



**Maynooth
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**Nature Connectedness in the 21st Century: Conceptualising and Measuring the Human-
Nature Relationship**

Thesis submitted to the Department of Psychology, Faculty of Science and Engineering, in
fulfilment of the requirements for the degree of Doctor of Philosophy at National University of
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For the little girl in the boat,
who trusted the water,
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Conference Lecture (n=1)

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Workshop (n=4)

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Summary

This research examines the complex dynamics involved in forming and maintaining a relationship with the natural world. In the context of increasing urbanisation, environmental degradation, and digitalisation, there is a growing need to understand how human–nature relationships are conceptualised, developed, experienced, maintained and measured. Added to this complex relationship is the unprecedented implications of a global pandemic, and strict lockdown restrictions. Although connection with nature has been associated with benefits for human wellbeing and pro-environmental outcomes, less attention has been given to the quality of this relationship and to the possibility that human–nature relationships may include ambivalent, difficult, or negatively valanced dimensions.

The research was conducted across four sequential stages, guided by a modified-Delphi methodology. These stages aimed to develop a deeper understanding of the human–nature relationship in light of current society, build consensus on its core components, and use co-productive methods to develop a robust and representative measure of relationship quality. Findings from the qualitative phase indicated that the human–nature relationship may be understood as a transactional process shaped by elements of shared identity, respect, care, and meaningful engagement. Importantly, expert and expanded-expert perspectives also suggested that this relationship is not always wholly positive, but may involve risk, vulnerability, discomfort, and other challenging relational experiences.

Building on these findings, a dedicated working group, consisting of experts in the areas of nature and scale validation, developed a preliminary 13-item Quality of Human–Nature Relationship Measure. Initial analyses indicated good internal reliability and validity. The measure captures dimensions including self-identification with nature, respect for nature, perceived risks associated with nature exposure, and longing for nature in its absence. The measure is described as preliminary because further validation and refinement are needed, particularly in relation to the potential subscales identified during factor analysis. Nevertheless, the findings offer an important

contribution to human–nature relationship research and provide a foundation for future work by researchers, practitioners, and policymakers interested in strengthening relationships between people and the natural world.

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Statistical Abbreviations and Symbols

α : Cronbach's alpha

CFI: Comparative Fit Index

CI: Confidence Interval

df: Degrees of freedom

I-CVI: Item-Level Content Validity Index

IQR: Interquartile Range

M : Mean

N : Total Number in Data Set

n : Sample in subset

p : Significance level

r : Pearson correlation coefficient

RMSEA: Root Mean Square Error of Approximation

SD : Standard Deviation

SRMR: Standardized Root Mean Square Residual

Std.all: Standardized factor loading

t : t -test statistic

TLI: Tucker-Lewis Index

χ^2 : Chi-Square Test Score

$\geq$: Greater than or equal to

$<$: Less than

$>$: Greater than

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Chapter 1: Rationale and Context

“A nature-positive future is within our reach, but achieving it requires that we transform our relationship with nature.”

Mary Robinson, Former President of Ireland (Business for Nature, 2023)

1.1 Introduction

As Gaeilge, the phrase *Comhbhá an Dúlra* is used to describe the human–nature relationship. It evokes a sense of nature working in harmony with a ruler who acts rightly and just (Ní Annracháin, 2020). The concept highlights a reciprocal partnership in which nature flourishes when humans act with care and respect, and becomes distressed when this partnership breaks down. Research has shown that when nature is flourishing so do the humans who engage with it. Modern societal pressures have led to a shift in the natural urge to connect and immerse oneself in nature. In many ways, the above phrase resonates with contemporary concerns: the depletion of natural resources, the accelerating climate crisis, and widespread declines in subjective well-being all suggest that the relationship between humans and nature is under strain. This research sets out to explore the complexity of the human-nature relationship in light of current barriers, and to develop a measure that allows for a reconceptualisation of what a relationship with nature presents in the modern day.

There is a growing recognition in research, practice and even policy that nature is no longer the backdrop to everyday life but is seen as a key component in mental, physical and even social health. At the European Union level, which has funded over €755 million in research and innovation in nature-based solutions in the past decade, nature is viewed as a fundamental component of climate resilience, and consistently cited as a basic need for liveable urban communities. Nature restoration has been on the global agenda for linking environmental protection to human behaviour as well as planetary and human health and wellbeing through the United Nations Sustainable Development Goals (SDGs). This Horizon2020 European funded PhD aligns with a number of SDGs (See Figure 1.1).

Figure 1.1

Sustainable Development Goal Mapping to Thesis and GoGreenRoutes



Other key initiatives which influence the direction of this EU project are the soft law initiatives initiated under the Presidency of Ursula von der Leyen including the EU Green Deal, New European Bauhaus, City Mission and most recently, the Nature Restoration Law. Against this backdrop, this research ambitiously aims to advance our understanding of the human-nature relationship beyond simply mere exposure or contact. It starts from the position that understanding and improving the human–nature relationship requires more than documenting “exposure” or frequency of contact. It requires greater conceptual clarity about what constitutes a relationship with nature in contemporary society, and the development of robust tools to measure the quality of that relationship. Modern trends of urbanisation and digitalisation have altered how nature is accessed, perceived, and integrated into everyday life. In response, this research set out (i) to reconceptualise human–nature relationships in a way that captures their complexity and context-sensitivity, and (ii) to operationalise this reconceptualisation through the development of a reliable and valid measure of quality of human–nature relationships.

1.2 Research Rationale

Three major societal challenges provide a backdrop to the central role of nature contact, interactions and connections. Each of these threats will be described in detail and

their potential impacts will be addressed. The opportunity that they each provide will then be outlined. Finally, specific issues with the construct of nature connectedness and related constructs will be discussed in light of the prevailing challenges.

1.2.1 Urbanisation

Firstly urbanisation, which based on current estimates will lead to 68% of the global population living in cities by 2050 (United Nations, 2019). Currently, 64% of Irish citizens and 76% of Europeans live in towns or cities (World Bank, 2024). This has direct impacts for citizens as loss of access to nature has changed citizens' experiences in their daily lives. GoGreenRoutes research has demonstrated that approximately 64% of Europeans do not have access to greenspace based on the World Health Organisation (WHO; 2016) recommendations (Barboza et al., 2021). The consensus of the urban health working group in 2016 led to a recommendation (i.e. not a guideline) that greenspace access (e.g. 0.5 hect.) within 300m (e.g. 5 mins. walk) of citizens residence. Lack of access to nature is a known health determinant and enabling all urban citizens to access nature would save an estimated 43,000 lives annually (Barboza et al., 2021). The models underlying this effect are complex and relate to diminished exposure to air pollutants, for example. However, it is not simply the absence of the co-hazards of noise and air-pollution that is beneficial for human health and well-being. In addition to the health impact, citizens' interactions with nature can be systematically more limited in many urban contexts (Kumar et al., 2019). For some citizens, they may have never formed a strong relationship with nature and for others who had prior experience of more natural settings, their connection may be diminished over time.

1.2.2 COVID-19 Pandemic

One of the impacts of COVID-19 was that many citizens returned to nature and green spaces for social interactions and the promotion of well-being (Nigg et al., 2023). Urban nature appears to be proactively used for psychosocial benefits not just for physical

activity according to this review. This shift towards nature augments research from previously funded EU research (e.g. PHENOTYPE, BLUEHEALTH) which links nature contact and exposure with mental health benefits (Bratman et al., 2019; Nieuwenhuijsen et al., 2022). More recently, RECETAS and Green Me projects have focused on nature based-interventions including social prescribing for those with lived experiences of psychological distress. Contemporary research highlights how green space was, through lower air pollution, associated with good mental health in an analysis of 3145 residents in Barcelona (Zijlema et al., 2024). Bratman et al.'s (2019) conceptual analysis and review concludes that despite consistent benefits for mental health and well-being there is little consensus on the underlying mechanism.

1.2.3 Digital Technology

A third challenge exacerbated in the urban context is the digital technology in our lives. Being tethered to our mobile devices including smartphones is associated with a range of negative well-being outcomes (Zhu et al., 2025). In addition, while we can access nature content through mobile devices and computing technology, what is termed technological nature, this offering may be much more limited in its impact (Litleskare et al., 2020).

Accumulating evidence on the mediating effect of nature connection and green space on well-being (Capaldi et al., 2014), mental health (Nieuwenhuijsen et al. 2022) and suggests that it could be vital in elucidating our understanding of human nature interactions, most notably in cities. Despite over four decades of research on human nature interactions, there is little consensus on the operational definition of the term nature connectedness.

1.3 Current Research

The present research aims to address gaps in our conceptualisation of the human-nature bond through a four-phase, mixed-methods research programme, exploring how modern developments play a role in this relationship. Phase 1 involves a Pan-European survey examining citizens' access to and use of natural spaces before, during and after COVID-19 restrictions, and how these relate to well-being, nature relatedness and pro-environmental behaviour. Phase 2 uses a modified-Delphi design with expert and expanded-expert panels to explore how nature relationships are understood in a 21st-century context, including urban and digital forms of nature. In Phase 3, a multidisciplinary working group translates the qualitative findings into a pool of candidate items for a new Nature Relationship Scale. Phase 4 evaluates the content validity and psychometric properties of this scale in an adult sample.

1.4 Aims, Objectives and the overarching Research Questions

This research has a number of aims and research questions spaced out throughout the chapters of the research. There is an overarching aim and research question guiding the process:

Aim: The initial aim of the research was to develop the construct of urban nature connectedness in light of current contextual issues. However, due to constraints in relation to the distribution of deliverables on the GoGreenRoutes project the aim of the research changed after the first year. Rather than exploring urban nature connectedness the research set out to develop a measure of urban nature connectedness. Upon further reflection with the research team this transformed once more to the current aim - To reconceptualise our understanding of the complex and dynamic elements of human-nature relationships, including concepts of connection, engagement and protection. This

reconceptualization is the guidance for the development of a robust psychometric measure of human-nature relationship quality.

Main Research Question: To what extent can human-nature relationships be reconceptualised and operationalised in the context of contemporary society, and how can this reconceptualisation inform the development of a psychometrically robust measure of human-nature relationship quality?

1.5 Thesis Outline

This thesis is comprised of a total of 8 chapters including this one. The flow of the chapters is as follows:

Chapter Two presents a review of relevant literature relating to the construct of human nature relationships, the relevant scales and the practical uses for this research.

Chapter Three explores the overall methodology used throughout this research and discusses the philosophical paradigm of which the research is coming from.

Chapter Four showcases phase one of the research in which an exploratory survey was conducted to gauge the impact the COVID-19 pandemic had on engagement and access to natural spaces.

Chapter Five presents Phase two of the project which involves a deeper qualitative exploration of individual experiences of forming relationships with nature.

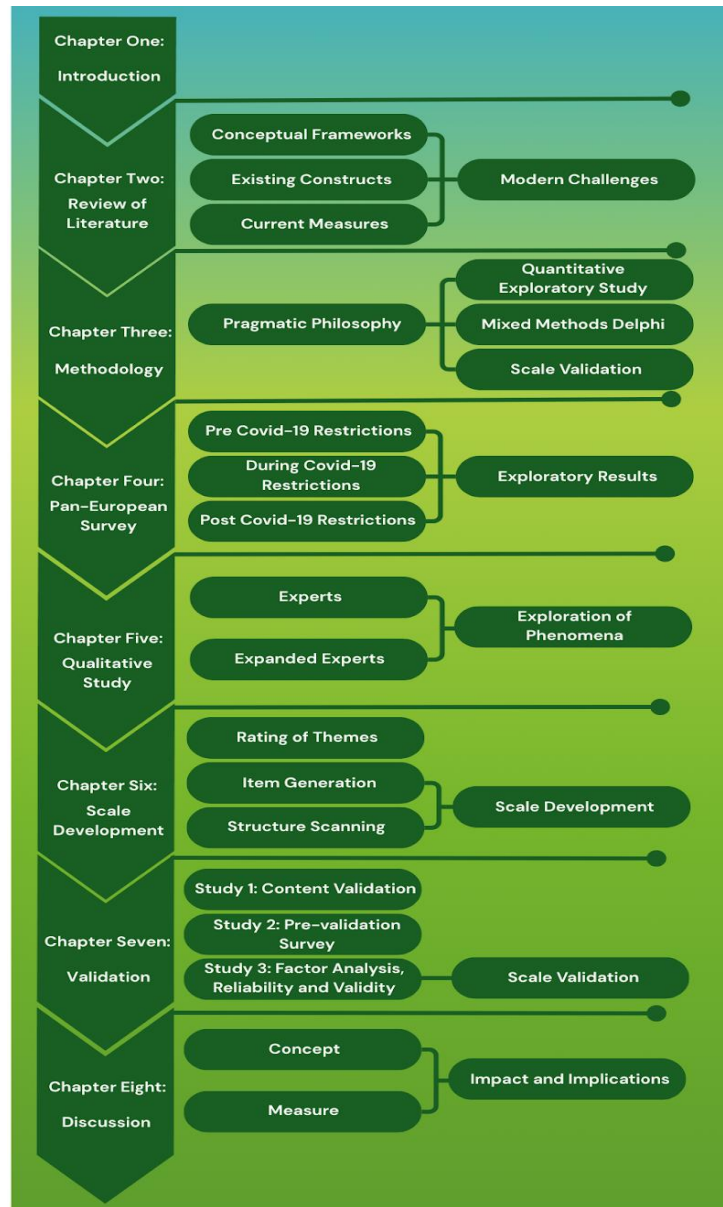
Chapter Six describes Phase three in which an external panel, referred to as a working group, underwent item development for a new measure, along with a description of the content validation process.

Chapter Seven wraps up with phase four, the wider validation process of the new measure, in which exploratory and confirmatory factor analysis were conducted on a sample of 214 participants to develop a 13-item measure.

Chapter Eight is a synthesis of the research in light of previous studies, along with a discussion of the impact and uses of the research.

Figure 1.2

Structure of PhD Thesis



Chapter 2: Review of the Literature

2.1 Introduction

Human–nature relationships have become a central concern across environmental psychology, sustainability science, public health, and urban studies, reflecting the growing recognition that how people relate to the natural world has profound implications for wellbeing, behaviour, and ecological outcomes. Against the backdrop of accelerating urbanisation, climate change, biodiversity loss, and widening social inequalities, understanding the psychological dimensions of these relationships is no longer simply a theoretical endeavour but also a practical and ethical necessity. This chapter provides a critical review of the literature on human–nature relationships, tracing their conceptual evolution over time, examining key psychological frameworks and constructs, and evaluating how these relationships have been measured to date.

The chapter will begin by presenting contemporary understandings of human–nature relationships within the broader historical and philosophical context, highlighting shifts from relational and reciprocal worldviews toward more instrumental and transactional models, and more recently, toward relational and transformational perspectives. It then reviews major conceptual frameworks that have shaped the field, including biophilia, attention restoration theory, stress reduction theory, identity-based approaches, place attachment, and value theory. Building on these foundations, the chapter examines core psychological constructs that embody nature relationships, such as connectedness to nature, inclusion of nature in the self, environmental identity, and nature relatedness, alongside evidence for the cognitive, emotional, social, and health benefits associated with these relationships. The latter sections address individual differences, real-world relevance, and the challenges facing current research and measurement practices. Together, this review establishes the conceptual and empirical groundwork for

evaluating existing measures and for advancing more robust approaches to assessing human–nature relationships.

2.2 The Evolution of Nature Relationships

Human–nature relationships have evolved substantially over the last number of centuries, shaped by cultural worldviews, philosophical movements, and scientific and technological advances. Early Indigenous communities and many preindustrial societies typically positioned humans as part of a wider living community, where relationships with aspects of the environment such as land, rivers, and other non-human living organisms were reciprocal and grounded in responsibility (Berkes, 2018). Animistic and relational worldviews saw nature and other organisms not as passive resources but as living, expressive relatives with their own agency and entities that people were expected to respect, care for, and stay in relationships with (Descola, 2012). These perspectives emphasised connection and reciprocity rather than separation. Early models of nature relationships embedded these interactions into daily life by centring on ongoing transactions between humans and their environments, rather than simply one-sided extraction.

This orientation shifted significantly during the period of the Enlightenment. Cartesian dualism and emerging mechanistic philosophies framed nature as inert matter, as something to be studied, manipulated, and controlled (Merchant, 1980). This worldview influenced the perspective where nature interactions were viewed predominantly as transactional, where nature became a backdrop or a barrier to human progress. The Industrial Revolution intensified this shift by transforming landscapes into industrial infrastructures, reinforcing a view of nature as a limitless supply chain for economic growth rather than a partner in human life (Garrard, 2014). Conversely, during

the same period, romantic and transcendentalist philosophers, including Thoreau and Muir, offered a contradictory perspective that emphasised the restorative, moral, and spiritual significance of wilderness, ultimately establishing foundations for modern conservation movements (Nash, 2014).

