; Hiebel et al., 2021; Sisto et al., 2019), the research on nature's wellbeing effects gives an additional support for the hypothesis that nature connectedness and psychological resilience are positively related to each other.

Both nature connectedness and psychological resilience have been separately observed to be positively associated with life satisfaction in many previous studies (Capaldi et al., 2014; Bajaj & Bande, 2016; Di Fabio & Palazzeschi, 2015; Fan et al., 2023; Hu et al., 2015; Kong et al., 2015; Liu et al., 2014; Pritchard et al., 2020; Wagnild and Young, 1993). Thus, it is hypothesized that nature connectedness and psychological resilience are both positively associated with life satisfaction. Hypotheses are not set for moderation and mediation analyses since there is no previous research on these questions. Furthermore, even though nature connectedness has been chosen as the moderator for the moderation analysis, it is noteworthy that either nature connectedness or psychological

resilience could have been selected for this role, since there is no prior research that would advocate the choice of one over the other. Nature connectedness has been chosen as the moderator because both this study and the broader research project, to which this study belongs, are primarily focused on examining the wellbeing effects of nature.

The exact research questions and hypotheses of this study are following:

Question 1. Are nature connectedness and psychological resilience associated with each other?

Hypothesis: There is a positive association between nature connectedness and psychological resilience.

Question 2. Are nature connectedness and psychological resilience associated with life satisfaction?

Hypothesis: Both nature connectedness and psychological resilience are positively associated with life satisfaction.

Question 3. Does nature connectedness moderate the relationship between psychological resilience and life satisfaction?

No hypothesis is set due to lack of previous research on this subject.

Question 4. Does nature connectedness mediate the relationship between psychological resilience and life satisfaction?

No hypothesis is set due to lack of previous research on this subject.

Question 5. Does psychological resilience mediate the relationship between nature connectedness and life satisfaction?

No hypothesis is set due to lack of previous research on this subject.

METHODS

Participants

This study was conducted with a random sample of Finnish people who were recruited from the population registry of Finland's Digital and Population Data Services Agency. The sample consisted of 667 individuals (60.0 % women, 38.7 % male, 0.1 % other, 1.2 % declined to response). Participants' age varied between 18–71 years ($M = 51.2$, $SD = 15.6$).

Participants' education level, employment situation, and household composition were also asked. Participants had a diverse range of educational backgrounds, including primary education 4.4 %, secondary education 27.1 %, vocational adult education 18.0 %, college or university degree 23.2 %, postgraduate degree 25.0 %, and doctoral degree or equivalent 2.3 %. Regarding employment status, participants were engaged in following activities: 50.8 % had a full-time employment, 6.4 % had a part-time employment, 7.3 % were studying full-time, 0.4 % were studying part-time, 0.1 % were suspended without pay, 28.2 % were retired, 4.9 % were unemployed, and 1.6 % were working unpaid at home. In terms of living arrangements, most of the participants (77.6 %) lived with someone; 50.2 % of the participants lived with partner without children, 20.0 % lived with partner and one or more children, 3.6 % lived with one or more children without partner, 2.5 % lived with parents, and 1.3 % lived with one or more friends or roommates. 22.4 % of the participants lived alone.

Procedure

The sample of this study was collected as a part of a larger Act With Nature -research project. In November 2022, Finland's Digital and Population Data Services Agency conducted a random sampling of 3500 individuals, aged between 18–70, from 195 Finnish municipalities. Invitation letters were mailed to participants in December 2022. Responses were collected online or through a paper questionnaire if online response was not possible. A reminder was sent in January 2023 for those who had not responded by that time. In March 2023, Digital and Population Data Services Agency conducted a new random sampling of 3200 individuals, aged between 18–70, from the same 195 Finnish municipalities. By May 2023, 667 answers were gathered. Each participant has given a written consent to the study. The study was funded by the Research Council of Finland, and it has received an approving statement from the ethic committee of the University of Surrey on 24.1.2023.

Measures

Nature connectedness

Nature connectedness was measured with the Finnish translation of the brief version of the Connectedness to Nature Scale (CNS-7). The CNS-7 (Pasca et al., 2017) is a short version of the Connectedness to Nature Scale (CNS) that measures an individual's affective and experiential connection to nature (Mayer & Frantz, 2004). The CNS and its short version are both unifactorial scales that assess nature connectedness as a unidimensional construct (Mayer & Frantz, 2004; Navarro et al., 2022).

The original CNS-scale has been found to be an adequately reliable and valid scale (Mayer & Frantz, 2004) and it has been used in many studies (e.g., Cervinka et al., 2012; Navarro et al., 2017; Mayer et al., 2009; Zhang et al., 2014). The CNS-7 has been observed to have even better psychometric properties compared to the original CNS (Pasca et al., 2017). Navarro et al. (2022) examined the psychometric properties of the CNS-7 in seven countries and found that the CNS-7 had a good reliability and an acceptable construct validity across these countries, which makes it suitable for cross-cultural research.

The CNS-7 consists of seven items drawn from the original CNS-scale (Mayer & Frantz, 2004) based on the best psychometric characteristics (Pasca et al., 2017). The scale items reflect one's connectedness with nature (e.g., "I think of the natural world as a community to which I belong"). The scale items are answered on a 7-point Likert-scale (1 = strongly disagree, 7 = strongly agree) in the Finnish translation. Total scores can vary between 7–49.

The original CNS or the CNS-7 have not been separately validated with a Finnish sample before. In this study, the Finnish translation of the CNS-7 showed good internal consistency ($\alpha = .88$). This is comparable to the internal consistency observed in other studies where Cronbach's alpha has ranged between .78–.91 (Navarro et al., 2022; Pasca et al., 2017) though it is noteworthy that the items in the English version of the CNS-7 are answered on a 5-point Likert-scale.