By the mid-twentieth century, ecological science, systems theory, and environmental psychology began to challenge the dominance of reductionist and one-directional models of human nature interactions. Leopold's (1949) '*Land Ethic*' reframed humans as "plain members and citizens" of ecological communities, advocating for a shift from extraction and use to a relationship, and from dominance to responsibility, to move away from extractive terminology and viewpoints. Naess's (1973) deep ecology advanced this further, arguing for the intrinsic value of non-human life and for cultivating an expanded ecological self. Subsequently, Wilson's (1984) biophilia hypothesis proposed that human-nature interactions were grounded in innate human tendency and desire to interact with living systems. Collectively, these important contributions, contrary to dominant capitalist and industrialist perspectives, shifted how nature relationships were viewed. Transformational models emerged where interacting with nature in fact shapes identity, ethics, and behaviour rather than simply providing resources or psychological benefits

Recent and contemporary research continues to build upon this perspective on the human-nature relationship. Concerns about reduced access to nature in increasingly urban and digital societies as captured in Louv's (2005) work on nature-deficit disorder have encouraged interdisciplinary efforts to understand how nature supports health, human development, and individual identity. More recent work on relational values (Chan et al., 2018) and human-nature connection models (Clayton, 2003; Ives et al., 2017;) have advanced the scientific discourse from abstract ideas of nature connection towards more

specific pathways through which nature shapes meaning, wellbeing, and moral commitment. These frameworks highlight that human–nature relationships are co-constructed, emerging through our interactions, practice, and ongoing reciprocity with nature. Rather than viewing nature connection as a static state, with the potential for disconnection, there is recognition of human nature interactions as a dynamic relational process that can transform both people and places.

2.3 Conceptual Frameworks

The conceptual frameworks included in this review were purposefully chosen to reflect the chronological and paradigmatic shifts in environmental psychology.

Foundational evolutionary and psychophysiological models, specifically the Biophilia Hypothesis, Attention Restoration Theory, and Stress Reduction Theory, are included because they established the empirical baseline for why humans seek out nature and derive restorative benefits from it. However, as contemporary research required a shift from transactional interactions to deeper, meaning-making connections, sociological and cognitive models, namely Identity Theory, Place Attachment Theory, and Value Theory, were selected. Together, these specific frameworks provide a comprehensive theoretical scaffolding that bridges basic human needs with the complex, identity-driven relationships necessary for the 21st-century context.

2.3.1 Biophilia Hypothesis

The Biophilia Hypothesis posits that humans possess an evolved, innate tendency to attend to, affiliate with, and obtain psychological benefit from other living organisms and natural systems. Wilson (1984) introduced the concept of biophilia as a biologically grounded human inclination toward life and life-like processes, rooted in the conditions under which human perceptual, emotional, and cognitive systems evolved. Kellert and

Wilson (1993) expanded upon this framework, arguing that human wellbeing, development, and cultural evolution have always been deeply shaped by continuous interaction with nature, and that diminishing contact with natural environments may have adverse psychological and ecological consequences.

Recent research has extended biophilia into fields such as conservation biology, environmental psychology, and urban design. Simaika and Samways (2010), for example, argue that biophilia provides a universal ethical basis for biodiversity conservation, and emphasise the importance of nurturing emotional and ethical bonds with non-human species. However, they also question the transmission of biophilic tendencies through genetic heritability and conversely suggest that learned experience may better account for biophilic tendencies.

Further research in psychology and public health offers tentative support by demonstrating associations between exposure to natural environments and reduced stress, improved mood, and enhanced cognitive functioning (Bratman et al., 2019; Kaplan, 1995). This growing body of evidence has also informed and driven the rise of biophilic design, which integrates natural patterns, materials, and forms into built environments to promote human wellbeing and reconnect individuals with natural systems. The challenge however, despite largely uncritical acceptance is to understand the value of such a hypothesis. Researchers have criticised the vagueness of the key tenet: ‘the innate tendency to focus on life and life-like processes’ (Wilson, 1984, p.1). For example, Joye and De Block (2011) question the terminology integral to the hypothesis. The lack of conceptual clarity with the term ‘focus’ for example. Specifically, what human-nature interaction does this convey? Is it referring to nature contact, connection or engagement of some form? And what are ‘life and life-like’ processes? Does this suggest that virtual natural environments provide the same stimulus as a walk in the park? And did Wilson

really provide us with a testable hypothesis? The majority of research supporting the hypothesis does not explicitly test the principle of biophilia directly as it lacks the specificity to be refuted as is the case with many theoretical accounts with evolutionary psychology approaches (Lumber et al., 2017).

Many of these questions remain unanswered in the literature and contemporary researchers now align with more recent conceptualisations. Overall the net benefit of this approach may have been in instilling human nature interactions as important to human health, as part of a paradigm shift in the Anthropocene.

2.3.2 Attention Restoration Theory

Attention Restoration Theory, developed by Kaplan and Kaplan (1989), proposes that prolonged engagement in tasks requiring directed, effortful attention leads to cognitive fatigue and reduced executive functioning. Attention Restoration Theory suggests that exposure to natural environments can restore our depleted cognitive resources because these settings offer soft fascination stimuli that are gently engaging but do not demand focused attention. Natural environments are characterised by four restorative properties: being away, extent, fascination, and compatibility, each of which supports recovery from attentional fatigue. Kaplan (1995) provided an integrative framework demonstrating that natural environments promote psychological restoration across affective, cognitive, and physiological domains. While accumulating research supports Attention Restoration Theory's core prediction criticisms remain. On the one hand, Berman et al. (2008) offered compelling evidence showing that individuals who walked in or viewed images of natural environments demonstrated significant improvements in working memory and directed attention compared with those exposed to urban environments. Further studies have replicated and extended these findings across diverse populations, linking green space exposure with enhanced executive functioning,

improved focus, and measurable cognitive benefits (Berman, Jonides, & Kaplan, 2008; Faber Taylor & Kuo, 2009, Dadvand et al., 2015, for example). However, these studies are predominantly not testing the ‘restorative’ effects of attention as evidence for the ‘depletion’ of cognitive resources has not been forthcoming. Secondly, natural environments offer complex stimuli, typically multi-sensory and complex in terms of visual structure which are difficult to assess in controlled conditions (MacIntyre et al., 2019). The extant literature employing the Attention Restoration Theory has been challenged by this issue of comparability between for example, urban (e.g. busy street) and natural (e.g. forest) settings in terms of the number of features and visual stimulus. Moreover, Kaplan and Kaplan (1989) proposed that natural environments restore depleted mental capacities through indirect attention which requires less effort than direct attention. The neural plausibility of these processes has yet to be clarified and evidence to support the parsimonious bottom up account based on the visual stimuli inherent in nature overlooks top-down processes which are increasingly being illuminated in the literature, including accounting for prior experience, the activity in nature (e.g. walking, running) and indeed the individual differences in their perceived relationship or connection with nature (MacIntyre et al., 2019).

2.3.3 Stress Reduction Theory

Stress Reduction Theory (Ulrich, 1983) describes the benefits to individuals of interactions with nature. The theory indicates that when exposed to natural environments, an immediate, automatic psychophysiological stress-recovery response is triggered. According to Stress Reduction Theory, humans are evolutionarily predisposed to respond positively to natural settings that are perceived as non-threatening such as greenery, water, and open landscapes, for example. These environments promote parasympathetic

activation and reduce physiological indicators of stress, such as heart rate, blood pressure, muscle tension, and cortisol.

The theory posits that restorative states are facilitated by nature through affective and attentional mechanisms. This produces rapid improvements in mood, decreases negative emotion, and shifts toward relaxed, positive affect. This recovery is thought to be most effective in natural settings than in built or urban environments lacking natural elements. Similar to the aforementioned Attention Restoration Theory model, Stress Reduction Theory overlooks individual differences in response to diverse natural typologies as some individuals respond adversely to greenspaces when it doesn't match their individual preferences (MacIntyre et al. 2019). Moreover, recent evidence suggests the theory is limited in explaining how some streetscape elements may significantly stimulate or relieve stress.

2.3.4 Identity Theory

Identity theory (Stryker, 1980) describes how our behaviours, thoughts, and motivations are shaped by the social roles we occupy and the meanings we attach to those roles. It is argued in the theory that multiple role identities make up our 'self', and these are each tied to social structures and societal expectations. For example, these role identities could include parent, student, environmental psychologist etc.

Identity salience is an important consideration of the theory, whereby more salient identities will result in greater behavioural influence. Burke's (1991) identity control model hypothesises that we act in ways that confirm our identity meanings. When incongruence is apparent between how we see ourselves and the situational feedback we receive, this can create a dissonance, which generates distress and motivates behaviour change to restore alignment (Burke, 1991; Burke & Stets, 2009).

Identity Theory explains behaviour through the enactment of internalised social roles, emphasising structure, meaning, and behavioural consistency rather than group-based processes. When it comes to nature relationships, Identity Theory provides a useful framework for understanding how individuals develop and enact nature-related identities. From this perspective, nature connectedness can be viewed as a role-linked identity (e.g., “outdoors person,” “nature custodian”), grounded in the meanings people attach to nature and the behavioural routines through which these meanings are expressed. Previous research on environmental identity (Clayton, 2003), conceptualises connection to nature as part of an individual’s self-definition. When these identities become salient and central within the self-concept, people are more likely to act in ways that are consistent with those identity meanings and expectations.

Research has shown that salient environmental identities predict sustainable actions across multiple scenario types (Whitmarsh & O’Neill, 2010), and that repeated engagement and interaction with nature can strengthen our commitment to these identities over time (Tam, 2013). This suggests that beyond attitudinal or emotional states, nature connectedness operates as an internalised identity that shapes behaviour through expectations of consistency, meaning, and self-verification.

2.3.5 Place attachment Theory

Place Attachment Theory describes the affective, cognitive, and behavioural connections that individuals develop with meaningful places. These bonds emerge through repeated interactions, personal experiences, social relationships, and the symbolic or functional meanings a place holds (Altman & Low, 1992). Place attachment consists of two interrelated components: place identity, which reflects how a place becomes integrated into one’s self-concept, and place dependence, which relates to the functional qualities of a place that support an individual’s goals, activities, and

preferences (Williams & Vaske, 2003). These attachments can influence how people perceive, use, interact with, and care for places, which shapes emotional wellbeing, sense of belonging, and stability.

Place attachment is also very much linked with human–nature relationships. Natural environments often evoke strong emotional and symbolic meanings, contributing to feelings of restoration, comfort and rootedness (Korpela, 1989; Scannell & Gifford, 2010). Attachment to natural places such as parks, forests, or outdoor settings from our childhood can strengthen our environmental identity and the feeling of connection to nature. Research shows that people who feel attached to natural environments are more likely to experience benefits to their wellbeing and show pro-environmental attitudes and behaviours (Raymond et al., 2010). Therefore, place attachment not only connects individuals to specific environments but also supports broader psychological relationships with nature, shaping how people understand themselves in relation to the natural world.

However, place attachment theory is also subject to sustained criticism over the past 40 years. For example, within the tripartite model of place attachment (Scannell & Gifford, 2010), the Person component has attracted more attention than the Place and Process components. Consequently, this emphasis on individual differences probably has inhibited the development of a theory of place attachment (Lewicka, 2011). Furthermore, definitional dilemmas persist and this limits the assessment of the construct. Nevertheless, it has added value to our understanding of human nature interactions and contemporary researchers have attempted to embed new complexities in our understanding of the application of place attachment. For example, (Fernandez de Osso Fuentes et al., 2023) have developed a model that gives insights into the broad range of practices for implementing digital placemaking for nature and wellbeing. This approach

from GoGreenRoutes project represents a major contribution to illuminating our understanding of the application of innovative technology to support Nature Based Solutions with the goal of enhancing the wellbeing of citizens.

2.3.6 Value Theory

Recent frameworks (Chan et al., 2018; Díaz et al., 2018) integrate social science, psychology, and ecology to describe how people derive meaning, identity, and ethics from nature. These approaches bridge instrumental and intrinsic values, emphasizing reciprocal human–nature responsibilities. Value theory provides a way of understanding how broad, stable priorities, such as prioritising care for the environment or valuing economic success over ecological protection for example, can shape our attitudes and behaviours, including how we relate to the natural world. In psychology, one of the most influential frameworks is Schwartz’s theory of basic human values, which defines values as guiding principles in life and identifies a set of near-universal value types organised along higher-order dimensions such as self-transcendence versus self-enhancement and openness to change versus conservation (Schwartz, 1992; Schwartz, 2012).

These abstract value priorities can influence more specific beliefs, norms, and choices, including environmental concern and our willingness to protect nature. In the environmental domain, this work has been extended in order to differentiate hedonic, egoistic, altruistic, and biospheric values, with biospheric values which reflects concern for nature and the biosphere for their own sake, emerging as particularly important for explaining pro-environmental beliefs and actions (de Groot & Steg, 2008; Steg & De Groot, 2012).

Building on this foundation, environmental psychology has developed value-based models of environmentalism, most notably the value–belief–norm (VBN) framework, which links value priorities to environmental worldviews, perceived consequences, moral

obligation, and behaviour (Stern et al., 1999). Within this line of research, biospheric and altruistic values are consistently associated with stronger environmental norms and behaviours, whereas egoistic values often predict weaker engagement (de Groot & Steg, 2008; de Groot & Thøgersen, 2012). More recent work in sustainability science has broadened the conversation by highlighting the limitations of framing nature's importance solely in terms of instrumental (for humans' sake) or intrinsic (for nature's sake) values. Chan and colleagues argue for a third class of "relational values", comprising preferences, principles, and virtues about human–nature relationships, that can better capture how people derive meaning, identity, and responsibilities through their interactions with nature (Chan et al., 2018). In parallel, the IPBES framework on "nature's contributions to people" explicitly integrates ecological science with social science perspectives to recognise diverse ways in which nature supports quality of life, including culturally embedded, relational dimensions (Díaz et al., 2018). Together, these developments move beyond abstract or esoteric discussions of value to more specific value pathways, showing how underlying value structures shape concrete nature relationships, from transactional, use-oriented interactions to more reciprocal and transformational forms of care, stewardship, and identity.

2.4 Psychological Constructs which Embody the Nature Relationship

Psychological research has increasingly moved beyond viewing nature relationships as a function of simple exposure or preference, instead conceptualising them as enduring psychological constructs that shape how individuals think, feel, and act in relation to the natural world. These constructs reflect different but overlapping ways in which nature becomes emotionally salient, cognitively integrated, and morally meaningful. Together, they demonstrate that human–nature relationships are not passive

or incidental, but actively embodied within identity, values, and everyday decision-making.

2.4.1 Connectedness to Nature

Connectedness to nature is one of the most widely studied constructs in this domain in recent decades. Mayer and Frantz (2004) defined connectedness to nature as an enduring emotional and cognitive bond with the natural world, capturing the extent to which individuals feel affectively linked to nature and experience it as meaningful. This construct emphasises feelings of belonging, care, and emotional closeness, rather than instrumental use. For example, individuals high in connectedness are more likely to describe feeling calm, restored, or “at home” in natural settings.

Empirical research consistently links connectedness to nature with higher life satisfaction, positive affect, environmental concern, and engagement in sustainable behaviours such as conservation support and reduced consumption (Mayer et al., 2009; Zelenski & Nisbet, 2014). Importantly, connectedness to nature has been shown to predict wellbeing independently of time spent in nature, suggesting that the psychological quality of the relationship matters as much as frequency of exposure.

2.4.2 Inclusion of Nature in Self

Inclusion of Nature in Self (INS) builds on self-concept theory and social identity research to examine whether people cognitively include nature as part of who they are. Schultz (2002) operationalised this idea using a simple visual measure depicting varying degrees of overlap between the self and nature, reflecting perceived interconnectedness rather than emotional attachment alone. From this perspective, environmental concern arises not only because nature is valued, but because harm to nature is experienced as harm to the self.

Empirical studies demonstrate that inclusion of nature in the self mediates the relationship between environmental values and pro-environmental behaviour, helping explain why values translate into action for some individuals but not others (Mayer et al., 2009). For example, people who strongly include nature in their self-concept are more likely to engage in environmentally responsible behaviour even when it involves personal inconvenience, as such actions align with maintaining self-integrity.

2.4.3 Environmental Identity

Environmental identity extends this idea further by conceptualising the human–nature relationship as a socially embedded identity. Clayton (2003) defined environmental identity as the degree to which individuals define themselves in relation to the natural environment, incorporating beliefs, emotions, and behavioural commitments. This identity develops over time through formative experiences with nature, cultural narratives, education, and social norms. For instance, childhood experiences in nature, participation in outdoor recreation, or involvement in environmental organisations can strengthen environmental identity, making environmental considerations more salient in everyday choices.

Research shows that a strong environmental identity predicts consistent pro-environmental decision-making across domains, including consumption, political engagement, and support for environmental policies (Clayton, 2003; Whitmarsh & O'Neill, 2010). Environmental identity therefore provides a framework for understanding how nature relationships become stable, self-reinforcing, and socially expressed.

2.4.4 Nature Relatedness

Nature relatedness offers a multidimensional account of the human–nature bond, integrating emotional, cognitive, and experiential components. Nisbet et al. (2009) developed the Nature Relatedness Scale to capture not only feelings of connection, but

also beliefs about human–nature relationships and patterns of engagement with the natural world. This approach recognises that individuals may value nature intellectually, feel emotionally connected to it, and seek out nature experiences in daily life.

Higher nature relatedness is associated with greater mindfulness, psychological wellbeing, empathy, and a stronger tendency toward sustainable behaviours (Nisbet et al., 2009; Nisbet & Zelenski, 2013). For example, individuals high in nature relatedness are more likely to notice wildlife in urban environments, reflect on the environmental consequences of their actions, and derive meaning from everyday encounters with nature.

Taken together, these constructs demonstrate that human–nature relationships are psychologically rich and multifaceted. Rather than reflecting a simple preference for green spaces or outdoor activities, they involve enduring patterns of identity, values, emotional attachment, and moral responsibility. This body of research supports a shift away from viewing nature connection as a passive or transactional experience, toward understanding it as a dynamic psychological relationship that shapes how people live, decide, and engage with the natural world.

2.5 Benefits of Nature Relationships

A growing body of empirical research demonstrates that relationships with nature confer a wide range of psychological, social, and physiological benefits. Importantly, these benefits extend beyond short-term exposure effects and are increasingly understood as outcomes of ongoing, meaningful relationships with natural environments. Research across environmental psychology, public health, and neuroscience suggests that when nature is experienced as psychologically salient, rather than merely as background scenery, it can support cognitive functioning, emotional regulation, social connection,

and physical health. This section synthesises key evidence across these domains, highlighting how nature relationships contribute to human functioning and wellbeing.

2.5.1 Cognitive Benefits

Cognitive benefits are among the most consistently documented outcomes of interaction with natural environments. Experimental studies show that exposure to nature improves directed attention, working memory, and cognitive flexibility, particularly following periods of mental fatigue (Berman et al., 2008). Atchley, Strayer, and Atchley (2012) further demonstrated that immersion in natural settings enhances creative problem-solving, suggesting that nature supports higher-order cognitive processes as well as basic attentional recovery. Attention Restoration Theory (Kaplan & Kaplan, 1989) provides a robust theoretical explanation for these effects, proposing that natural environments restore depleted cognitive resources through “soft fascination”, stimuli that engage attention effortlessly while allowing reflective thought. These findings indicate that nature relationships can play a functional role in sustaining cognitive performance in demanding modern contexts.

2.5.2 Emotional Benefits

Emotional benefits of human-nature interactions are well established. Since the classic study by Ulrich over four decades ago where hospital patients with view of nature had better recovery trajectories (Ulrich, 1984), accumulating research has found positive impacts on mood, well-being and mental health. Exposure to green environments has been shown to reduce physiological and psychological indicators of stress, including anxiety, negative affect, and depressive symptoms (Ulrich et al., 1991; Bowler et al., 2010). Ulrich’s stress reduction framework suggests that natural settings trigger rapid, affective responses that support emotional regulation and recovery from stress. A major review by Bratman et al. (2019) proposed with a conceptual model how ecosystem service

assessments can include mental health as a key outcome of human nature interactions. One key aspect of this new model is that it accounts not simply for nature exposure but the ‘experience’, encapsulating the interactions with nature using the engagement of ones senses.

In recent decades research evidence suggests that not all natural environments are equally restorative. Fuller et al. (2007) found that greater biodiversity within urban green spaces is associated with enhanced psychological wellbeing, suggesting that the quality and richness of nature experiences influence emotional outcomes. These findings support the idea that emotionally meaningful relationships with nature, rather than generic exposure, are central to the beneficial effects reported in the literature.

2.5.3 Social Benefits

Nature relationships also yield significant social benefits. Research indicates that engagement with natural environments promotes prosocial behaviour, generosity, and empathy, both toward other people and toward non-human life (Weinstein et al., 2015). Kuo (2015) argues that nature can function as a social resource, supporting community cohesion and trust by providing shared spaces that encourage informal interaction and collective use. Shared outdoor activities such as walking, gardening, or community conservation efforts can create opportunities for social bonding and the development of collective identities rooted in place. In this way, nature relationships contribute not only to individual well-being but also to the social fabric of communities. For example, GoGreenRoutes in the development of Nature Based Solutions in the cultivating cities put an emphasis on this social aspect with co-creation and participatory approaches in the development of green infrastructure critical to the success of the project. What were termed seedbed interventions (temporary Nature Based Solutions innovations) aligned with SDG 11, focused on creating inclusive and safe spaces through participatory

strategies to boost social cohesion, aligning with global sustainability goals (Gäcke et al., 2025).

2.5.4 Health Benefits

Health benefits provide further evidence of the importance of sustained relationships with nature. Epidemiological studies consistently link access to green spaces with reduced cardiovascular risk, improved immune functioning, and lower all-cause mortality (Hartig et al., 2014). Frumkin et al. (2017) synthesise evidence across disciplines to show that nature exposure supports physical health through multiple pathways, including stress reduction, increased physical activity, improved air quality, and social engagement. These benefits appear to accumulate over time, suggesting that regular interaction with natural environments embedded within daily life can play a protective role in long-term health outcomes.

Collectively, this body of evidence demonstrates that nature relationships offer multidimensional benefits that extend across cognitive, emotional, social, and physiological domains. Rather than acting as a passive backdrop, nature functions as an active contributor to human functioning and wellbeing. These findings reinforce the importance of moving beyond narrow exposure-based models toward a relational understanding of human–nature interactions, where sustained engagement, meaning, and reciprocity underpin the benefits derived from the natural world.

2.6 Nature Relationships and Individual Differences

Although a growing body of research demonstrates the benefits of nature relationships, these relationships are not uniform across individuals or contexts. Psychological, cultural, and structural factors shape how people experience, interpret, and engage with nature. Recognising individual differences is therefore critical for avoiding

overly generalised models of nature connection and for ensuring that theoretical frameworks, measures, and interventions are inclusive and contextually grounded. This section reviews key individual-level moderators of human–nature relationships, highlighting why a one-size-fits-all approach is insufficient.

2.6.1 Personality Traits

Personality traits are closely associated with both the likelihood and quality of engagement with nature. Openness to experience has been consistently linked with stronger connectedness to nature and higher nature relatedness, reflecting a tendency toward curiosity, aesthetic sensitivity, and receptivity to novel experiences (Tam, 2013). Individuals high in openness are more likely to seek out and reflect on nature experiences, engage emotionally with natural environments, and integrate nature into their sense of self.

In contrast, higher levels of neuroticism have been linked to lower frequency and reduced quality of nature interactions, potentially due to heightened anxiety, threat sensitivity, or discomfort in less controlled environments. However, caution must be applied regarding the direction of causality in these associations. While specific personality traits may drive individuals toward or away from natural settings, it is equally plausible that sustained, high-quality exposure to nature actively shapes the development and expression of these traits over time. Therefore, rather than a strictly one-way causal mechanism, the dynamic between personality and how nature is emotionally processed is likely bidirectional and mutually reinforcing.

2.6.2 Cultural Background and Meaning Making

Cultural context strongly shapes how nature is understood, valued, and experienced. Cross-cultural research demonstrates that cultural narratives influence whether nature is framed primarily as a source of spiritual meaning, collective identity,

livelihood, or recreation (Coscieme et al., 2020). Collectivist cultures often emphasise relational, moral, and spiritual dimensions of human–nature relationships, viewing nature as embedded within social and ethical systems. In contrast, individualist cultures are more likely to emphasise instrumental, aesthetic, or leisure-based relationships with nature. These differences have important implications for how nature connectedness is conceptualised and measured, as constructs developed within Western contexts may not fully capture relational or communal orientations to nature present in other cultural settings.

More broadly, environmental psychology has been criticised for its reliance on WEIRD (Western, Educated, Industrialised, Rich, and Democratic) populations, raising concerns about the cultural generalisability of dominant theories and measures of nature connection (Henrich et al., 2010). This critique underscores the need for culturally sensitive frameworks that recognise diverse ontologies, values, and lived relationships with nature, particularly those grounded in Indigenous and non-Western worldviews.

2.6.3 Life Experiences and Developmental Pathways

Life-course perspectives highlight the importance of early experiences in shaping adult nature relationships. Longitudinal and retrospective studies show that regular exposure to natural environments during childhood is a strong predictor of adult connectedness to nature, environmental concern, and stewardship behaviours (Wells & Lekies, 2006). Childhood experiences such as unstructured outdoor play, family activities in nature, or engagement with wildlife appear to foster emotional bonds and positive associations that persist into adulthood. These findings suggest that nature relationships develop through cumulative, experiential pathways rather than isolated encounters, reinforcing the importance of developmental timing and continuity in nature engagement.

2.6.4 Socioeconomic status, urbanisation, and environmental justice

Structural factors, including socioeconomic status and patterns of urbanisation, significantly shape opportunities to form and maintain nature relationships. Access to safe, high-quality green spaces is unevenly distributed, often reflecting broader social and economic inequalities (Jennings et al., 2017). Communities with lower income or marginalised status frequently experience reduced access to green infrastructure, higher exposure to environmental hazards, and fewer opportunities for restorative nature experiences. These disparities raise important environmental justice concerns, as the psychological and health benefits of nature relationships are less accessible to populations who may benefit most from them.

Urbanisation further complicates nature relationships by altering both physical access and cultural expectations of nature. While urban green spaces can support meaningful nature interactions, their availability, quality, and cultural relevance vary widely. Research increasingly emphasises that promoting nature relationships must involve addressing systemic barriers and designing inclusive environments that reflect diverse cultural practices, needs, and histories (Hartig et al., 2014).

2.6.5 Beyond one-size-fits-all models

Collectively, this literature demonstrates that human–nature relationships are shaped by intersecting psychological, cultural, developmental, and structural factors. Models that assume universal pathways to nature connection risk overlooking important differences in meaning, access, and experience. Recognising individual differences and contextual influences is therefore essential for developing equitable, effective approaches to fostering nature relationships, whether through research, policy, or intervention design. This perspective aligns with broader shifts toward relational and justice-oriented

frameworks, which emphasise that how people relate to nature is inseparable from who they are, where they live, and the social conditions that shape their lives.

2.7 Current Measures of the Concept

It could be argued that in the extant literature, several measures of nature connectedness or similar constructs exist. The field currently relies on a diverse set of measures that reflect differing conceptualisations of what it means to be “connected” to nature. However, existing scales variously emphasise emotional attachment, cognitive inclusion, identity, or dispositional tendencies, resulting in a fragmented measurement landscape. While these instruments have contributed valuable insights, they often capture only partial aspects of the construct, rely heavily on self-report, and are rooted in specific cultural and theoretical traditions. As a result, they may struggle to account for the relational, reciprocal, and context-sensitive nature of contemporary understandings of human–nature relationships. A critical review of current measures is therefore necessary, not only to acknowledge their contributions, but to identify conceptual and methodological gaps that justify the development of a more integrative and robust measure.

Below some of these measures are described:

2.7.1 Nature Relatedness Scale (NR: Nisbet et al.,2009)

The NR scale (21 items; with a validated short form NR-6) captures cognitive, affective, and experiential dimensions of human–nature relationships. It explicitly includes comfort in nature, environmental concern, and identification with the natural world.

The NR scale offers a more holistic account than many alternatives and shows strong predictive validity for wellbeing and sustainable behaviour. However, some items

blend attitudes and behaviours, making it less precise for disentangling underlying psychological mechanisms.

2.7.2 Connectedness to Nature Scale (CNS: Mayer & Frantz, 2004)

The CNS is a 14-item self-report scale measuring an individual's emotional connection to the natural world. It conceptualises nature connection primarily as an affective sense of belonging and care for nature, rather than behavioural engagement or identity.

Although the CNS is widely used and psychometrically robust, it places strong emphasis on emotional affinity while underrepresenting experiential and identity-based dimensions. Critics note that it may capture general pro-environmental sentiment rather than lived relational engagement, and it can be sensitive to social desirability bias.

2.7.3 Inclusion of Nature in Self Scale (INS: Schultz, 2002)

The INS is a single-item pictorial measure adapted from social identity research, assessing the degree to which individuals cognitively include nature as part of their self-concept. Respondents select overlapping circles representing self–nature closeness.

While the INS is elegant, intuitive, and cross-culturally adaptable, making it valuable for large surveys, its single-item nature limits reliability and depth, and it does not distinguish between emotional, behavioural, or moral aspects of nature relationships.

2.7.4 Environmental Identity Scale (EID: Clayton, 2003)

The EID measures the extent to which individuals define themselves in relation to the natural environment, emphasising identity, values, and moral commitment. It reflects how nature becomes integrated into one's broader self-narrative.

The EID is theoretically rich and well suited for research on values and identity. However, it is less sensitive to situational or experiential aspects of nature relationships and may reflect relatively stable self-concepts rather than dynamic interactions.

2.7.5 Love and Care for Nature Scale (LCN: Perkins, 2010)

The LCN focuses explicitly on emotional attachment, empathy, and moral concern for nature. It aims to capture caring orientations that motivate protective behaviour.

The scale is valuable for highlighting affective and ethical dimensions often overlooked elsewhere. However, it overlaps conceptually with connectedness measures and offers limited insight into behavioural pathways or identity processes.

2.7.6 Disposition to Connect with Nature Scale (DCN: Brügger et al., 2011)

The DCN assesses a general tendency to connect with nature across situations, conceptualised as a dispositional orientation rather than a specific emotional state or identity.

The DCN contributes conceptual clarity by distinguishing dispositional tendencies from situational experiences. However, it is less widely used and less validated across cultures than CNS or NR, limiting comparability across studies.

2.7.7 Implicit Association Test for Nature (IAT-Nature: Schultz et al., 2004)

This implicit measure assesses automatic associations between self and nature, aiming to bypass self-report bias and capture unconscious aspects of nature relationships.

The IAT-Nature provides valuable insight into implicit cognition, but it is methodologically demanding, less practical for applied research, and does not directly capture experiential or relational meaning.

Collectively, these measures demonstrate that nature relationships can be conceptualised as emotional bonds, cognitive inclusion, identity, dispositions, or place-based attachments. However, no single measure fully captures the dynamic, reciprocal, and context-dependent nature of human–nature relationships. Most scales are rooted in Western psychological traditions, raising concerns about cultural generalisability and the applicability of these constructs beyond WEIRD populations. This fragmentation across measures highlights ongoing challenges in operationalising nature relationships and underscores the need for integrative or pluralistic approaches that reflect relational, developmental, and contextual dimensions.

2.8 Real-World Need for Understanding of Nature Relationships

The need to better understand human–nature relationships has become increasingly urgent in the context of accelerating social, environmental, and public health challenges. Rapid urbanisation, climate change, widening social inequalities, and rising mental health concerns have intensified interest in how people relate to nature and how these relationships influence behaviour, wellbeing, and resilience. Importantly, these challenges highlight that human–nature relationships are not abstract or peripheral concerns, but central to addressing contemporary crises in sustainable and equitable ways. A new range of initiatives both legal instruments, soft law initiatives and global commitments in the past decade provide a strong rationale for deeper understanding of human nature interactions.

Ten years ago the UN 2030 Agenda for Sustainable Development with its 17 SDGs provided global ambition which notably links to the domain of the GoGreenRoutes project and this research. For example, SDG 11, which aims to establish “inclusive, safe, resilient, and sustainable cities and human settlements” (UN, 2024), which promises a

pathway toward greener, fairer, and more resilient urban environments will obviously benefit from a more comprehensive understanding of human nature interactions and relationships.

Under the leadership of Ursula von der Leyen, EU Commission President, the EU Green Deal, New European Bauhaus initiative, City Mission and Nature Restoration Law (NRL) all support to varying degrees reductions in the co-hazards of air and noise pollution, the re-greening of cities, access to nearby nature and citizen engagement in local Nature Based Solution initiatives. Supported by legislation (EU 27 are enacting the NRL with few exceptions), funding (e.g. estimated €1 trillion in sustainable investments between 2021-2030) and above all leadership, this new era promises that nature will be at the heart of Europe.

Urbanisation presents one of the most immediate pressures on human–nature relationships. As populations concentrate in cities, opportunities for everyday contact with nature are often reduced, fragmented, or unevenly distributed. Louv (2005) popularised concerns about the psychological and developmental consequences of diminished nature exposure, particularly for children, arguing that reduced contact may undermine wellbeing, attentional functioning, and emotional regulation. Subsequent research has supported these concerns, showing that urban residents with limited access to green space report poorer mental health outcomes and weaker connections to nature. From a biophilia perspective, increasing urban density may disrupt evolved human tendencies to affiliate with natural environments, potentially weakening both individual wellbeing and broader pro-environmental orientations (Hartig et al., 2014).

Understanding human–nature relationships is also critical in the context of climate change and environmental stewardship. Addressing climate change requires widespread behavioural shifts, including changes in consumption, mobility, energy use, and political

engagement. Research consistently shows that individuals with stronger emotional, cognitive, or identity-based relationships with nature are more likely to engage in sustainable behaviours and support environmental policies (Hartig et al., 2014). These findings suggest that fostering meaningful nature relationships may play a role in motivating climate-relevant action, complementing structural and technological solutions. Without such psychological engagement, climate interventions risk remaining transactional, relying on compliance rather than internalised commitment.