Psychological resilience

Psychological resilience was measured with the Finnish translation of the RS-14 scale (Losoi et al., 2013). The RS-14, designed by Wagnild in 2010, is a shortened version of the original 25-item Resilience Scale (RS) created by Wagnild and Young in 1993 (Losoi et al., 2013). Both the original RS-scale and the RS-14 have been found to be adequately valid and reliable tools for measuring

psychological resilience and they have been used in many studies across different cultures and countries (e.g., Ahern et al., 2006; Losoi et al., 2013; Mirošević et al., 2019; Wagnild, 2009, Windle et al., 2011). The RS-14 has been found to correlate strongly with the original RS, and it is suggested to be more user-friendly since it is shorter than the original scale (Losoi et al., 2013; Mirošević et al., 2019). Adequate psychometric properties, time efficiency, and wide use in research makes the RS-14 a recommended research tool (Mirošević et al., 2019).

The RS-14 consists of fourteen items drawn from the original RS scale that reflect individual resilience (e.g., “I usually manage one way or another”) (Losoi et al., 2013). The scale items are answered on a 7-point Likert-scale (1 = strongly disagree, 7 = strongly agree). Total scores of the RS-14 can vary between 14–98 and have been interpreted according to Wagnild in a following way: scores between 14–56 indicate “very low resilience”, scores between 57–64 indicate “low resilience”, scores between 65–73 indicate “resilience on the low end”, scores between indicate 74–81 “moderate resilience”, scores between 82–90 indicate “moderately high resilience” and scores between 91–98 indicate “high resilience”.

In this study, the Finnish translation of the RS-14 showed good internal consistency ($\alpha = .90$) which is close to the alpha value found in Losoi et al.’s (2013) study ($\alpha = .87$) with a Finnish sample. Comparable results have been obtained in other studies across different cultures and countries where Cronbach’s alpha has ranged between .76–.96 (Mirošević et al., 2019).

Life satisfaction

Subjective wellbeing was operationalized as a subjective experience of life satisfaction. Life satisfaction was measured with the Finnish translation of the Satisfaction With Life Scale (SWLS) which has been designed to assess global life satisfaction (Diener et al., 1985). The SWLS has been found to have good psychometric properties across different studies including high internal and moderate temporal reliability and good convergent and discriminant validity (Pavot & Diener, 1993). Thus, the SWLS can be seen as a valid and reliable measure of life satisfaction.

The SWLS consists of five items that reflect one’s subjective experience of life satisfaction (e.g., “In most ways my life is close to ideal”) (Diener et al., 1985). The scale items are answered on a 7-point Likert-scale (1 = strongly disagree, 7 = strongly agree). Total scores of the SWLS can range from 5 (low life satisfaction) to 35 (high life satisfaction).

The SWLS has not been separately validated with a Finnish sample before. In this study, the Finnish translation of the SWLS showed good internal consistency ($\alpha = .88$) which is comparable to

the internal consistency found in other studies where Cronbach's alpha has ranged between .79–.89 (Pavot & Diener, 1993).

Data-analysis

Data was analyzed with the SPSS IBM Statistics 29.0.1.0 -program. The research questions were analyzed with Pearson and Spearman correlations (question 1 and partially question 2), hierarchical multiple regression (questions 2 and 3) and with mediation analysis using PROCESS macro 4.2 program (questions 4 and 5). Prior to these actual analyses, the fulfillment of their assumptions and other factors impacting the analyses, such as missing values, were investigated.

First, possible missing values were examined. No missing values were found in 667 participants' answers on any of the questions of the CNS-7, RS-14 or SWLS scales. Since there were no missing values, mean scores were calculated for each participant based on their answers on the CNS-7, RS-14 and SWLS scales. Thus, the three mean summary variables (CNS-7, RS-14 and SWLS) required to the statistical analyses were created based on participants' answers to these surveys.

Next, possible outliers were examined. One outlier (i.e., participant with deviant response pattern) was identified in the boxplot that described the distribution of the RS mean sum variable. Later analyses also identified this participant as an outlier: the scatterplot of the residuals of the hierarchical multiple regression and the value of Cook's distance showed an additional reason to remove this participant from the final analyses. Thus, the final analyses were conducted with a sample size of 666. Removing the outlier slightly improved the values of skewness and kurtosis as well as the histograms of the mean sum variables.

To examine the first and partially also the second research question, correlation analyses were conducted. First, the assumptions of the Pearson correlation analysis were examined. The assumptions of the measurement scale (at least an interval scale) and the assumption of linear relationship between variables were met because the mean sum variables were on a ratio scale and the separate scatterplots revealed sufficiently linear relationships between the CNS-7, RS-14 and SWLS scores. The Kolmogorov-Smirnov tests were significant, indicating that the mean sum variables were not fully normally distributed. However, the values of skewness and kurtosis and the histograms of the mean sum variables showed that the mean sum variables were sufficiently normally distributed. In addition, Spearman correlation analyses were conducted to confirm the validity of the results of the Pearson correlations. There were no remarkable differences between Pearson and Spearman correlations (the differences between the Pearson and Spearman correlation coefficients

were .01 for each examined relationship). Thus, the similar results of correlation analyses further confirmed that the mean sum variables were adequately normally distributed.

The magnitude of the correlations was primarily interpreted according to the new guidelines for Pearson correlations presented by Gignac & Szodorai, (2016) where correlations of .10, .20, .30 are interpreted as relatively small, typical and relatively large. For clarity, the word “typical” describing correlation of .20 is replaced by the word “medium” from Cohen’s (1988) classification because it describes more clearly the magnitude of correlation than the word typical. In addition, if correlations .50 or bigger occur, they are interpreted as large according to Cohen (1988) because Gignac and Szodorai’s (2016) guidelines end with the description “relatively large” for .30 correlation.