Public health considerations further underscore the real-world relevance of nature relationships. A growing body of evidence links access to natural environments with improved physical and mental health outcomes, including reduced stress, lower risk of chronic disease, and enhanced wellbeing. Jennings and Bamkole (2019) argue that integrating green infrastructure into urban planning offers a dual benefit: supporting ecological sustainability while promoting human health. Understanding how people experience and relate to these spaces is essential for ensuring that green infrastructure is not only present but meaningfully used and valued. This highlights the importance of moving beyond exposure metrics to consider psychological relationships with nature when designing health-promoting environments.

Finally, social equity considerations demand a nuanced understanding of human–nature relationships. Access to safe, high-quality natural environments is unevenly distributed, often reflecting broader patterns of socioeconomic inequality, racial segregation, and historical disinvestment. Wolch et al. (2014) demonstrate that marginalised communities are frequently underserved by green infrastructure, limiting opportunities for restorative nature experiences and associated benefits. Research on human–nature relationships can inform more equitable policy and planning by identifying how cultural meanings, safety perceptions, and structural barriers shape engagement with

nature across different groups. Without this attention, interventions risk reinforcing existing inequalities rather than addressing them.

Together, these challenges illustrate why understanding human–nature relationships is not only of theoretical interest but of practical and societal importance. Insight into how people relate to nature and how these relationships vary across contexts, can inform urban design, climate policy, public health strategies, and environmental justice initiatives. This reinforces the need for robust, inclusive frameworks and measures capable of capturing the complexity and real-world relevance of human–nature relationships.

2.9 Challenges in This Research to Date

Despite accumulating research on human–nature relationships, the field continues to face a number of conceptual, methodological, and practical challenges. These challenges limit theoretical integration, complicate empirical comparison, and constrain the development of robust and transferable measurement tools. A critical examination of these issues is essential, particularly in the context of efforts to develop more comprehensive and inclusive measures of human–nature relationships.

Conceptual Blurring: One of the most persistent challenges concerns conceptual ambiguity in the conceptualisation. Terms such as ‘*connection*’, ‘*relationship*’, ‘*relatedness*’, ‘*attachment*’, and ‘*identity*’ are frequently used interchangeably, despite reflecting distinct theoretical traditions and psychological processes. Ives et al., (2017) highlight how this conceptual overlap has led to inconsistent operationalisation across studies, making it difficult to compare findings or build cumulative theory. In some cases, constructs emphasise emotional affinity, while others focus on cognitive inclusion, moral concern, or behavioural engagement. Without clear conceptual boundaries, it remains

difficult to determine whether studies are examining the same underlying phenomenon or different aspects of human–nature relationships.

Measurement Limitations: Measurement presents a closely related challenge. While several validated instruments exist, including the Connectedness to Nature Scale, Nature Relatedness Scale, Inclusion of Nature in Self, and Environmental Identity Scale, most rely heavily on self-report methods. Such approaches are vulnerable to social desirability bias, demand characteristics, and culturally specific interpretations of items (Mayer et al., 2009). Moreover, many measures conflate attitudes, identity, and behaviour, limiting their ability to isolate psychological mechanisms. Objective behavioural indicators and observational measures remain underdeveloped, and few tools adequately capture reciprocal or relational processes between humans and natural environments.

Cultural Bias: A further limitation lies in the cultural scope of existing research. Much of the literature has been conducted within Western, Educated, Industrialised, Rich, and Democratic (WEIRD) populations, raising concerns about the generalisability of dominant constructs and measures (Henrich et al., 2010). Cultural worldviews strongly shape how nature is understood and valued, yet cross-cultural research remains limited. As a result, prevailing models may inadequately represent relational, spiritual, or collective understandings of human–nature relationships that are common in non-Western and Indigenous contexts. Addressing this bias is critical for developing measures that are both culturally sensitive and globally relevant.

Temporal and Contextual Dynamics: Human–nature relationships are also inherently dynamic, evolving across the life course and in response to changing social and environmental conditions. Early experiences, life transitions, and exposure to environmental change can all reshape how individuals relate to nature over time (Bixler

& Floyd, 1997). Despite this, most research relies on cross-sectional designs, offering only static snapshots of a relationship that is likely to be developmental and context-dependent. Longitudinal studies remain rare, limiting understanding of how nature relationships are formed, maintained, or disrupted across different stages of life.

Integration Across Disciplines: Interdisciplinary integration poses an additional challenge. Research on human–nature relationships spans psychology, ecology, public health, planning, and sustainability science, yet these disciplines often operate in parallel rather than in dialogue. Many studies focus either on human benefits or ecological outcomes, without explicitly examining reciprocal interactions between people and natural systems (Chan et al., 2018). This separation risks reinforcing transactional models of nature relationships and overlooks the mutual dependencies that underpin relational and sustainability-oriented frameworks.

Urbanization and Technology: Contemporary patterns of urbanisation and digital engagement further complicate the study of human–nature relationships. Increasing time spent in digital environments may displace direct experiences of nature or alter how such experiences are perceived and valued (Bratman et al., 2019). At the same time, emerging forms of mediated or virtual nature raise questions about what constitutes meaningful nature engagement and how relational depth should be assessed. These shifts challenge traditional assumptions about exposure and complicate measurement of authentic or sustained nature relationships.

Linking theory to application: A further, often overlooked challenge lies in translating theoretical constructs into applied contexts. While many studies demonstrate associations between nature relationships and desirable outcomes, fewer provide clear guidance on how these relationships can be intentionally supported through policy, design, or intervention. This gap between theory and practice limits the practical utility

of existing measures and highlights the need for tools that can inform real-world decision-making.

Together, these challenges illustrate that, despite significant advances, the study of human–nature relationships remains constrained by conceptual fragmentation, methodological limitations, and contextual blind spots. Addressing these issues requires greater conceptual clarity, the development of culturally inclusive and multidimensional measures, increased use of longitudinal and mixed-methods designs, and stronger interdisciplinary collaboration. Recognising and responding to these challenges is essential for advancing both theory and practice and provides a clear rationale for the development of new approaches capable of capturing the complexity, dynamism, and real-world relevance of human–nature relationships.

2.10 Conclusions

Across the literature reviewed in this chapter, a clear trajectory emerges in how human–nature relationships have been conceptualised and studied. Early perspectives, rooted in animistic, Indigenous, and preindustrial worldviews, emphasise reciprocity, moral responsibility, and embeddedness within ecological systems. These relational perspectives were progressively eclipsed by the Enlightenment-era dualism and industrial logics that framed nature as inert, external, and primarily instrumental and an extractive supply source. While romantic and conservationist movements offered important counterpoints, it was not until the mid-to-late twentieth century that scientific disciplines began systematically re-engaging with the relational dimensions of human–nature interactions.

Contemporary research reflects a deliberate move away from simplistic exposure-based models toward more nuanced accounts that recognise nature relationships as

psychologically embedded, developmentally shaped, and socially situated. Conceptual frameworks such as biophilia, attention restoration theory, and stress reduction theory have played an important role in legitimising the study of nature within psychology and public health, particularly by demonstrating measurable benefits to cognition, affect, and physiological regulation, as described earlier. However, as the literature reviewed here shows, these frameworks also possess various limitations, including conceptual vagueness, insufficient attention to individual differences, and challenges in accounting for reciprocal or meaning-based interactions with nature.

In response, identity- and value-oriented approaches have gained prominence, reframing human–nature relationships as integral to our self-concept, moral orientation, and social practice. Constructs such as connectedness to nature, inclusion of nature in self, environmental identity, and nature relatedness provide increasingly sophisticated tools for capturing how nature becomes emotionally salient, cognitively integrated, and ethically meaningful. Importantly, this work indicates that nature relationships are not uniform or static, rather they are shaped by personality, culture, life experience, access, and broader structural conditions. This challenges the assumptions of universality and emphasises the need for context-sensitive, inclusive approaches to both theory and measurement.

Concurrently, the review also highlights a persistent fragmentation in how nature relationships are operationalised. Existing measures tend to privilege particular dimensions such as affect, identity, or disposition while neglecting some others, with most relying heavily on self-report instruments developed within Western cultural contexts. As a result, no single measure fully captures the dynamic, reciprocal, and relational qualities increasingly recognised as central to human–nature relationships. This

fragmentation is further amplified by the conceptual overlap between constructs and by limited attention to temporal change, lived practice, and real-world application.

The real-world consequences of these limitations are significant. As cities densify and areas of urbanisation spread, climate pressures intensify, and policy agendas increasingly champion nature-based solutions, there is a growing demand for evidence that can inform design, governance, and intervention design and delivery. Without robust and theoretically coherent ways of evaluating human–nature relationships, efforts to promote wellbeing, stewardship, and equality risk being poorly targeted or conceptually misaligned. The literature reviewed here, therefore, points to a clear need for more integrative approaches, that move beyond transactional metrics of exposure or preference and toward relational evaluations that reflect meaning, identity, reciprocity, and context.

In summary, this chapter demonstrates that human–nature relationships are multifaceted, psychologically grounded, and socially consequential, yet they are insufficiently captured by existing measurement approaches. By synthesising historical, theoretical, empirical, and applied perspectives, this chapter establishes a strong rationale for critically re-evaluating how nature relationships are conceptualised and assessed. This sets the stage for the subsequent chapters, which aim to address these gaps by advancing a more comprehensive and contextually grounded approach to evaluating human–nature relationships.

Chapter 3: Methodology

3.1 Introduction

This chapter provides an overview of the perspectives that guide and develop the diverse research methodologies employed. First, the chapter outlines the philosophical underpinning of the research before detailing the rationale for data collection. Ethical considerations are also addressed, concluding the chapter with a reflection from the researcher about the positionality within the research. The research described in this PhD thesis presents a pragmatic methodological approach that guides the development and validation of a Human-Nature Relationship Quality Measure. The four-phase mixed-methods approach is described and justified (Creswell & Clark, 2017).

3.2 Philosophical Underpinning of the Research

This research project employs a multi-phase mixed-methods design to address a gap in contemporary environmental psychology evidence: the conceptualisation and measurement of human-nature relationships within the 21st Century. The overarching research aim is to develop a psychometrically robust, context-sensitive scale that captures the multifaceted, relational and emotionally complex ways in which individuals engage with nature in contemporary society (Boateng et al., 2018; DeVellis, 2016; Ives et al., 2017) including perspectives of urbanisation, digitalisation and adaptation to the post-pandemic world (Miller, 2005; Soga & Gaston, 2016; Venter et al., 2021).

To answer these questions, a mixed philosophical approach of pragmatism and pluralism was adopted due to the nature of the research study. Pluralism frames the construct as inherently multi-layered and diverse, with no one way to answer the question, while the pragmatic approach anchors the research in problem-solving and scale development. This paradigmatic stance reflects the fundamental nature of the research

problem and the mixed-methods approach required to address it (Creswell & Clark, 2017; Morgan, 2014).

Pragmatism is particularly suited to this research because the overarching goal is not theoretical exploration for its own sake, but rather the practical development of a measurement tool that addresses a real-world gap in environmental psychology (Bishop, 2015; Creswell & Clark, 2017; Morgan, 2014). Under a pragmatist ontology, reality is understood as both mind-dependent and action-tested. Epistemologically, pragmatism treats knowledge as “double-faced” (Morgan, 2014; Tashakkori et al., 2010). In the case of this research this means that knowledge simultaneously looks outward at the observable, objective world, as captured through quantitative surveys and factor analyses, and inward at subjective human interpretation and meaning making, captured through qualitative interviews and expert consensus. Axiologically, pragmatism holds that values and interests are inevitably present in research and should therefore be made explicit and used to guide inquiries toward socially useful outcomes. Following the pragmatist tradition exemplified by philosophers such as Peirce, James, and Dewey (as cited in Sisti & Brendel, 2015) and contemporary articulations by Creswell & Clark (2017) and Morgan (2014), they encourage the researcher to question the best approach and method to answer the research question and produce useful knowledge for the field. Rather than adhering rigidly to a single epistemological position (purely positivist or purely interpretivist), pragmatism allows for flexible methodological choices. Adhering to this approach, this research project presents a mixture of methods in quantitative surveys where breadth is needed (Phase 1), qualitative interviews where depth and consideration of construct definition are needed (Phase 2), collaborative item generation combining both approaches (Phase 3), and empirical psychometric testing (Phase 4) (Boateng et al., 2018; Ives et al., 2017; Roberts & Povee, 2014)).

In addition, to further explore the topic of this research, pluralism acknowledges that the construct of human-nature relationships cannot be adequately understood through a single disciplinary lens or methodological approach (Coscieme et al., 2020; Ives et al., 2017). The pluralism approach of the research argues that human- nature relationships are ontologically and epistemically plural since they involve subjective affect and identity, objective ecological knowledge, social meanings, and moral-philosophical stances toward human–nature boundaries (Clayton, 2020; Plumwood, 2005; Richardson et al., 2021; Schultz, 2002). Nature relationships are simultaneously psychological (individual attachment, emotional responses; Clayton, 2020; Mayer & Frantz, 2004; Nisbet & Zelenski, 2013), ecological (understanding of natural systems and interdependence; (Dunlap et al., 2000; Ives et al., 2017) and social (cultural meanings and collective environmental responsibility; Keaulana et al., 2021; Petersen et al., 2019; Riechers et al., 2021). Thus, methodological pluralism can then be defined as an intentional use of different, sometimes epistemically heterogeneous methods to do justice to such complexity, which has been advocated in systemic design and sustainability research that weaves quantitative indicators with participatory, embodied, and narrative approaches (Norström et al., 2020). This research deliberately incorporates multiple ways of knowing and multiple expert perspectives (academics, practitioners, natural science specialists, farmers, eco-therapists, creative artists and horticulturists) to ensure the resulting measure captures the genuine complexity of how diverse individuals experience their relationships with nature.

3.3 Rationale for the Research Approach

To consider the complex elements of the human-nature relationship, this research process required an approach that allows the exploration of human experiences in nature in rich detail. To answer our question, the research unfolded across four interconnected

phases (Figure 3.1) each building upon the findings of the previous (Creswell & Clark, 2017). The research is based on a modified-Delphi methodology which spans over a 4-phase stage study. The research combines qualitative and quantitative data, which are equally important, providing different lenses to solve the problem stated. Moreover, it also provides space for the expert and expanded experts to be part of the study at different stages, avoiding bias and providing a rich understanding of the phenomena explored. Research rigour was strengthened through methodological and data-source triangulation, comparing convergences and divergences across Phase 1 survey findings, Phase 2 interviews, co-production with iterative Delphi feedback in Phase 3, and Phase 4 psychometric testing (Noble & Heale, 2019).

To ensure participant's experiences and thoughts were considered in the study and they could freely express themselves, it was important to engage meaningfully and broadly with the different human experiences in nature. Thus, a multi-phase mixed-method modified-Delphi approach was chosen allowing for qualitative depth and breadth of information, augmented by quantitative techniques to produce a concise but representative result.

The typical Delphi method uses core features such as participant anonymity, multiple rounds, structured feedback and aggregated group ratings to move expert panels toward consensus (Egolford & Sund, 2020). It was originally developed at the RANDTM Corporation as a way to improve the quality of group judgement with variants of the Delphi are now widely applied in empirical research including traditional Delphi studies (Grime & Wright, 2016) online e-Delphi designs (Hong et al., 2019), and policy Delphi approaches (de Loë et al., 2016).

This modified-Delphi focused on human-nature relationships to include external parties to ensure external and content validity to the new measure. Due to the multi-phase

nature of this study, data collection took place between over a three-year period. The modification of the Delphi resided in the multi-stage and mixed-method approach.

Figure 3.1

Flow of Modified-Delphi Method

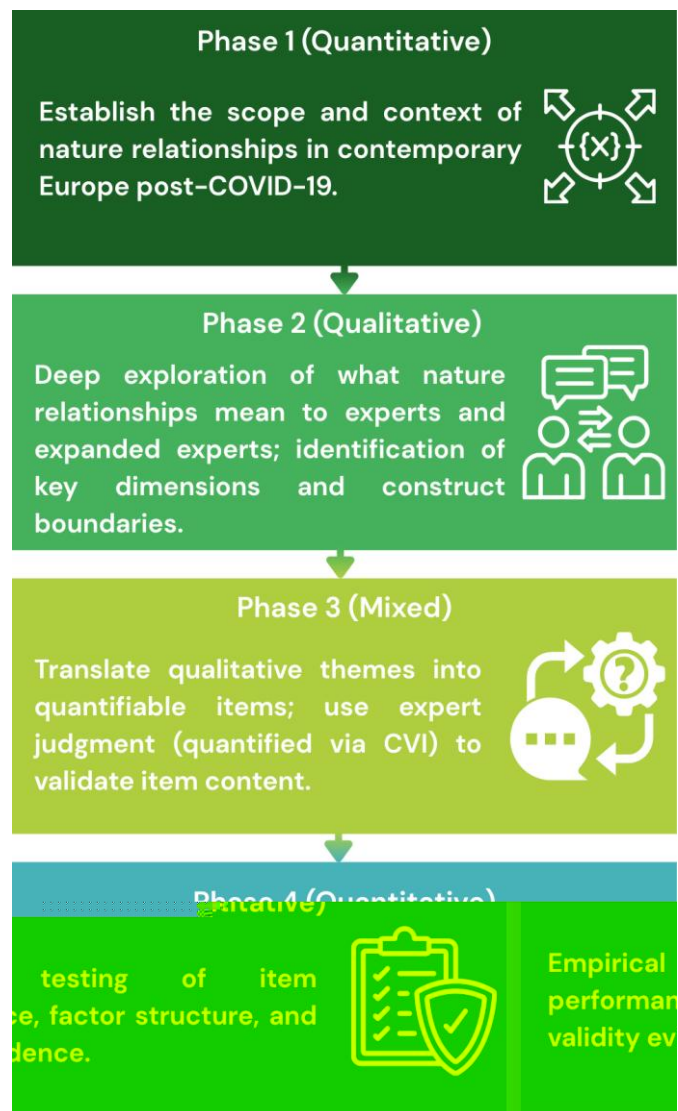


Note. SME refers to Subject Matter Experts.

Regarding the multi-phase, mixed-method modified-Delphi approach, key elements were chosen to best fit with the phenomena explored. First, sequential mixed methods are integrated on a four-phase development where Phase 1 provides quantitative context (breadth); Phase 2 provides qualitative depth and construct definition; Phase 3 translates qualitative understanding into quantified measurement; Phase 4 empirically tests that measurement (Boateng et al., 2018). Each phase informs the scope, design, and focus of the next.

Figure 3.2

Flow of the Four Research Phases



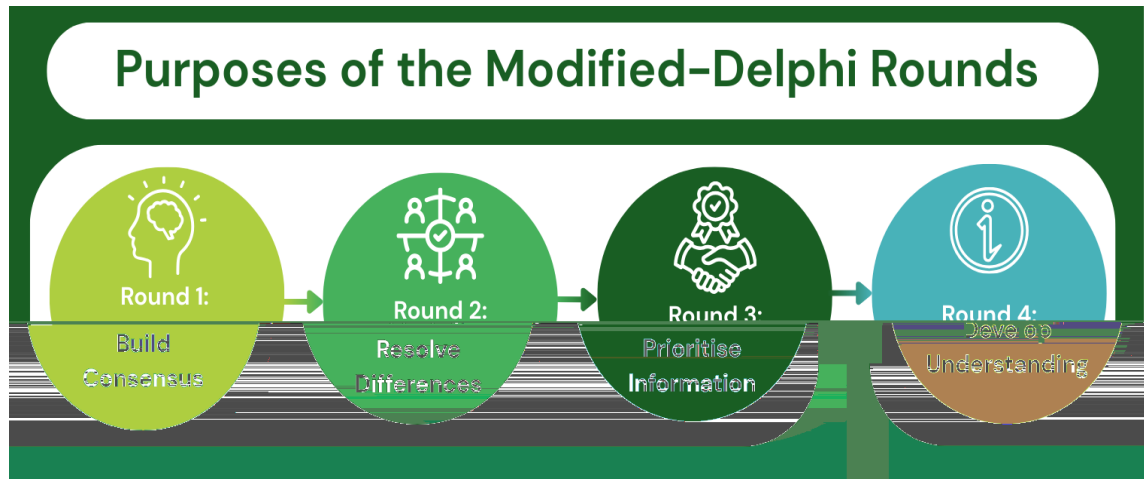
The four-phase research design is not arbitrary or exploratory in the sense of fishing for interesting findings. Rather, each phase's design was predetermined to directly answer research questions that would necessarily inform the next phase. This sequential logic is critical to understanding the overall research rigor. Specifically, the initial round involved a qualitative phase using semi-structured interviews (Avella, 2016; Hasson et al., 2025). This provided rich, in-depth insights into the phenomenon and informed the development of more precise items for the subsequent quantitative Delphi rounds (Harrison et al., 2024; Nawagi et al., 2023). Following quantitative rounds help narrow and refine the result to finally answer the research question.

Second, the research design presents methodological flexibility to increase the adaptability based on emergent findings rather than adhering to a predetermined protocol. Phase 1 involved a pan-European survey which aimed to explore how the COVID-19 restrictions disrupted citizens' engagement with nature. It explored the changes in engagement levels and the perceptions of nature post restrictions (Ugolini et al., 2020; Venter et al., 2021). Phases 2, 3 and 4 all employed elements of a modified-Delphi design with expert and expanded-expert panels to qualitatively explore how nature relationships are conceptualized and experienced across diverse professional, geographic, and demographic contexts. Phase 3 convened a multidisciplinary working group to translate Phase 2 qualitative findings into a candidate item pool for a new measure, employing rigorous item development and content validity procedures grounded in steps for best practice as outlined in Boateng et al., (2018). Phase 4 conducted comprehensive psychometric validation of the resulting scale across three studies, examining factor structure, internal consistency, reliability, and evidence of validity (Badenes-Ribera et al., 2020; Clayton et al., 2021; Dima, 2018). Specifically, the use of external panels to complete the second and third questionnaire rounds is based on the flexibility of the

method (Dixon & Lazenby, 2023; Hong et al., 2019). Delphi-Rounds two, three and four employed a separate panel to enhance validity.

Figure 3.3

Purpose of Each Modified-Delphi Round



Third, the research emphasises on practical outcomes. At every stage, decisions about method and analysis are guided by the question: "Does this produce a better measure of human-nature relationships?" This pragmatic focus is evident in the iterative content validity procedures of Phase 3 and the comprehensive validity testing of Phase 4 (Boateng et al., 2018; DeVellis, 2016).

Finally, diverse experts participate in the research, including both academic experts and "expanded experts" (practitioners, public figures, individuals with lived experience of nature relationships). Thus, the research honours plural ways of knowing and avoids external biases (Collins & Evans, 2002; Norström et al., 2020). Academic expertise provides theoretical grounding and methodological rigor, while expanded-expert expertise provides practical, lived, and contextual understanding that would not emerge from academic literature alone. This research project used both subject matter 'Experts' and 'Expanded-Experts' (Collins & Evans, 2002; Norström et al., 2020). Experts were defined as individuals with specialist knowledge of the concept who had

published on the topic and held a relevant institutional or programme role, particularly in the domains of human–nature connections. Experts were identified via a literature search for the most cited articles using the terms “nature connectedness” and “nature relatedness,” and the authors of these papers were invited to participate. Expanded experts were recruited through snowball sampling via social media posts (See Appendix E) Participants in this category included a poet, a farmer, psychotherapists and many more who had informal training or lived experience working with nature (see Chapter 5).

The first round of the modified-Delphi consisted of 45-to-60-minute semi-structured interviews, guided by a protocol refined through two pilot interviews. Questionnaire rounds were administered via Qualtrics using a mixture of a 5-point Likert scale with the following anchor points: “strongly agree” to “strongly disagree” (Appendix J) “not relevant” to “extremely relevant” (Appendix L) and a 2-point answer range of “I’m happy with this” or “Suggest change” (Appendix M; Schneider et al., 2016; von der Gracht, 2012) These items were augmented by a small number of open-ended questions and rating items.

All questionnaires were piloted to minimise participant burden and fatigue (Boateng et al., 2018; DeVellis, 2016) and to ensure clarity and relevance. To support validity and reliability, each instrument underwent expert review and pilot testing (Boateng et al., 2018; Miller et al., 2021), and the iterative Delphi structure capitalised on participant expertise across successive rounds (Hasson et al., 2025). The anonymous nature of the process was designed to enhance freedom of expression among participants (Egfjord & Sund, 2020).

In summary, the research integrates a modified-Delphi approach using qualitative and quantitative data using a sequential explanatory design (Creswell & Clark, 2017) to answer the research questions (Figure 3.2). At each transition point, findings from the

prior phase directly inform the scope and design of the next phase. The rationale is that quantitative breadth (Phase 1) requires qualitative depth (Phase 2) to adequately define the construct; qualitative definition requires rigorous operationalisation (Phase 3); operationalisation requires empirical validation (Phase 4).

3.3.1. Phase 1 to Phase 2 Transition

Phase 1 established that human-nature relationships are indeed multifaceted, contextual, and disrupted (or transformed) by major environmental and social events like COVID-19. However, Phase 1 data (exploratory quantitative questionnaire) were insufficient to define what contemporary nature relationships entail, particularly with respect to negative emotions, relational complexity, and contemporary contexts (urban, digital, household). The theoretical literature review (Chapter 2) identified conceptual ambiguity: existing measures focus on positive connection but often lack items capturing grief, loss, reciprocal obligation, or situational contexts (Keaulana et al., 2021). Therefore, the subsequent phases employed a modified-Delphi design specifically to achieve expert consensus on what constitutes a nature relationship in the 21st century, including its relational, emotional, and contextual dimensions. This qualitative consensus in Phase 2 was essential before attempting to operationalise the construct into measurable items.

3.3.2 Phase 2 to Phase 3 Transition

Phase 2 generated rich qualitative data (interview transcripts, reflexive thematic analysis,) but did not produce a measurement scale. Translating qualitative themes into valid, reliable scale items requires methodological rigor beyond interview analysis. Phase 3 employed a co-productive methods using working group of experts using modified-Delphi and validation procedures to: identify which themes should be operationalised as scale items, compared to conceptual understanding; draft items grounded in both

qualitative data and measurement theory; assess content validity using expert judgment; and refine items iteratively based on feedback. This process ensures that the resulting scale items authentically represent the construct as defined by Phase 2 experts and qualitative data, not researcher interpretation.

3.3.3 Phase 3 to Phase 4 Transition

Phase 3 produced a content-valid item pool, which underwent content validation in Phase 4. However, content validity alone does not establish that items will perform well in empirical testing. Phase 4 conducted psychometric validation through Exploratory Factor Analysis and Confirmatory Factor analysis to determine whether the items measure the construct reliably, whether they form the predicted factor structure, and whether they relate meaningfully to other variables. This empirical testing with actual participants, rather than expert judgment alone, is essential for establishing that the measure is suitable for research and applied use.

3.4 Ethical Considerations

Since this research involves human participants, it is necessary to consider several ethical aspects of its design, data collection and participant recruitment. Appropriate codes of ethics and relationships with participants are adhered to by the researcher. Moreover, this research received formal ethical approval at three separate occasions. The first approval came from The University of Limerick's Education and Health Sciences Research Ethics Committee (EHSREC) in 2020. The research team began this research in the University of Limerick prior to transitioning to Maynooth University as the GoGreenRoutes Project migrated institutions.

The other two approvals came from the Maynooth Research Ethics Committee conducted by the University's Social Research Ethics Sub-Committee (SRESC) in 2021

and 2023. The submission included key aspects of the research such as purpose, method and participant protection, including interview protocol, survey, information sheet, consent form and example of key references for the design procedures. Extensions for the two final applications were requested and granted. The research is also conducted under the auspices of the Horizon 2020 programme (Grant Agreement No. 869764), which includes its own ethical monitoring and governance requirements. The researcher-maintained compliance with both institutional and funder requirements throughout all four phases.

All participant consent was recorded before any data collection took place, safely stored in password protected files on the researcher's laptop. The participant pool included individuals over the age of 18 without intellectual disabilities. No vulnerable population was included. However, personal experiences and vulnerable topics could be brought up in the interview stages. Therefore, specific considerations were required for this and detailed debrief forms were provided to all participants at each stage of the research.

When involving personal experiences by individuals, there is a risk of power dynamics to affect the participants' responses to reflect the researchers' beliefs and aims (Kvale, 2006; Taua et al., 2014). Thus, it is essential to ensure measures are in place to avoid and counteract these power differentiations, ensuring participants freely engage and express themselves (Berger, 2015).

Considerations were made regarding the composition of the participant groups. It was determined to have separate groups between the modified-Delphi study and the working group as it would be more beneficial and prevent any imbalanced power dynamics from experts in Academia to practitioners, who might feel concerned to voice their experiences or feelings reluctant to be candid about their experiences. More

specifically, several key actions were taken to ensure an inclusive and open approach to recruitment and data collection. A detailed account of the recruitment process is outlined in Chapter 5.

The principles of anonymity and confidentiality are foundational ethical commitments in social research, as outlined in guidelines from the American Psychological Association (2017) and discussed by (Tilley & Woodthorpe, 2011). Anonymity refers to the protection of any identifiable information about participants so that they remain unrecognizable while confidentiality refers to protecting the privacy of data once collected (Kaiser, 2009).

However, recent scholarship has questioned whether strict anonymity is always in participants' best interests, particularly in qualitative research involving personal and emotional topics. (Grinyer, 2009) identified a "loss of ownership" experienced by research participants when their words were attributed to pseudonyms despite their willingness to be identified. In a 2001 study, Grinyer offered participants the option to waive anonymity. Surprisingly, many participants, particularly those discussing emotionally significant experiences, chose to do so because they wanted their contributions recognized and associated with their names or professional identities. The researchers, having followed traditional norms of confidentiality, reported this finding as unexpected and suggested that future researchers reconsider whether blanket anonymity serves participants' interests. When such individuals participate in research interviews, their responses inevitably overlap with previously published work and publicly articulated positions. In such cases, attributing these insights to a pseudonym serves neither the participant (who loses recognition of their intellectual contribution) nor science (which cannot trace ideas to their source and established expertise).

Moreover, participants with public profiles may specifically wish to be identified because association with this research enhances its credibility or communicates their commitment to the research topic. Conversely, forced anonymity may feel disrespectful to their professional identity and intellectual property.

To honour the autonomy and differing needs of the diverse participant groups included in the studies, this research includes an option on certain consent forms allowing participants to waive their anonymity if they believe it serves their interests or the research quality. In particular the participants involved in Phase 2 and phase 3 of this research.

Participants are explicitly informed at the outset that anonymity is the default. The researcher removed all identifying information, assign pseudonyms, and code all responses to protect identity. Participants are then offered a second option: If they believe being identified would be of benefit to them (e.g., professional recognition, clarifying their intellectual contribution) or to the research (e.g., establishing authority/expertise of the participant), they may explicitly choose to waive anonymity on the consent form.

If a participant chooses to waive anonymity, their name may appear in the thesis, associated with their contributions, quotes from interviews, and any publications arising from the research. If a participant chooses not to waive anonymity (the default), all identifying information will be removed, responses will be coded, and the researcher will not disclose participant identity even if their responses are identifiable in content. This choice is documented on the consent form and participants are explicitly assured that choosing not to waive anonymity will not disadvantage them or affect their participation. Any identifying information regarding others brought up in the interviews was retracted.

This thesis supports Open Science methods and attention to research transparency by providing detailed reporting of methods, measures, and the overall analytical

procedure. All participants consented to their anonymised data being used in future research. An anonymised dataset for the quantitative components will be made available via a research repository, subject to ethical approval and checks to minimise re-identification risk. Qualitative transcripts, following final member checking and confirmation from participants, will also be publicly shared, along with the interview guide and analytic framework using the author's OSF profile.

3.5 Researcher Positionality Within the Research Process

To limit the risk bias in research, particularly qualitative research, remaining aware of one's own position to the phenomena being explored is vital and must reflect on their own experience with the phenomena (Braun & Clarke, 2019). This could be through reflective diaries or memos throughout the research process. Throughout the process of this research a reflective journal and diary was kept. I, as the researcher guiding these studies, chose to interact with *The Reflective Journal for Researchers and Academics* (Taylor, 2020) during the early stages of designing the research plan. Throughout the qualitative process a detailed diary was kept with entries spanning from before the first pilot interview all the way to the final meeting of the working group. For me as a researcher, understanding my own positionality to the topic was important to understanding my line of questioning and analysis of interview data, as well as a way of motivation throughout the research process.

My foundational relationship with nature was shaped by my upbringing on a rural island off the South-West coast of Ireland. Growing up in a household centred around farming and fishing, nature was an active presence within my house and often spoken about as if it was another member of the family sitting at the table with us for dinner. I spent my mornings before school checking on sheep and lambs with my father or helping

my uncle manage cows and calves. There was many a pet lamb, or wounded bird brought into the house to be cared for by my mother or I. Fondly I watched as my parents spent their time in the garden, moving plants around to stop them overpowering each other, and taking up their individual allocated space, like separating siblings who insist on picking on each other. I was always shown that nature was deserving of our love and attention. Weekends often involved time in the water or walking my dog in local scenic areas. This immersion instilled an innate awareness of the need to protect the natural environment, to protect the extra member of the Murphy household.

This inherited connection became profoundly apparent when I undertook my first long-term experience away from home, a six-month period living in Paris, France. Despite enjoying my time in the city, I had always dreamed of living in, I began feeling increasingly stressed and irritated, a feeling I attribute primarily to the role of culture shock. This feeling culminated in a deeply emotional experience during a trip to the coastal city of La Rochelle. Standing by the sea and feeling the salty breeze on my face triggered an unexplainable sensation that resulted in both a behavioural and affective response. Simultaneously I stood there with tears streaming down my face, but I felt at peace. Peace, I had not felt the 4 months previous. This short moment served as a personal revelation: I missed the sea. This was my connection to the world around me, to my family and to my sense of self.