Second and third research questions were examined with a hierarchical multiple regression analysis. To assess the second research question, the mean sum variables of the CNS-7 and RS-14 were introduced into the regression model as the independent variables and the mean sum variable of the SWLS as the dependent variable. To examine the third research question, concerning the possible moderation effect of nature connectedness, an interaction term was added to the model, along with aforementioned variables. The interaction term was created by multiplying the standardized values of the CNS-7 and RS-14 mean sum variables.

To assess the validity of the regression model, the assumptions of the hierarchical multiple regression were examined. The assumption of the measurement scale (the dependent variable at least on an interval scale) was met since the dependent variable (SWLS) was on a ratio scale. Also, the assumption of large enough sample (at least twenty participants per independent variable) was met, since the total number of participants included in the final analyses was 666 individuals. The assumptions of the linearity, normally distributed residuals and homoscedasticity were interpreted from graphs. The assumption of linearity between the independent variables and the dependent variable was met because the scatterplot of the residuals of the hierarchical multiple regression indicated linearity between the independent variables (CNS-7 and RS-14) and the dependent variable (SWLS). The assumption of normally distributed residuals was sufficiently met since the histogram and the normal probability plot of the standardized residuals showed an approximate normal distribution. The assumption of the homoscedasticity (constant variance of the residuals across all levels of the independent variables) was also met since the dots in the scatterplot of the hierarchical multiple regression were sufficiently scattered. Finally, no remarkable multicollinearity was found, since the VIF-values of the independent variables were between 1.07–1.12 and the tolerance values were between .89–.94. A VIF-value greater than five and tolerance value less than .10 have been interpreted to indicate high multicollinearity between the independent variables (Daoud, 2017). Thus, the assumption of the absence of multicollinearity was also met.

Research questions four and five, concerning the possible mediation effects, were investigated with mediation analysis using PROCESS Macro 4.2 which is a supplementary program for SPSS. The statistical significance of the mediation models was analyzed with bootstrapping method. In the process of bootstrapping, sampling distributions were generated for the indirect effects, and 5000 resamples were drawn from the original sample. Bias-corrected 95 % confidence intervals were calculated to evaluate the significance of the results. If the confidence interval does not include a zero, the test is interpreted statistically significant (Hayes, 2017). Only unstandardized regression coefficients are reported for the relationships in the results section because the PROCESS primarily provides them, except for the indirect relationships.

Before conducting mediation analyses, the fulfillment of the mediation assumptions was examined. The assumption of the measurement scale (variables at least on an interval scale) and the assumption of approximately normally distributed variables were met. Simple linear regression analyses were conducted for CNS-7, RS-14 and SWLS variables to confirm that there were linear relationships between independent, dependent and mediator variables. The scatterplots of the separate regression analyses confirmed linear relationships between the CNS-7 and RS-14 scores, between the CNS-7 and SWLS scores and between the RS-14 and SWLS scores. The scatterplots of the separate linear regressions also showed that the assumptions of normally distributed residuals and homoscedasticity were sufficiently met. The assumption of the absence of multicollinearity was also met, as indicated by the VIF and tolerance values of the above-mentioned hierarchical multiple regression analysis.

RESULTS

Descriptive results

Descriptive statistics of nature connectedness, psychological resilience, and life satisfaction are shown in table 1. Mean values were close to five for all the study variables (possible ranges for scores were from 1 to 7). Thus, mean values for all the study variables were relatively high. The highest mean value was for psychological resilience ($M = 5.31$) and the lowest for nature connectedness ($M = 4.90$).

TABLE 1. Descriptive statistics of the study variables ($n = 666$)

Variable	<i>M</i>	<i>SD</i>	Min	Max
Nature connectedness (CNS-7)	4.90	1.22	1.00	7.00
Psychological resilience (RS-14)	5.31	0.83	1.50	7.00
Life satisfaction (SWLS)	5.06	1.18	1.00	7.00

CNS-7 = Brief version of the Connectedness to Nature Scale, RS-14 = Short version of the Resilience Scale, SWLS = Satisfaction With Life Scale, *M* = mean, *SD* = standard deviation

Associations between nature connectedness, psychological resilience, and life satisfaction

Correlation analysis showed significant positive linear relationships between the study variables. A significant approaching relatively large positive association was found between nature connectedness and psychological resilience ($r = .27, p < .001$). This means that higher sense of nature connectedness was associated with higher experience of psychological resilience, and vice versa. A significant large positive association was found between psychological resilience and life satisfaction ($r = .60, p < .001$), which means that higher experience of psychological resilience was associated with higher experience of life satisfaction, and vice versa. A significant, though relatively small, positive association was found between nature connectedness and life satisfaction ($r = .12, p < .01$). This means that as sensed connectedness to nature increases, there is a slight simultaneous increase in life satisfaction, and vice versa. The correlation coefficients between study variables are shown in table 2.