While progressing through this research I reflected on my conversations with others. Acknowledging the privileged childhood experiences I have had climbing trees, picking edible berries, swimming in the sea and forming emotional bonds with animals. I had such formative positive experiences that shaped how I view nature and my relationship with it. Another privilege I had was getting to experience the power of nature. Growing up on an island meant I was exposed to the dangers of nature early on. Ironically

to those who know me now, I didn't learn how to swim until I was 11 years old as I knew the risks involved with water. I had family members volunteer with the local lifeboat and saw them out on volunteer missions. I had heard the stories of the sea 'taking someone's life'. Why would I want to put myself into the hands of something that seemed like a cruel monster? I tried to sleep through many wild storms and saw the lasting damage nature could cause. Despite these somewhat 'negative' experiences, I still saw the beauty in nature. I knew my limitations within my relationship with nature. However, until this research I had not reflected on the impact these experiences had on my own relationship.

Within this reflective process I am aware that I am not separate from this data. However, by engaging with this reflexive experience I attempted to harness my personal experience and identify potential biases to produce a rich interpretation of the data.

3.6 Conclusions

In conclusion this research follows a pragmatic approach to discovering information. Information was gathered through a sequential multi-phase research plan focused on a modified-Delphi methodology. The aim of the overall research is to gain an understanding of the complexity of human-nature relationships in modern society to aid in the development of a new measure of quality of human-nature relationships. A wide range of participants were recruited through the process of this data collection including Experts, Expanded Experts, Subject Matter Experts and a general population sample data was gathered.

The research occurred over four stages, beginning with an exploratory study, followed by qualitative interviews before a longitudinal co-production process and concluding with psychometric validation. The researcher remained reflective throughout the duration of the research.

Chapter 4: Changing Perceptions of City Green Space: A Pan European Survey

4.1 Introduction

The physical and mental health benefits of nature are increasingly supported by robust scientific evidence (Bratman et al., 2019; Donnelly & MacIntyre, 2019). Nature connectedness and one's proximity to nature have been proven to be beneficial when socially isolated (Cartwright et al., 2018). Despite this evidence, during the planning of protective measures against the coronavirus pandemic, nature and its potential to support mental health was not the priority in many regions. Globally the COVID-19 outbreak led to major restrictions negatively impacting people's psychosocial health and their health behaviours (Nigg et al., 2023).

The WHO (2017) recommendation that all individuals have access to at least two hectares of green space no further than 300m (a five minute walk) from their home is even embedded in UN SDG target 11.7. to “provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and person.” Evidence from across 1,000 European cities conveyed that 62% of Europeans residences did not meet this recommendation and access to this minimum level would save approximately 43,000 lives annually. During the pandemic access to green space was made more difficult during the pandemic due to restrictions on travel, leaving your own residence or even going outside. In Ireland the implementation of the 2km restrictions made accessing natural space impossible for a significant portion of the population. Irish travel restrictions made access to preferred or meaningful natural spaces difficult for many individuals, particularly where those spaces were beyond the permitted travel radius. This aligns with wider evidence that COVID-19 restrictions shaped people's access to, use of, and perceived value of natural environments during the pandemic (Nigg et al., 2023). Providing a review of the restrictions across EU states is beyond the scope of this chapter, however, Nigg et al., (2023) conducted a scoping review which

synthesises the evidence for links between natural environments and psychosocial health or health behaviours at this time.

In this context, GoGreenRoutes, which commenced in September 2020, was one of several EU-funded projects positioned to generate insights from the lockdown period and to advance understanding of the role of nature in urban areas. A collaboration between two Horizon2020 projects, ReNature and GoGreenRoutes, led to the development of a pan-European city survey, led by the PhD researcher. The survey examined urban citizens' relationships with natural spaces before, during, and after lockdown measures, with a particular focus on patterns of use, engagement, and perceptions of nature. Focusing on partner locations across the two projects, the survey aimed to understand whether, and how, local lockdown measures were associated with shifts in how urban citizens used, experienced, and perceived natural spaces. Therefore, the present study uses data from this survey to explore changes in urban citizens' engagement with natural spaces and perceptions of nature across the pre-lockdown, lockdown, and post-lockdown periods.

4.2 Methods

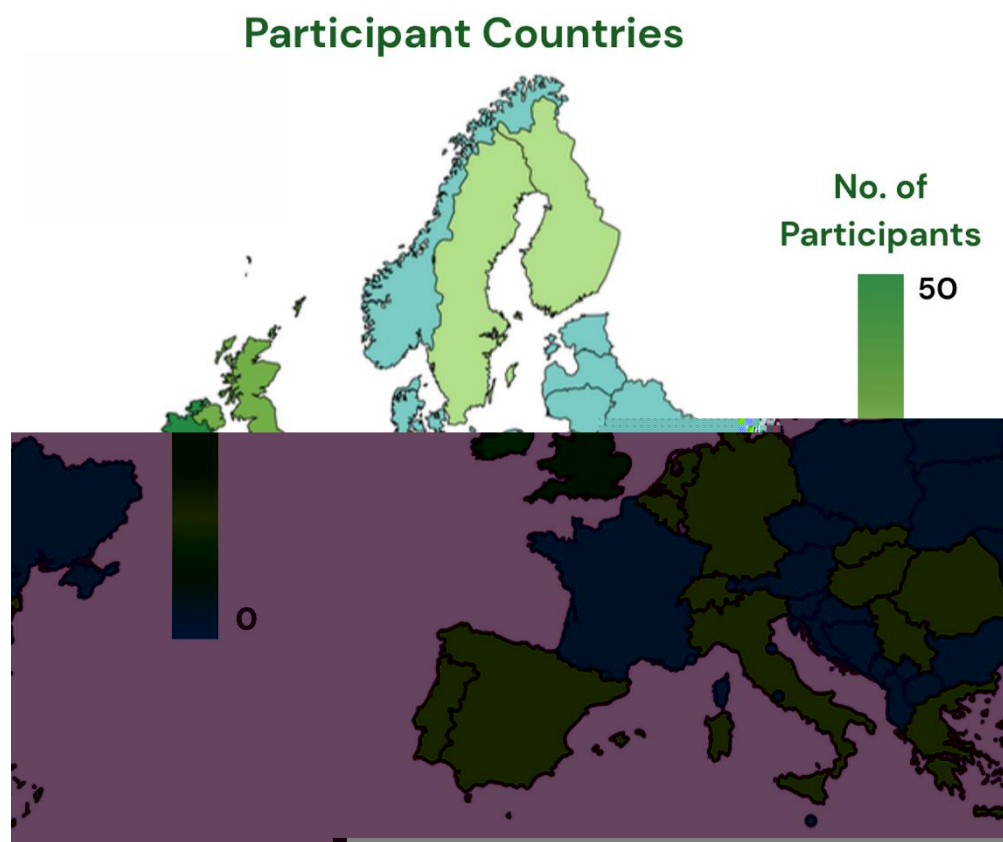
4.2.1 Participants

A total of $N = 125$ participants completed the study. Eligibility criteria required participants to be at least 18 years of age. Recruitment, which took place online through the associated project social media pages, was targeted at citizens from ReNature and GoGreenRoutes partner cities, however the survey was not restricted to these locations. Despite the non-restrictive inclusion criteria, the studies participants were primarily from Ireland (40%) and Malta (28.8%), the host countries of both projects. A breakdown of the countries that participants came from can be seen in Figure 4.1. Of the 125 participants

47.2% reside in urban core areas, 42.4% in small towns/villages, and 10.4% in dispersed rural settlements. Participants ranged in age from 21 to 69 years ($M = 41.0$, $SD = 11.33$). The sample consisted of 63.2% female and 33.6% male. 3.2% of participants selected the options ‘other’ or ‘prefer not to say’. Participants reported living with between 1 and 8 adults (including themselves; $M = 2.44$, $SD = 1.20$). Among those who reported having children, the number of children under 18 years of age ranged from 1 to 4 ($M = 1.86$, $SD = 0.78$). The majority of participants were employed full time (63.2%), with students making up 12.8% and part time employees accounting for 8%. The majority of respondents remained in their current residence during the strictest COVID-19 measures (95.2%).

Figure 4.1

Distribution of Participants across European Member States



4.2.2 Design

The cross-sectional correlational survey took place following the COVID-19 restriction measures. Given the unprecedented and rapidly evolving context of COVID-19 at the time of the research, the study was designed to provide an exploratory understanding of how urban citizens' engagement with natural spaces may have changed during periods of restricted movement. The study took place following the lifting of COVID-19 restriction measures. Participants were presented with retrospective questions about their behaviours before, during and after their respective restrictions on movement.

4.2.3 Measures

The items for the online survey were based on large scale surveys on access to nature in Europe and in the UK. For example, Horizon 2020 project BlueHealth developed a large scale Community-Level Survey (BCLS; BlueHealth, 2020), the UK Monitor of Engagement with the Natural Environment survey (Natural England; MENE; 2019) both assessed a number of the behavioural and contextual questions presented in the study (see Appendix B for full survey). These surveys addressed issues including access to green and blue spaces, frequency and duration of nature visits, mode of travel, barriers to access, and perceived environmental quality. Specific questions about specific natural typologies and the role of nature-based solutions and green infrastructure were developed based on items from the EU Special Eurobarometer 444: Citizens' view on nature-based solutions report (European Commission, 2016). The surveys uniquely addressed issues that were also of concern in this survey and they would provide the potential for comparative data.

Table 4.1*Sample Items that were Adapted from Large Scale Surveys*

Item	Type of Scale	Factor of Interest	Source
To what extent do you agree that there should be increased funding in your locality for the following areas? -Access to greenspace -Access to bluespace	Likert 1-7 point scale with anchor points (1 Strongly Agree; 7 Strongly Disagree)	Investment in more green and blue space	EU Eurobarometer 444
Did you visit natural spaces on a regular basis?	-Y/N	Frequency of visits to natural spaces-this was adapted for pre-COVID-19 and post-COVID-19.	BCLS; BlueHealth, 2020
How often did you visit this space?	Daily, several times a week, once a week, several times a month, once a month, less than several times a month etc.		
Which of these activities, if any did you undertake?	Eating, field sports, fishing, running, road cycling, swimming outdoors, walking (w/wo dog)	Adapted to include draw, paint, meditate.	(Natural England; MENE; 2019)

4.2.3.1 Nature Relatedness

Nature Relatedness was measured on the shortened Nature Relatedness Scale (NR-6; Nisbet & Zelenski, 2013). This six-item measure is a shortened version of the original Nature Relatedness Scale (Nisbet et al., 2009). It uses a 5-point Likert scale response format. The purpose of the scale is to measure cognitive, affective, and

experiential connection to nature. Higher scores indicate stronger nature relatedness (see Section 2.6 for details).

4.2.3.2 Wellbeing

Wellbeing was measured using the WHO-5 Wellbeing Index (WHO-5; WHO, 1998). This brief scale measures subjective psychological wellbeing, particularly positive mood, vitality, and general functioning over a recent period (i.e. past two weeks. It uses a 6-point Likert scale ranging from 0 (at no time) to 6 (all of the time) and has established cut-offs for thriving, languishing and distress.

4.2.3.3 Pro-Environmental Behaviour

Pro-Environmental Behaviour (PEB) was measured as a habit by adapting the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). This 12-item inventory measures the strength of a specific habit. The scale is designed to allow the specific habit to be applied to each statement in the scale. it assesses how automatic, identity-linked, and history-dependent a behaviour is. It uses a seven-point Likert scale response format with levels of agreement where higher scores indicate greater presence of habits.

4.2.4 Procedure

Participants were invited to participate in an anonymous online survey which they accessed through the link attached to a social media post. The social media post included a short promotional video to draw in the participants attention while explaining the context of the survey. Once participants clicked on the survey link, they were directed to a detailed information sheet outlining the purpose of the study, the background to the projects supporting the research and considerations for ethics.

4.2.4.1 Ethical Considerations

Ethical approval was attained from the University of Limerick Education and Health Sciences Ethical Committee (prior to the researchers move to Maynooth University). The research was approved under the following title: *2019_06_43_EHS GO GREEN ROUTES: Citizens attitudes toward Nature Based Solutions and Environment across European Cities*. All participants gave informed consent to participate in the study. There were no known risks to participants who took part in the study.

4.3 Results

4.3.1 Descriptive Demographic and Contextual Statistics

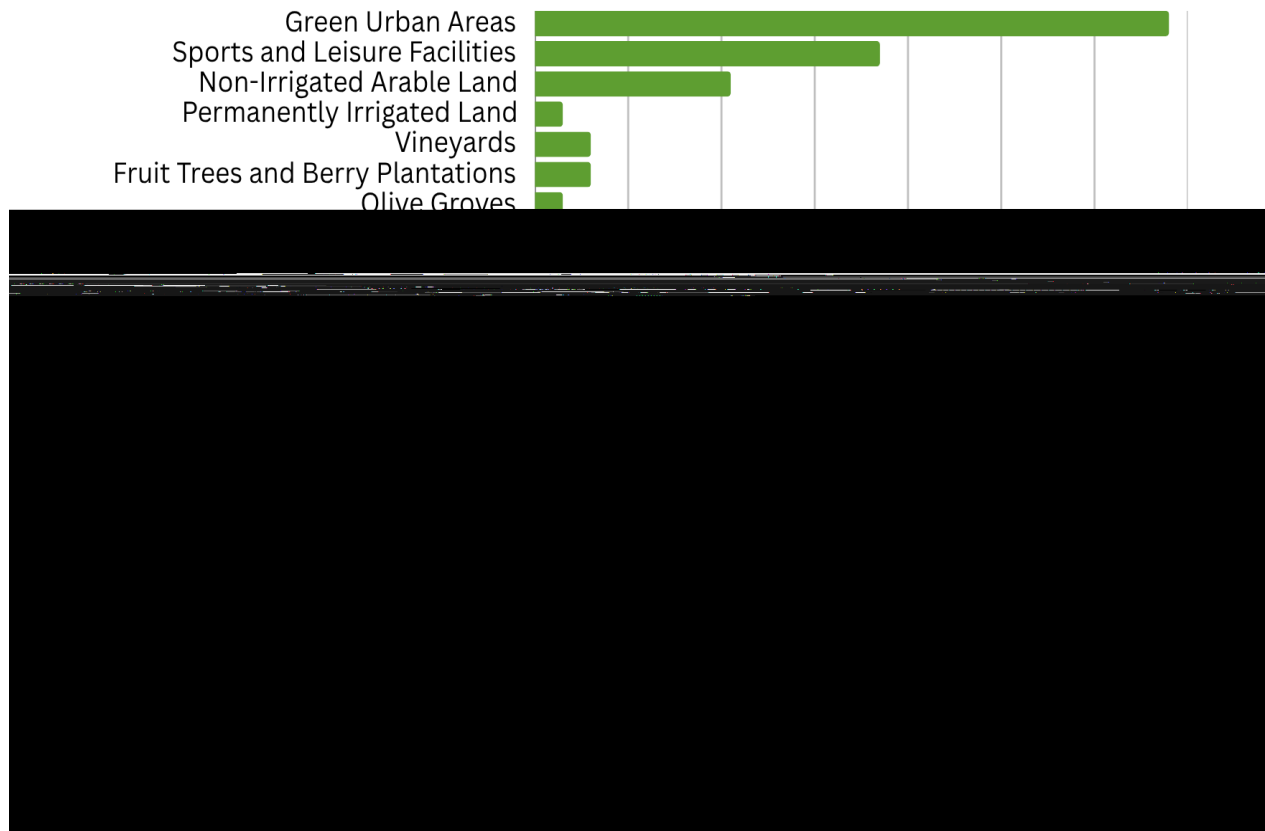
A descriptive analysis ($N = 125$) explored the characteristics of the participants' self-reported levels of wellbeing, nature connectedness and pro-environmental habits, alongside information regarding perceptions of, and engagement with, natural spaces.

4.3.1.1 Nearby Nature characteristics

When asked about their access to natural spaces adjacent to their home, approximately 28.8% reported access to a private garden, 15.2% access to a communal green area, and 13.6% no nearby natural space. 24.8% stated that they had access to both communal and private spaces while 4.8% had access to agricultural land. The most common land-cover types adjacent to respondents' homes included urban green areas (54.4%), sport and leisure facilities (29.6%), land used primarily for agriculture (24.8%), sea and ocean (19.2%) and non-irrigated arable land (16.8%). No participants had access to rice fields or peat bogs.