TABLE 2. Pearson correlations among nature connectedness, psychological resilience, and life satisfaction ($n = 666$)

Variable	1.	2.	3.
1. Nature connectedness (CNS-7)	-		
2. Psychological resilience (RS-14)	.27***	-	
3. Life satisfaction (SWLS)	.12**	.60***	-

CNS-7 = Brief version of the Connectedness to Nature Scale, RS-14 = Short version of the Resilience Scale, SWLS = Satisfaction With Life Scale

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

The results of the hierarchical regression estimating the effects of nature connectedness and psychological resilience on life satisfaction are presented in table 3. Model 1 was statistically significant ($R^2 = .36$, $F(2, 663) = 182.86$, $p < .001$) explaining 36 % of the variance in the dependent variable (i.e., life satisfaction). In model 1, psychological resilience had a significant large positive association with life satisfaction ($\beta = .61$, $p < .001$). This means that for every one standard deviation increase in psychological resilience, life satisfaction increases by .61 standard deviations when controlling the effect of nature connectedness. Nature connectedness did not have a significant association with life satisfaction ($\beta = -.04$, $p = .201$). Model 2 was statistically significant ($R^2 = .36$, $F(3,662) = 121.89$, $p < .001$). The results regarding the size and significance of regression coefficients remained the same in the second model compared to the first model (except for minor decimal changes). Thus, psychological resilience had a significant positive association with life satisfaction and nature connectedness did not. The interaction term, which measured whether nature connectedness modifies the relationship between psychological resilience and life satisfaction, was not statistically significant ($\beta = .02$, $p = .568$). Thus, the strength of nature connectedness did not modify the relationship between psychological resilience and life satisfaction.

TABLE 3. Nature connectedness and psychological resilience as predictors of life satisfaction

Variables	ΔR^2	R^2	B	SE	β	t	95 % CI	
							LB	UB
Step 1: Predictors	.36	.36						
1. Nature connectedness			-.04	.03	-.04	-1.22	-.10	.02
2. Psychological resilience			.87***	.05	.61***	18.47	.78	.96
Step 2: Moderator	.00	.36						
3. Nature connectedness * Psychological resilience			.02	.03	.02	.57	-.04	.08

ΔR^2 = the change in the coefficient of determination (R^2) when all variables of the step were included, B = unstandardized regression coefficient, SE = standard error of the unstandardized regression coefficient, β = standardized regression coefficient, t = t-test value, CI = confidence interval for B. All coefficients and values are from the final step of the model (when all variables of the model are included).

*** $p < .001$

The first mediation analysis aimed to investigate whether nature connectedness mediates the relationship between psychological resilience and life satisfaction. The results revealed that nature connectedness did not mediate the effect of psychological resilience on life satisfaction because the indirect path (the path from psychological resilience to life satisfaction via nature connectedness) was not statistically significant (B = -.02, 95 % CI [-.04, .01], β = -.01, 95 % CI [-.03, .01]). However, the direct effect of psychological resilience on life satisfaction was significant (B = .86, $t = 18.74$, $p < .001$, 95 % CI [.77, .95]). The total effect (combined indirect and direct effect) of the psychological resilience on the life satisfaction was significant (B = .85, $t = 19.10$, $p < .001$, 95 % CI [.76, .94]). The relationship diagram of the first mediation analysis is presented in figure 1.

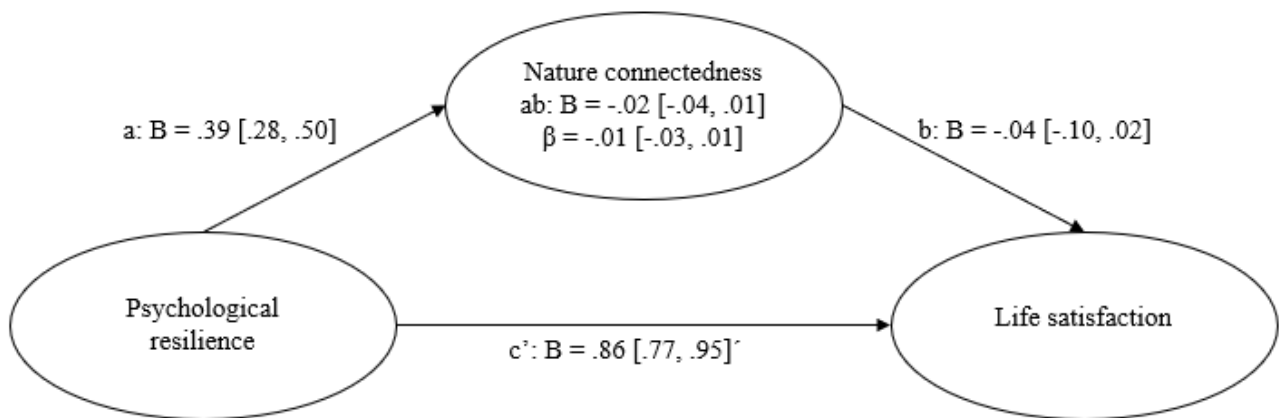


FIGURE 1. Simple mediation model with regression coefficients and 95 % confidence intervals for the relationship between psychological resilience and life satisfaction as potentially mediated by nature connectedness.

ab = the indirect effect of psychological resilience on life satisfaction through nature connectedness, c' = the direct effect of psychological resilience on life satisfaction, β = standardized regression coefficient, B = unstandardized regression coefficient

The second mediation analysis investigated whether psychological resilience mediates the relationship between nature connectedness and life satisfaction. The mediation analysis revealed a statistically significant indirect effect of nature connectedness on life satisfaction ($B = .16$, 95 % CI [.11, .22], $\beta = .16$, 95 % CI [.11, .22]). In other words, psychological resilience significantly mediated the relationship between nature connectedness and life satisfaction. Since the direct effect of nature connectedness on life satisfaction was not significant ($B = -.04$, $t = -1.28$, $p = .201$, 95 % CI [-.10, .02]), psychological resilience fully mediated the relationship between nature connectedness and life satisfaction. The total effect (combined indirect and direct effect) of nature connectedness on life satisfaction was significant ($B = .12$, $t = 3.11$, $p = .002$, 95 % CI [.04, .19]). The relationship diagram of the second mediation analysis is presented in figure 2.

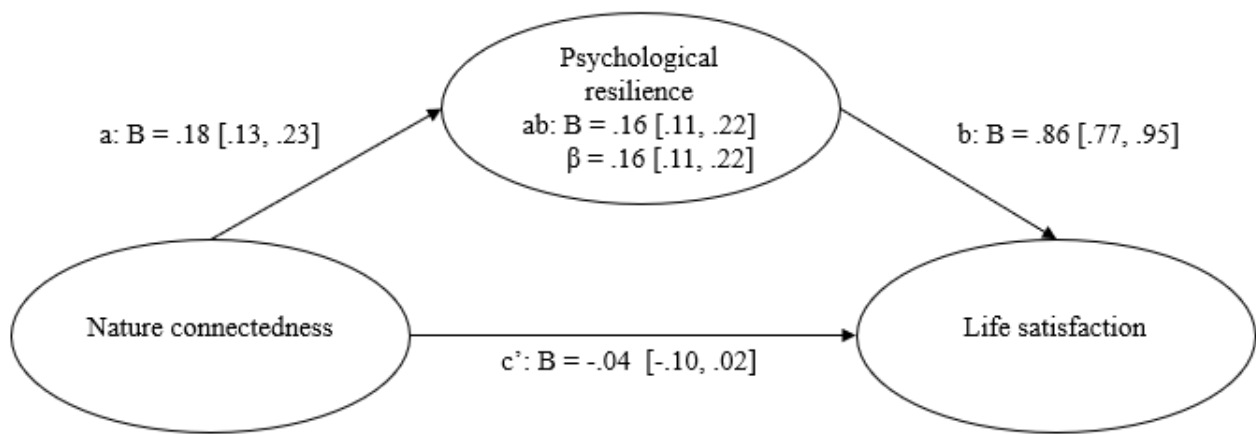


FIGURE 2. Simple mediation model with regression coefficients and 95 % confidence intervals for the relationship between nature connectedness and life satisfaction as mediated by psychological resilience. All the relationships in the model are also significant at level .01.

ab = the indirect effect of nature connectedness on life satisfaction through psychological resilience, c' = the direct effect of nature connectedness on life satisfaction, β = standardized regression coefficient, B = unstandardized regression coefficient

DISCUSSION

The aim of this study was to investigate the relationships between nature connectedness, psychological resilience, and life satisfaction, which is a commonly used measure of subjective wellbeing. Specifically, the aim was to investigate whether nature connectedness and psychological resilience are related to each other and whether they are associated with life satisfaction in a Finnish sample. This study also investigated if the strength of nature connectedness moderates the relationship between psychological resilience and life satisfaction. Additionally, this study investigated whether nature connectedness mediates the relationship between psychological resilience and life satisfaction as well as whether psychological resilience mediates the relationship between nature connectedness and life satisfaction.

Relationship between nature connectedness and psychological resilience

The aim of the first research question was to examine whether nature connectedness and psychological resilience are related to each other. A positive association was found between nature connectedness and psychological resilience, which supports the hypothesis of this study. The magnitude of the connection between nature connectedness and psychological resilience was .27, thus approaching relatively large (see Gignac & Szodorai, 2016). This means that as the strength of nature connectedness increases, there is a tendency for a simultaneous increase in psychological resilience, and vice versa. The result of this study aligns with the finding of Ingulli and Lindbloom's (2013) study, where a similar, though slightly larger ($r = .38$), positive association was found between nature connectedness and psychological resilience.

However, the result of this study contradicts with the finding of Brown's (2017) study where nature connectedness and psychological resilience were not associated with each other. One reason for the conflicting findings might be that the participants in Brown's study (2017) had experienced a nature disaster. This may have negatively impacted the participants' relationship with nature or their sense of resilience. For example, experiencing a nature disaster may have produced feelings of fear and mistrust towards nature and helplessness in front of disaster. These may have led to diminished feelings of connectedness with nature and lower sense of resilience.

On the other hand, the measurement scales of nature connectedness and psychological resilience used in Brown's study (2017) were different from the measurements used in this and Ingulli and Lindbloom's (2013) study. Brown (2017) used the Connectedness with Nature–Single Item (CWN-SI) scale to measure nature connectedness and the Brief Resilience scale to measure psychological resilience. Ingulli and Lindbloom (2013) used the CNS and RS scales, and this study used the short versions of these scales. It is possible that the longer CNS scales and the Resilience scales catch nature connectedness and psychological resilience better than the CWN-SI scale and the Brief Resilience scale. Thus, the results of Brown's (2017) study could have been more like the results of this and Ingulli and Lindbloom's (2013) study if different scales had been used.

The positive relationship between nature connectedness and psychological resilience found in this study is also understandable given the evidence that nature connectedness is a potential mediator of beneficial effects of nature exposure (Baceviciene & Jankauskiene, 2022; Liu et al., 2022; Mayer et al., 2009), and that nature exposure in turn is likely to ease stress or even enhance individual coping as suggested by many studies and theories (Gaekwad et al., 2023; Hatala et al., 2020; Kaplan & Kaplan, 1989; Møller et al., 2023; Ulrich, 1983; Yao et al., 2021; White et al., 2023). Recovery from stress and adversities and the ability to cope with and overcome difficult life situations are in turn phenomena linked to psychological resilience (Aburn et al., 2016; Hiebel et al., 2021; Sisto et al., 2019).

Relationships between nature connectedness, psychological resilience, and life satisfaction

The aim of the second research question was to investigate whether nature connectedness and psychological resilience are associated with life satisfaction, one aspect of subjective wellbeing (see Pavot & Diener, 1993). The hypothesis that both nature connectedness and psychological resilience are positively associated with life satisfaction was partially supported.