Figure 4.2

Characteristics of Nearby Nature Reported by Respondents from Available Items

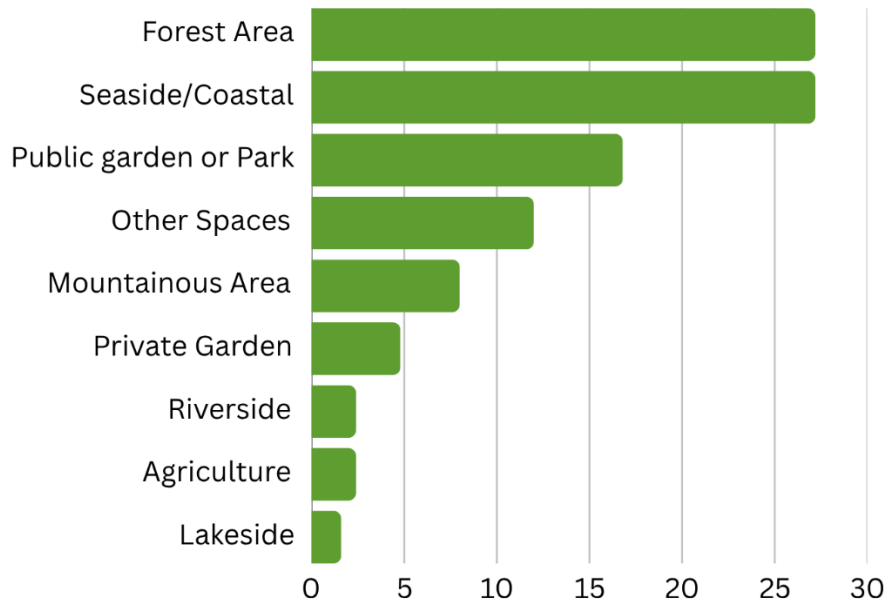


Note. The figure excludes characteristics with scores of 0 (Rice Fields; Peat Bogs), 1 (Sclerophyllous Vegetation; Glaciers and Perpetual Snow; Inland Marshes; Intertidal Flats), or 2 (Burnt Areas; Salines; Coastal Lagoons).

When asked to choose a favourite area in nature there was an equal split between forest (27.2%) and Seaside/Coastal (27.2%). Twenty participants (16.8%) stated that public gardens or parks were their preferred area followed by 15 participants (12%) who selected the ‘other’ option. The top options participants listed were riverside (2.4%), agriculture (2.4%) and lakeside (1.6%).

Figure 4.3

Favourite Natural Space Reported by Respondents



4.3.2 Main Constructs

4.3.2.1 Wellbeing and Nature Relatedness

The mean wellbeing (WHO-5) score is 47.04 ($SD = 21.85$). 54.4% of respondents had a WHO-5 score below 50, indicating poor well-being, while 9.6% of respondents had a score above 80, which is equated with thriving.

Figure 4.4

Psychological Wellbeing (WHO-5) Classifications During Confinement



The nature relatedness score (NR)-6 has a median of 4.5 (IQR = .83). 79.2% of respondents had a NR6 score above 4.0, and 36.8% of respondents had a score above 4.8. No participants had a score of 1, indicating a very high level of self-reported nature relatedness. Caution should be given to the generalisability of these results due to the high levels of self-reported nature relatedness.

4.3.2.2 Pro-environmental behaviour and perceived change

A paired-samples t-test was conducted to compare self-reported pro-environmental behaviour before and after the COVID-19 period. There was a small but statistically significant decrease in pro-environmental behaviour from before COVID-19 to after COVID-19, with pre-COVID-19 scores being on average 0.41 points higher than post-COVID-19 scores, mean difference = 0.41, 95% CI [0.02, 0.79], $t(120) = 2.09$, $p = .039$.

4.3.3 Pre-Lockdown

4.3.3.1 Nature engagement habits before lockdown measures

When asked about their nature habits prior to the COVID-19 restrictions, 89.51% of participants reported visiting nature spaces regularly ($n = 124$). In a subsequent question, based on the participants who completed the frequency item ($n = 111$), 43.24% reported visiting natural spaces multiple times per week and 21.62% reported visiting them daily before the COVID-19 lockdown measures.

4.3.3.2 Benefits and Barriers to Nature Engagement

Participants were asked to rank the benefits experienced from engaging with nature before the COVID-19 restrictions, based on items adapted from previous large-scale surveys,. The top five benefits were identified by calculating the mean rank values of each option. Lower mean rank values correspond to higher perceived importance. The top benefits were recreational activities linked to staying fit (mean rank = 1.88), experiencing an internal connection with the natural environment (mean rank = 1.89) and sharing time with family and friends (mean rank = 2.03). Experiencing close contact with nature (e.g. through mindfulness, spirituality and other practices) and reducing stress levels (mean rank = 2.06) tied as the fourth most important benefit of nature.

In this sample, few participants chose to identify barriers to accessing nature. The main barriers individuals identified to access nature prior to COVID-19 restrictions were lack of public toilet facilities ($n = 4$) or lack of appropriate space within their local vicinity ($n = 4$), followed by the weather conditions ($n = 3$). Notably, no respondents identified lack of dog-walking facilities, play areas for children, sports facilities, or higher crime/anti-social behaviour as barriers in this dataset.

4.3.4 During Lockdown

4.3.4.1 Mental health during lockdown measures

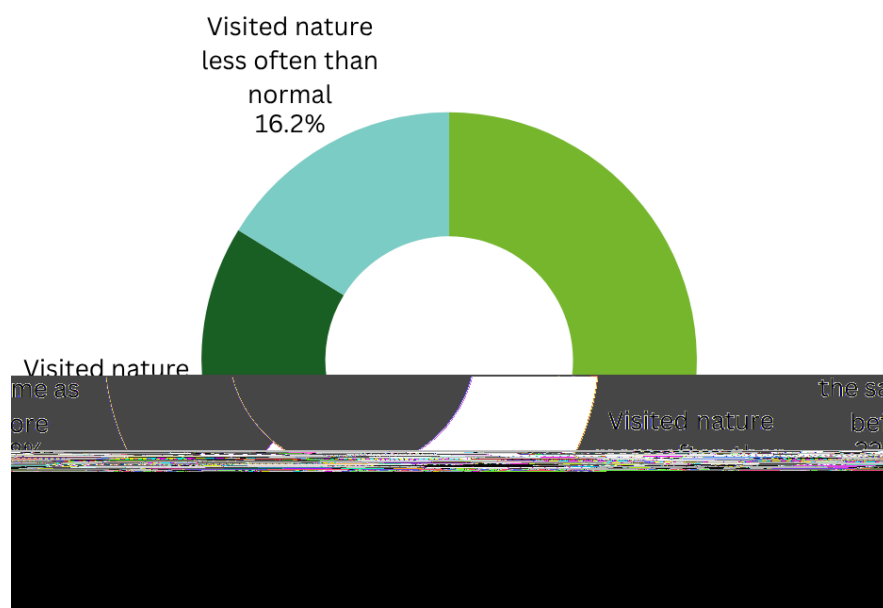
Participants' perception of the impact of the COVID-19 pandemic on their mental health were mixed. 55.3% of participants ($n = 123$) selected 'agree' or 'strongly agree' to the statement *"I feel my mental health has suffered as a result of the COVID-19 crisis."* 22.7% selected 'disagree to some extent' with 22% of participants selecting 'neither agree or disagree'.

4.3.4.2 Nature engagement habits during lockdown measures

When asked about their engagement with nature during the restrictive period ($n = 122$), 86.1% of participants reported that they did visit natural spaces during the restriction, while 13.9% did not. 61% of participants stated that they visited these spaces more often than before restrictions. 16.2% of participants visited less often than normal with 22.8% highlighting they visited the same as before.

Figure 4.5

Self-Reported Changes in Frequency of Natural Space Visits During Pandemic Restrictions Compared to Pre-Pandemic Baselines



Novel information was gained when the participants responded to open-ended questions to identify barriers to access during this time recurring themes. Some recurring themes identified were fear of illness: *“lockdown...too many people - fear of infection”* and overcrowding even in outdoor spaces: *“Overcrowding of green spaces near home, inability to drive outside the city”*. Additional challenges noted by respondents were that:

“There were no barriers to actually going, however, since there were a lot of people crowding the few natural areas in the south I did not want to risk getting sick (and transferring it to my 63 year old father)”

Another concern individuals had was the use of masks in natural spaces.

“It is quite annoying to wear a mask all the time even in natural spaces and even if you are all alone.”

Or not being able to visit their favourite natural spaces .

“I haven't been able to access the spaces I love best.”

“No impact to local area but could not access woodlands or sea.”

4.3.5 Post-Lockdown

4.3.5.1 Benefits and appreciation of nature

Participants were again asked to rank the benefits they experienced from engaging with nature after the COVID-19 restrictions were lifted, using the same set of benefit items. As before, the top five benefits were identified by calculating the mean rank values of each option, where lower mean rank values indicate higher perceived importance. After the onset of COVID-19 restrictions, the most highly ranked benefit remained recreational activities linked to staying fit (mean rank = 2.10). This was followed by experiencing close contact

with nature (e.g. through mindfulness, spirituality and other practices; mean rank = 2.63), reducing stress levels (mean rank = 2.63), sharing time with family and friends (mean rank = 2.64), and experiencing an internal connection with the natural environment (mean rank = 2.75).

Table 4.2

Comparison of Mean Ranks of Benefits Before and After COVID-19

Benefit	Pre COVID-19	Post COVID-19
Enjoying scenery	2.08	2.9
Observing wildlife	2.08	3
Experiencing close contact with nature	2.06	2.63
Feeling a strong sense of place	2.26	3
Experiencing an internal connection with the natural environment	1.89	2.75
Learning/sharing knowledge about natural environment	2.67	3.16
Recreational activities linked to staying fit	1.88	2.1
Reducing stress levels	2.056	2.63
Sharing time with family and friends	2.03	2.64
I don't know / don't want to answer	11	-
Other	6	5

4.3.5.2 Increased Awareness post COVID-19

Participants were asked if they had increased awareness post restriction of the nature that is around their residence but also increased environmental awareness in general. In both scenarios participants reported a moderate increase in awareness of nature close to their residence ($M = 1.97$, $SD = 0.84$,) and a slightly higher perceived increase in environmental awareness more generally ($M = 2.12$, $SD = 0.80$), based on 121 responses to each item.

4.3.6 Inferential Statistics

4.3.6.1 Group differences in WHO, NR-6, and PEB in terms of Residential Area

An independent-samples t-test was conducted to examine whether changes in pro-environmental behaviour differed by residential area type. Due to the insignificant number of participants in the third category (Dispersed Settlements and Rural Areas) the analyses were conducted on two groups. Those living in the urban cores and a combination of small towns, villages and urban fringes. Participants living in urban cores ($M = -0.40$, $SD = 1.73$, $n = 58$) did not differ significantly in PEB change from those living in small towns, villages, or urban fringes ($M = -0.42$, $SD = 2.56$, $n = 50$), $t(106) = 0.06$, $p = .96$, 95% CI [-0.80, 0.85]. This suggests that residential area type was not associated with differences in PEB change.

Furthermore, an independent-samples t-test examined whether well-being differed by residential area type. Participants living in urban cores ($M = 46.51$, $SD = 21.19$, $n = 59$) did not differ significantly in WHO-5 well-being scores from those living in small towns, villages, or urban fringes ($M = 44.91$, $SD = 22.35$, $n = 53$), $t(110) = 0.39$, $p = .70$, 95% CI [-6.55, 9.76]. This suggests that residential area type was not associated with overall well-being in this sample.

Next, independent-samples t-tests were conducted to examine whether nature relatedness differed by residential area type. Participants living in urban cores ($M = 4.41$, $SD = 0.57$, $n = 59$) did not differ significantly in NR6 scores from those living in small towns, villages, or urban fringes ($M = 4.24$, $SD = 0.81$, $n = 53$), $t(92.52) = 1.25$, $p = .21$, 95% CI [-0.10, 0.43]. This suggests that nature relatedness was similar across residential area types in this sample.

4.3.6.2 Group differences in WHO, NR-6, and PEB in terms of Nature Visit Frequency

Next, an independent-samples t-test examined whether nature relatedness differed between participants who reported visiting natural spaces on a regular basis and those who did not. Participants who visited natural spaces regularly ($M = 4.40$, $SD = 0.67$, $n = 111$) reported somewhat higher NR6 scores than those who did not ($M = 4.06$, $SD = 0.63$, $n = 13$), but this difference did not reach conventional levels of statistical significance, $t(122) = 1.69$, $p = .09$, 95% CI [-0.06, 0.72].

Finally, an independent-samples t-test examined whether well-being differed between participants who reported visiting natural spaces on a regular basis and those who did not. Participants who visited natural spaces regularly ($M = 48.22$, $SD = 21.38$, $n = 111$) reported higher WHO-5 well-being scores than those who did not ($M = 36.62$, $SD = 24.70$, $n = 13$), but this difference did not reach conventional levels of statistical significance, $t(122) = 1.82$, $p = .07$, 95% CI [-1.01, 24.21].

4.3.6.3 Correlations among main constructs

A Pearson correlation was conducted to examine the association between wellbeing (WHO-5) and nature relatedness (NR-6). The correlation was positive but very small and not statistically significant, $r(123) = .09$, indicating that higher wellbeing scores were not reliably associated with higher NR-6 scores in this sample.

4.4 Discussion

Consistent with contemporary research from North America, the United Kingdom, Europe and Australia, nature proved to be a means of socialising for many, while for others it was a way to “escape” their home environment and “get breathing

space” during the pandemic. Much is still unknown of the long-term effects of the pandemic, yet it is understood that the quality of green space has improved with a reduction in noise pollution and greater soundscape suggesting the benefit of spending time in natural spaces being amplified. On a macro-level it could have been described as a window into a carbon-neutral future. All that is certain is the inequalities in high quality green spaces must be considered for the implementations of lockdown restrictions and beyond.

4.4.1 Limitations

This research was meant to contribute to the original research question about urban-nature connectedness, which is why there is a focus on urban residents in recruitment. Due to the nature of the COVID-19 pandemic there was an urge by researchers to explore the effects of this phenomenon. The research presented here required a large amount of retrospective self-reporting on the part of the participant. The results provide a snapshot into the individuals' perceptions of the changes and experiences of what was happening for them and contributes to the development of the interview schedule for Phase 2 of this research. However, it should be noted that they are purely for descriptive purposes. Furthermore, because this was primarily an exploratory study, no statistical corrections for multiple comparisons were applied to the inferential tests. Consequently, any statistical differences or associations observed should be treated with caution and viewed as preliminary findings that guided subsequent qualitative inquiries, rather than definitive causal models.

4.5 Conclusions

The opportunity to conduct a multi-site survey provided insights into the perceptions of citizens towards green space, their rationale for spending time in nature

and conveyed that across multiple contexts natural settings have a special role in supporting health and well-being. Nigg et al. (2023) concluded that natural settings have considerable potential in buffering the impact of stressful events mental health. Fundamental to this inference is the need to elucidate our human nature interactions more deeply to appreciate the extent of the relationship with nature and its impact on both human and environmental health.

The findings from this survey must also be interpreted through the specific national contexts of the primary respondent cohorts: Ireland and Malta. During the strictest phases of the COVID-19 pandemic, Ireland implemented severe confinement protocols, including a strict 2km travel limit from citizens' residences. This legislative barrier fundamentally altered the accessibility of natural spaces, disproportionately impacting urban residents who lacked immediate, walkable access to high-quality green or blue spaces. Similarly, Malta represents a unique geographical context characterised by high population density and limited natural land cover, meaning pandemic restrictions rapidly exacerbated the demand for, and overcrowding of, finite communal green spaces. These localised pressures align with broader cross-country studies (Ugolini et al., 2020), which demonstrated that severe national lockdown policies across Europe inadvertently highlighted existing green space inequities, transforming everyday urban nature from a recreational amenity into a critical psychosocial necessity.

Chapter 5: Qualitative Exploration of Nature Connectedness Construct

5.1 Introduction

The central concept in our understanding of human-nature interactions is an individual's subjective sense of connection with the environment and natural world. In the extant literature the concept has been referred to as *nature connectedness*. Nature connectedness is often described as a trait-like emotional, cognitive and behavioural connection between human beings and the natural world (Capaldi et al., 2014; Nisbet et al., 2009; Schultz, 2002), however recent research would suggest that it may be more complex than originally assumed (Ives et al., 2017; Soga & Gaston, 2016). In recent years, researchers have tried to unravel the complexity of this construct due to accumulating evidence from reviews that human-nature interactions are vital for human health (Bratman et al., 2012; Kotera et al., 2022; Richardson et al., 2021; White et al., 2019). Recent evidence has conveyed that access to nature is a determinant of health (Barboza et al., 2021) and mental health (Nieuwenhuijsen et al., 2022). Time spent in nature has been linked to mental health benefits with 120 minutes the recommended dose per week (White et al., 2019). Similarly, links between nature connectedness and high levels of wellbeing and engaging in pro-environmental behaviours have been established (Anderson & Krettenauer, 2021; Barragan-Jason et al., 2021; DeVille et al., 2021; Richardson et al., 2021; Riechers et al., 2021). Collectively, this evidence signifies the importance of elucidating our understanding of human nature interactions more given its significance for both human and environmental health.