Regarding psychological resilience, the hypothesis was supported since a positive association between psychological resilience and life satisfaction was found in both correlation analysis and in hierarchical regression analysis. In correlation analysis, the magnitude of this positive connection was large ($r = .60$) (see Gignac & Szodorai, 2016), which means that higher psychological resilience was consistently associated with higher experience of life satisfaction, and vice versa. The magnitude of the positive connection between psychological resilience and life satisfaction remained practically the same in regression analysis where the effect of nature connectedness was assessed at the same time. Previous studies have also found a positive association between psychological resilience and life satisfaction (e.g., Bajaj & Bande, 2016; Fan et al., 2023; Hu et al., 2015; Kong et al., 2015; Liu et al., 2014; Wagnild and Young, 1993). Additionally, the magnitude of the relationship observed in this study was comparable to the magnitude reported in previous studies. For example, twelve studies included in the Hu et al.'s (2015) meta-analysis reported a large ($r \geq .30$) effect size for the relationship between psychological resilience and life satisfaction.

Regarding nature connectedness the hypothesis was not fully supported. Correlation analysis showed a positive association between nature connectedness and life satisfaction. The magnitude of this positive connection was small ($r = .12$) (see Gignac & Szodorai, 2016), implying that there is a slight tendency for individuals with higher levels of nature connectedness to also experience slightly elevated life satisfaction, and vice versa. This finding aligns with previous studies that have also found a positive relationship between nature connectedness and life satisfaction (e.g., Capaldi et al., 2014; Pritchard et al., 2020). Also, the magnitude found in this study ($r = .12$) was close to the magnitude observed in previous meta-analyses: Both Capaldi et al. (2014) and Pritchard et al. (2020), reported the effect size of .17 for the relationship between nature connectedness and life satisfaction. However, the positive relationship between nature connectedness and life satisfaction became non-significant and slightly negative in the regression analysis where the effect of psychological resilience on life satisfaction was assessed at the same time. Thus, the impact of psychological resilience seemed to overpower the association between nature connectedness and life satisfaction when both predictors were present.

The aim of the third research question was to examine whether the strength of nature connectedness moderates the relationship between psychological resilience and life satisfaction. No hypothesis was set to this research question because there is no previous research on this subject. The result was that the strength of nature connectedness did not moderate the relationship between psychological resilience and life satisfaction. In other words, the strength of nature connectedness did not impact the relationship between psychological resilience and life satisfaction; regardless of the experienced amount of nature connectedness the relationship between psychological resilience and life satisfaction remained consistent.

As there is no previous research that would have investigated whether the strength of nature connectedness moderates the relationship between psychological resilience and life satisfaction, it is difficult to interpret this result in the light of previous research. However, because the estimates for the effects of nature connectedness and psychological resilience on life satisfaction remained practically the same between the first regression model estimating only the main effects and the second model estimating also moderation, it could be possible that the strength of nature connectedness truly does not moderate the relationship between psychological resilience and life satisfaction. Nevertheless, additional research is recommended to confirm this finding.

It is noteworthy that psychological resilience could also have been chosen as the moderator because there is no previous research that would have specifically supported the selection of nature connectedness for the moderator. Nature connectedness was chosen as the moderator because the primary interest of this study and the broader research project, to which this study belongs, have been interested in the wellbeing effects of nature.

Mediative role of psychological resilience

The aims of the fourth and the fifth research questions were to examine whether nature connectedness or psychological resilience function as a mediator. Hypotheses were not set because there is no previous research regarding these research questions. Mediation analyses revealed that psychological resilience mediated fully the relationship between nature connectedness and life satisfaction. Nature connectedness in turn did not mediate the relationship between psychological resilience and life satisfaction, which is understandable given the mediative role of psychological resilience. The mediative role of psychological resilience on the relationship between nature connectedness and life satisfaction also increases the comprehensibility of the results of hierarchical

regression where the effect of nature connectedness on life satisfaction became non-significant when assessed together with the effect of psychological resilience.

To the author's knowledge, there is no existing literature about mediation effects among nature connectedness, psychological resilience, and life satisfaction. However, psychological resilience has been observed to partially mediate the positive effect of physical activity in alpine environment on quality of life in patients with psychosomatic disorders (Ower et al., 2019). Thus, given the previous findings that nature connectedness has mediated the beneficial effects of nature exposure (Baceviciene & Jankauskiene, 2022; Liu et al., 2022; Mayer et al., 2009) the result of this study can be seen to align at least partially with findings of one previous study where the interest has been in the beneficial effects of nature and the mediative effect of psychological resilience.

The mediative role of psychological resilience is also understandable in the light of previous research in a sense that the effect of psychological resilience on life satisfaction has been consistently stronger compared to the effect of nature connectedness. For example, in the studies included in the Hu et al.'s (2015) meta-analysis, reported effect sizes for the relationship between psychological resilience and life satisfaction were mostly large ($r \geq .30$), with three studies reporting medium effect sizes ($r \geq .20$), and only one study reporting an effect size below .20. In contrast, the effect sizes for the relationship between nature connectedness and life satisfaction have been .17 in two meta-analyses (Capaldi et al., 2014; Pritchard et al., 2020), thus clearly smaller.

Nevertheless, the observation that psychological resilience has been consistently more strongly associated with life satisfaction compared to nature connectedness, does not itself explain what mechanisms could explain the mediative role of psychological resilience. Thus, it remains ambiguous why psychological resilience might mediate the relationship between nature connectedness and life satisfaction. Some ideas can be drawn based on previous research regarding the associations between nature exposure, nature connectedness, stress recovery and individual coping. It is important to note, that the finding of psychological resilience mediating the relationship between nature connectedness and life satisfaction, does not guarantee causality. The causality in these relationships and the ideas of underlying processes presented below should be examined with longitudinal studies in future.

One explanation for the mediative effect of psychological resilience could be that the sense of nature connectedness promotes some aspects of psychological resilience such as the ability to cope with stress. In one study, it was found that nature connectedness was associated with lower levels of perceived stress via adaptive emotion regulation strategies (Bakir-Demir et al., 2021). As emotion regulation is closely linked to coping (Aldao et al., 2010; Marroquín et al., 2017) it could be hypothesized that experiencing connectedness to nature could promote emotion regulation as well as other coping strategies. Enhanced emotion regulation and coping strategies would in turn help to cope with life challenges and eventually promote psychological resilience. Resilience could in turn

function as a resource promoting feelings of life satisfaction and other aspects of subjective wellbeing. In previous research, psychological resilience has been observed to partially mediate the relationship between mindfulness and life satisfaction (Bajaj & Pande, 2015) and it has been viewed as an important source of subjective wellbeing and mental health (Bajaj & Pande, 2015; Fan et al., 2023; Hu et al., 2015).

There might be also some underlying processes that associate nature connectedness, psychological resilience, and subjective wellbeing to each other. For example, an ability to take a distanced perspective toward one's feelings and thoughts (also referred as decentering) has been found to be positively associated with both nature connectedness (Hanley et al., 2017; Nisbet et al., 2019; Sanyer et al., 2023) and psychological resilience (Musil et al., 2021; Nila et al., 2016): Nila et al. (2016) found in their longitudinal study that decentering mediated the effect of Mindfulness-Based Stress Reduction (MBSR) intervention on resilience and suggested that the ability to decenter can be considered as responsible for increases in resilience. Decentering has been found to be positively associated also with nature connectedness (Hanley et al., 2017; Nisbet et al., 2019; Sanyer et al., 2023). Furthermore, ART theory (Kaplan & Kaplan, 1989) argues that the recovery of attentional capacity, being away, and gaining distance from daily concerns are factors contributing restoration. Nature has also been reported as a place that can produce feelings of calm, promote the development of new perspectives (Møller et al., 2023) and where self-reflection might occur (Korpela et al., 2001). Thus, it could be possible that being in nature and feelings of nature connectedness could produce feelings of calm and enable a more reflective state of mind. A reflective state of mind could in turn promote the ability to take a distanced perspective towards one's feelings and thoughts (decentering) and daily concerns, which could in turn lead into new insights of one's life. For example, one could perceive her or himself to be part of the natural cycle and surrounding world making personal worries seem smaller. The new insights and feelings of calm could increase feelings of resilience or lead to a development of new coping abilities which could promote psychological resilience. Resilience could in turn promote life satisfaction and other aspects subjective wellbeing.

Strengths and limitations of this study

The main strength of this study is that it brought **new knowledge** on the relationships between nature connectedness, psychological resilience, and life satisfaction. Specifically, new information regarding the relationship between nature connectedness and psychological resilience can be considered important since the subject has not been studied much before, apart from Ingulli &

Lindbloom's (2013) and Brown's (2017) studies. The positive association between nature connectedness and psychological resilience found in this study clarifies the conflicting findings of these previous studies. This study also provided new knowledge regarding the possible mediative effect of psychological resilience on the relationship between nature connectedness and life satisfaction.

The sample of this study can be considered as one of the strengths of this study. The sample size was large, which increases the reliability of the results. Another strength is the diversity of the sample in terms of educational backgrounds, employment situations, living arrangements, and age range, as it increases the generalizability of the results: However, it is noteworthy that women were overrepresented (60 %) in the sample, which could potentially weaken the generalizability of the results for men.

Sufficient fulfillment of the assumptions of the analytical methods can also be considered as a strength. However, it is noteworthy that the mean sum variables were not fully normally distributed according to statistical tests. Nevertheless, since the sample size was large and because adequate normality was ensured with other methods, this violation can be considered minor with no significant impact on the reliability of the results.

Research design has both strengths and limitations. This study was conducted with a cross-sectional design. One limitation in cross-sectional designs is that they do not provide reliable information on causal relationships. However, cross-sectional designs enable wider data collection and thus describe well the studied phenomena in different population groups at a given moment.

One limitation of this study is that the study variables were measured only with **self-assessment scales**. Thus, different answer styles or misunderstandings of questions may have impacted the results. It is also noteworthy that even though the used measurement scales have been documented to have good psychometric properties (see Mirošević et al., 2019; Navarro et al., 2022; Losoi et al., 2013; Pasca et al., 2017; Pavot & Diener, 1993) they represent only certain theoretical viewpoints. For example, nature connectedness was addressed as one's emotional and experiential connection to the natural world (Mayer & Franz, 2004), and psychological resilience was understood as a relatively stable positive personality characteristic that moderates the negative effects of adversity and promotes individual adaptation (Wagnild and Young, 1993). However, there are many definitions and scales for nature connectedness (see Kals et al., 1999; Nisbet et al., 2009; Perkins, 2010; Schultz, 2001), psychological resilience (see Aburn et al., 2016; Ahern et al., 2006; Hiebel et al., 2021; IJntema et al., 2019; Sisto et al., 2019) and life satisfaction (see Charlemagne-Badal et al., 2015; Weber et al., 2015) that could be used in research.

Another limitation is that **subjective wellbeing** was assessed only as the amount of experienced life satisfaction, which is not the only way to assess subjective wellbeing. For example, the

assessment of positive and negative affect is often included in wellbeing evaluations (e.g., Bajaj & Bande, 2016; Capaldi et al., 2014; Fan et al., 2023; Hu et al., 2015; Pritchard et al., 2020). Sometimes also other measures (e.g., vitality, meaning in life, personal growth) are used as indicators of wellbeing (e.g., Capaldi et al., 2014; Capaldi et al., 2017; Nisbet et al., 2019; Pritchard et al., 2020).

One aim of this study was to examine open-mindedly whether moderation or mediation effects occur between nature connectedness, psychological resilience, and life satisfaction because these have not been studied before. On the other hand, this has given an opportunity to bring new knowledge. However, **the lack of previous research** also posits a limitation for making conclusions based on the results of the moderation and mediation analyses. Thus, the results of moderation and mediation analyses should be taken as preliminary findings that require additional research.

Future research

Further examination of the relationships between nature connectedness, psychological resilience, and subjective wellbeing would be important in the future. More research is especially needed on the relationship between nature connectedness and psychological resilience because there is still not much research on this subject. It would be also important to investigate more how nature connectedness and psychological resilience are related to life satisfaction and other aspects of subjective wellbeing within the same sample. Specifically, the new finding of psychological resilience mediating the relationship between nature connectedness and life satisfaction needs further investigation. The research should be done with different research designs and methods in the future.

Information about one's experience of nature connectedness, psychological resilience and subjective wellbeing should be collected with **different quantitative and qualitative research methods** in the future. As described previously, several self-assessment scales have been developed for nature connectedness, psychological resilience, and life satisfaction. In addition, the assessment of positive and negative affect as well as other measures (e.g., vitality, meaning in life, personal growth) are often included in the evaluations of subjective wellbeing. Thus, the use of different self-assessment scales and the wider assessment of subjective wellbeing are recommended for the future research as it would produce more diverse and comprehensive knowledge about the relationships between nature connectedness, psychological resilience, and subjective wellbeing. For example, including the assessment of positive and negative affect into future research would provide valuable information on how nature connectedness and psychological resilience are associated with the emotional dimension of subjective wellbeing. In addition to self-assessment scales, the use of

qualitative research methods such as interviews and open questions are recommended so that a deeper understanding could be gained regarding individual's experience of nature connectedness, psychological resilience, and subjective wellbeing.

More cross-sectional research should be done to investigate the relationships between nature connectedness, psychological resilience, and subjective wellbeing. Additional research should be done with different populations to gather information on whether the findings of this study are generalizable across different population groups. For example, it is possible that the finding regarding positive association between nature connectedness and psychological resilience is not found in all population groups. For instance, experiencing nature disaster could weaken one's trust with nature and thus also the relationship between nature connectedness and psychological resilience. Furthermore, many other factors such as culture, residence, age, and individual differences may also affect the presence or strength of the relationship between nature connectedness and psychological resilience. For example, it is possible that the positive relationship between nature connectedness and psychological resilience is stronger for those who live nearby nature or spend a lot of time in nature. Similarly, more cross-sectional research should be done to examine how nature connectedness and psychological resilience are simultaneously associated with life satisfaction and other aspects of subjective wellbeing because there still limited knowledge on this subject. The findings of this study suggest that the effects of nature connectedness on subjective wellbeing may occur through psychological resilience. However, as this is a preliminary finding, it needs to be further investigated across different population groups to gather more information about it.

Conducting **longitudinal studies** would also be important. Longitudinal studies could deepen the understanding about the relationships between nature connectedness, psychological resilience, life satisfaction and other aspects of subjective wellbeing. Longitudinal studies would help to determine for example the causality in these relationships. Based on this study's results, it could be hypothesized that experiencing nature connectedness might increase psychological resilience which would in turn lead to increased subjective wellbeing. However, because this study was cross-sectional, conclusions regarding the causality cannot be made. Thus, longitudinal studies are needed to confirm the findings of this study and to answer the question of causality.

Longitudinal studies could also reveal if other factors affect or explain the relationships between nature connectedness, psychological resilience, and subjective wellbeing. Specifically, the reason why nature connectedness and psychological resilience are associated with each other remains ambiguous as the research to this day has only focused on the question whether they are associated. For example, a mindful ability to take a distanced perspective toward one's feelings and thoughts (decentering), linked both psychological resilience (e.g., Musil et al., 2021; Nila et al., 2016) and nature connectedness (e.g., Hanley et al., 2017; Nisbet et al., 2019; Sanyer et al., 2023) might explain

the association between these two phenomena. The hypothesized mediative effect of decentering on the relationship between nature connectedness and psychological resilience could be studied for example with a resilience-building intervention that includes mindfulness-practices (e.g., observation and acceptance of one's thoughts and emotions, focusing on environment). Participants could be divided into experimental and control groups, of which the experimental group does the practices in nature and the control group does the same practices inside. Dividing participants into these groups could help to find out if doing practices in nature promotes decentering more than practices inside. Based on previous research regarding stress relieving effects of nature it could be hypothesized that being in nature produces feelings of calm and enables a reflective state of mind which in turn promotes to the ability to decenter. Self-assessment scales and interviews could be used before and after the intervention to assess participants' experience of decentering as well as nature connectedness, psychological resilience, and subjective wellbeing.

Conclusions

This study brought new knowledge regarding the relationships between nature connectedness, psychological resilience, and subjective wellbeing. This study provided further evidence for the previous finding that nature connectedness and psychological resilience are positively associated with each other, and further confirmed the previous findings that psychological resilience is positively associated with life satisfaction, one dimension of subjective wellbeing. The new finding of psychological resilience mediating the relationship between nature connectedness and life satisfaction opens new research possibilities for the future. Based on the results of this study, it is suggested that psychological resilience is likely an important factor contributing to subjective wellbeing, and that the effects of nature connectedness on subjective wellbeing may be mediated through psychological resilience. It is further suggested that the feelings of nature connectedness might enhance at least some aspects of psychological resilience or processes linked to resilience (i.e., stress coping, perspective taking) which in turn would lead to greater subjective wellbeing. The development of resilience-building interventions that incorporate nature as well as additional research with different research methods and settings are recommended so that a more comprehensive understanding can be gained about the relationships between nature connectedness, psychological resilience, and subjective wellbeing.

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