Despite our current knowledge of the benefits of nature interactions and human-nature connections, there are clear gaps in our understanding. While urbanisation is still increasing and individuals reported to be less connected than ever however little is known about this transition (Barrable & Booth, 2022). This loss in contact has been referred to as an *extinction of experience*, in which over time and generations, humans have lost

two distinct groups of participants were recruited to share their own personal and professional experiences with nature. These groups comprised established researchers in the field, referred to as ‘experts’ (e.g. chosen based on field of study and citations) and another group who had either informal training or rich experiences in nature and well-being, referred to as ‘expanded-experts’.

The original focus of the study was on the conceptualisation of urban nature connectedness, however it was clear from the pilot studies that there was a prior gap in

5.2 Methods

The study protocol for this research was published on Open Research Europe (Murphy et al., 2024). Due to changes in the consortium (A partner left) the research had to be adapted as the inventory then had to be developed by the coordinating partner in the consortium. The methods outlined in this section are more representative of the methodological approach that was employed following changes. An updated version 2 edition of this protocol is in-preparation by the authors in line with the projects' commitment to Open Science principles

5.2.1 Study Design

This study was phase two of the research plan (see Chapter 3) and will begin the process of the modified-Delphi study by following steps 1-7 (Figure 5.1). The rationale for the methodological approach was that it had been applied successfully to elicit knowledge on complex constructs and ultimately achieve consensus among experts on a range of topics (Noble & Heale, 2020; Fink-Hafner et al., 2019; Taylor, 2020; Trevelyan & Robinson, 2015). The Delphi method is often used when there is limited or conflicting information on a phenomenon, (Taylor, 2020). This particular study is focused on Round 1 of the modified-Delphi in which the goal is to develop an understanding of the phenomenon of human-nature relationships prior to the rating activities.

Figure 5.1

Purpose of Each Delphi Round

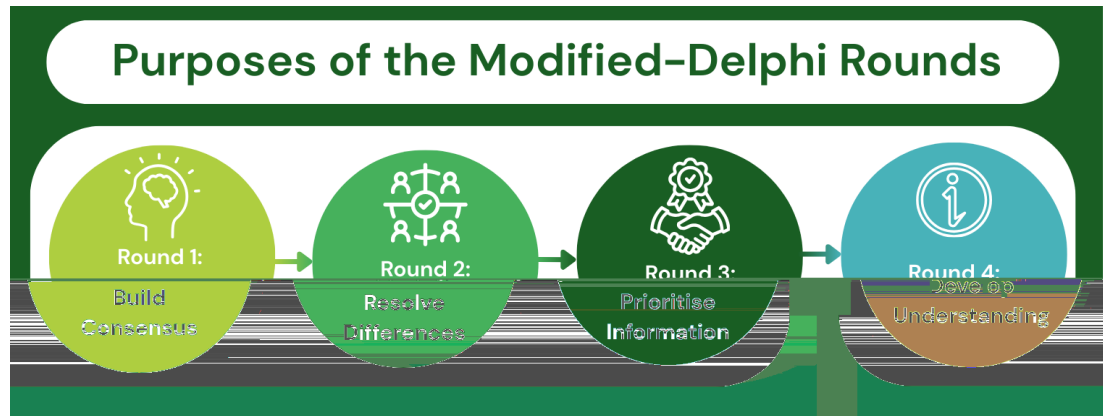
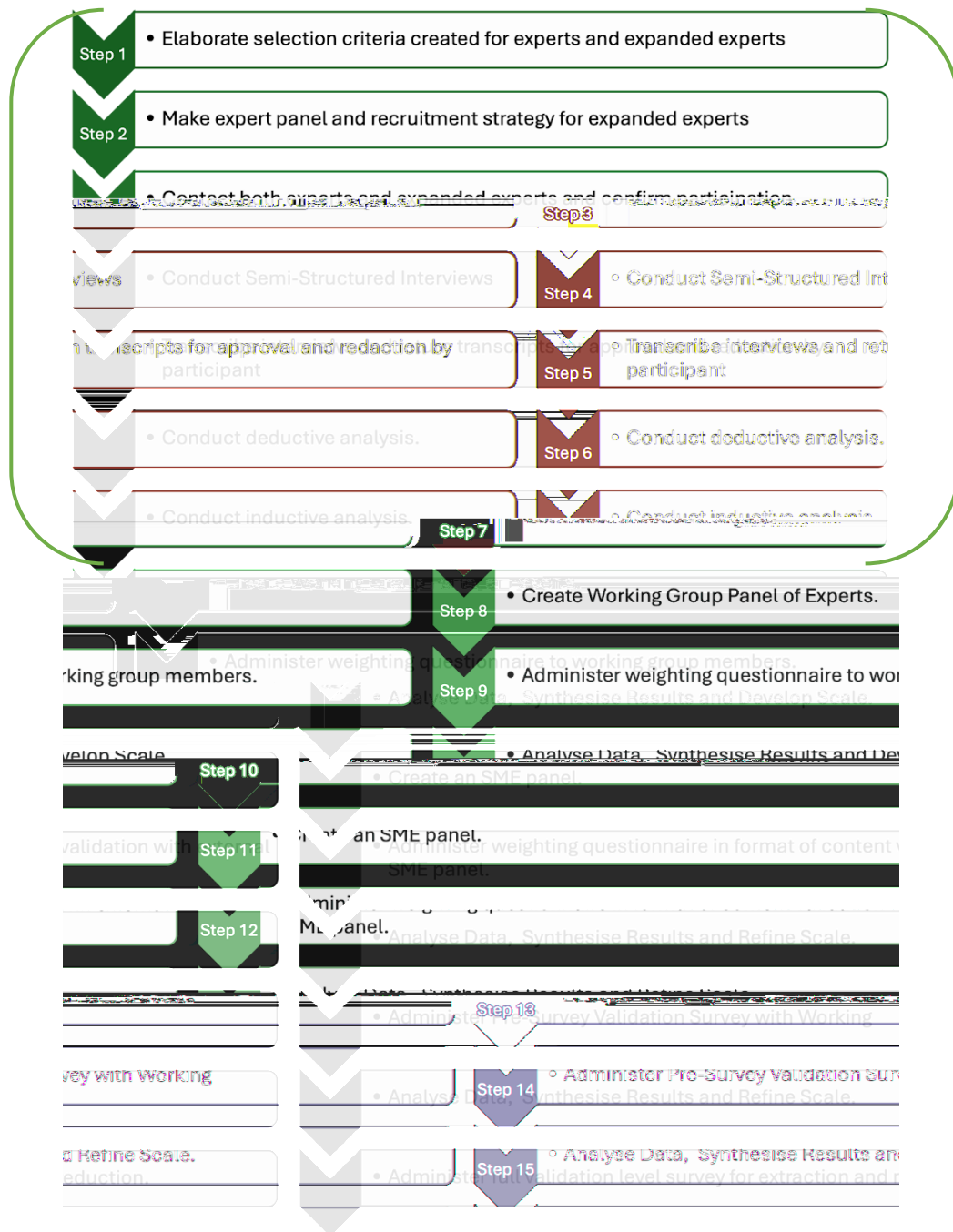


Figure 5.2

Steps of Modified-Delphi Being Discussed in Chapter 5



Note. SME refers to Subject Matter Experts.

5.2.2 Participants

For the purpose of expanding knowledge beyond the current literature the participants of this round of the Delphi study were recruited from two groups, as outlined earlier. Scholars have long noted that Delphi outcomes can be biased when the panel comprises experts drawn primarily from a single discipline or epistemic community, as this can reinforce shared assumptions and limit the diversity of perspectives informing the consensus (Hsu & Sandford, 2007). For that purpose, two separate groups were recruited:

1. 'Expert' Group (E): Researchers, predominantly in environmental psychology or environmental science and allied areas, who have published on the concept of nature connectedness.
2. 'Expanded Expert' Group (EE): Individuals and practitioners for whom a connection with nature is central to their work or hobbies, or whom have informal training in their profession in supporting others to foster relationships with nature. Professionals from the creative arts, psychotherapy, horticulture, child development, health promotion and urban planning participated.

A total of 23 participants volunteered to participate in the research, of which 12 were categorised into Expanded Experts and 9 were categorised into the Expert category. The demographic characteristics of both groups are outlined in Tables 5.2a and 5.2b. Two of the participants were part of the pilot interview stage and agreed to have their interview part of the full study. Each participant represented an independent category. Saturation of topics was reached within both groups. Saturation occurred at interview number 9 for the expert category, and interview number 11 for the expanded expert category, and this approach is designed to optimise sampling based on the current literature guidelines

(Hennink & Kaiser, 2022). This also aligned with literature on the application of the Delphi methodology which suggests that 15–20 participants may be sufficient (Hsu & Sandford, 2007).

Table 5.1

Pilot Interview Information

Pilot Number	Role	Category	Gender	Location	Date
<i>Pilot 1</i>	<i>Psychotherapist</i>	<i>Expanded Expert</i>	<i>F</i>	<i>IE</i>	<i>March 10th 2022</i>
<i>Pilot 2</i>	<i>Researcher</i>	<i>Expert</i>	<i>M</i>	<i>IE</i>	<i>March 22nd 2022</i>

Table 5.2a

Demographic Characteristics and Roles of “Expanded Expert” Group

<i>Name</i>	<i>Age Band</i>	<i>Gender</i>	<i>Country</i>	<i>Profession and Role</i>
<i>Melanie Labor (EE1)</i>	<i>30-39</i>	<i>F</i>	<i>IE</i>	<i>Postdoctoral researcher on topic of supporting Independence and enhanced quality of life among ageing populations</i>
<i>Hiten Chojer (EE2)</i>	<i>20-29</i>	<i>F</i>	<i>PT</i>	<i>PHD Student and Poet</i>
<i>Liam Cantwell (EE3)</i>	<i>40-49</i>	<i>M</i>	<i>IE</i>	<i>Programme Manager Limerick Sports Partnership</i>
<i>Sarah O’Malley (EE4)</i>	<i>30-39</i>	<i>F</i>	<i>IE</i>	<i>GoGreen Routes City Lead in Limerick and Researcher</i>
<i>Anonymo us (EE5)</i>	<i>30-39</i>	<i>M</i>	<i>IE</i>	<i>Horticulturist</i>
<i>Conor O’Brien (EE6)</i>	<i>70-79</i>	<i>M</i>	<i>IE</i>	<i>Retired Farmer</i>
<i>Connie Neill (EE7)</i>	<i>40-49</i>	<i>F</i>	<i>IE</i>	<i>Community Development Worker</i>
<i>Joanne Hanrahan (EE8)</i>	<i>50-59</i>	<i>F</i>	<i>IE</i>	<i>Ecotherapist and Psychotherapist</i>
<i>Owen Wiseman (EE9)</i>	<i>20-29</i>	<i>M</i>	<i>CA</i>	<i>Medical Advisor; Naturopathic Doctor</i>
<i>Anonymo us (EE10)</i>	<i>40-49</i>	<i>F</i>	<i>IE</i>	<i>Educator</i>
<i>Oscar Alvarado (EE11)</i>	<i>30-39</i>	<i>M</i>	<i>NL</i>	<i>Programme Manager</i>
<i>Katia Hueso-Kortekaas (EE12)</i>	<i>50-59</i>	<i>F</i>	<i>ES</i>	<i>Nature-Based Kindergarten Practitioner and Lecturer in Biological Science</i>

Table 5.2b

Demographic Characteristics and Roles of “Expert” Group

<i>Name</i>	<i>Age Band</i>	<i>Gender</i>	<i>Country</i>	<i>Profession</i>	<i>Citations* (h-index)</i>
<i>Eleanor Ratcliffe (E1)</i>	<i>30-39</i>	<i>F</i>	<i>UK</i>	<i>Lecturer in Environmental Psychology</i>	<i>2347 (19)*</i>
<i>Holli-Anne Passmore (E2)</i>	<i>50-59</i>	<i>F</i>	<i>CA</i>	<i>Professor, Researcher</i>	<i>6086 (31)*</i>
<i>Anonymous (E3)</i>	<i>50-59</i>	<i>F</i>	<i>US</i>	<i>Professor</i>	<i>10069 (19)*</i>
<i>Ryan Lumber (E4)</i>	<i>30-38</i>	<i>M</i>	<i>UK</i>	<i>University Lecturer (Psychology)</i>	<i>1606 (10)**</i>
<i>Kirsten McEwan (E5)</i>	<i>40-49</i>	<i>F</i>	<i>UK</i>	<i>Researcher</i>	<i>10565 (46)*</i>
<i>Anonymous (E6)</i>	<i>40-49</i>	<i>M</i>	<i>NL</i>	<i>Professor</i>	<i>5151 (33)*</i>
<i>Samantha Friedman (E7)</i>	<i>20-29</i>	<i>F</i>	<i>UK</i>	<i>Lecturer in Education</i>	<i>314 (7)*</i>
<i>Ross Cameron (E8)</i>	<i>50-59</i>	<i>M</i>	<i>UK</i>	<i>Academic</i>	<i>4924 (30)*</i>
<i>Alexia Barrable (E9)</i>	<i>40-49</i>	<i>F</i>	<i>UK</i>	<i>Researcher</i>	<i>1427 (17)*</i>

*Sourced from Google Scholar, ** Sourced from ResearchGate

5.2.3 Procedures

5.2.3.1 Recruitment

A dual technique was used to recruit participants for this study, dependent on the category of expertise they were assigned to. Those on the expert panel were recruited through a systematic search for papers using the keywords ‘nature connectedness’, ‘nature relatedness’, and ‘human nature relationship’. Using software such as Scopus and researchrabbit.ai, a list of the top cited authors who have published in these areas were collated and contacted by the principal investigator of the study. Those who were interested in taking part were emailed an information sheet and invited to contact the researcher for next steps.

The expanded-expert panel were recruited through snowball sampling via a social media recruitment campaign to find interested parties (see Appendix M). The recruitment post was shared via researchers' social media platforms (LinkedIn, Instagram, Twitter [now X]) looking for interested parties to reach out for more information.

5.2.3.2 Screening Survey

A screening survey took place for all participants, via Qualtrics software, to ensure that their job or hobby aligned with the expectations for their respective category of participation. All participants were asked to provide information on their career or hobby, and expand on how nature played a role in that. They were also asked to complete two measures, the six-item Nature Relatedness Scale (NR-6; Nisbet & Zelenski, 2013b) to assess each participant’s level of connection to nature, and the Self-Report Index of Habit Strength (Verplanken & Orbell, 2003) to gauge their pro-environmental habits. Both measures were previously used in Phase One of the research (Chapter 4). The main

purpose of these measures was not for analysis, but rather as a start point for the interview discourse.

In this screening survey participants also gave their consent, including a digital signature after reading a detailed information sheet. Participants were offered the opportunity to waive their anonymity. Given that many experts would want to share their views they may also wish to be identified with their opinions. It was considered that there may be aspects of the discussion which could link their work, and intellectual property to the findings of this study rather than their independent work. Ethical approval (SSREC approval no. 2441635) facilitated this flexible approach to the interview in terms of anonymity. For ease of reading in this thesis the illustrative quotes are not accompanied by the individuals name, however the tables 5.2a and 5.2b outline the participant characteristics, including the names of those who waived their anonymity.

5.2.3.3 Interviews

All interviews took place between March 2022 and January 2023. The study used a semi-structured interview method to augment the traditional Delphi rounds. Based on the previous literature (see Appendix H; Donnelly & MacIntyre, 2019) the interview schedule underwent minor refinement based upon the results of the two pilot interviews.

All participants were given the opportunity to ask questions or withdraw consent prior to the interview beginning, or after the interview took place. All interviews were conducted in English. Three interviews took place in person while the other 20 took place online via Microsoft Teams (Classic Version 1.5.00.22362). This was dependent on the participant's preference and availability. Each interview was audio or video-recorded with the participant's permission: in-person interviews were recorded using a Voice Memo app on an iPhone 12 mini, while online interviews were recorded via the Teams

platform. Once the interview took place any recordings in video format were transformed into mp4 files for transcription, and the original video deleted.

Interviews covered questions on the participants' experiences and perspectives related to nature connectedness and the elements that play a role in building a relationship with nature, and varied in duration from 45 minutes to 98 minutes.

5.2.3.4 Analysis of Interviews

A hybrid reflexive thematic analysis approach was taken in relation to the analysis of this data (Braun & Clarke, 2022, 2023; Fereday & Muir-Cochrane, 2006; Swain, 2018). This was conducted using MAXQDA Pro software. The goal of the analysis was both to identify themes grounded in existing theory and to uncover new patterns in the data. The analysis was conducted using the six-step reflexive thematic analysis guidelines (Braun & Clarke, 2022), which include becoming familiar with the data through multiple readings of the transcripts, noting new concepts, and iteratively refining codes into higher-order themes, before writing up the report (Figure 5.3). While Braun and Clarke's (2022) guidelines are deemed inherently inductive they can be combined with deductive approaches to allow for a more in-depth analysis of the data (Fereday & Muir-Cochrane, 2006; Naeem et al., 2023). When conducting step two of Braun and Clarke's (2019, 2022) guidelines a dual process of collaborative coding took place in which the researcher and a supervisor worked together to code the data. The coding was broken up into two independent rounds:

1. **Deductive coding:** The first round of coding applied an initial coding framework based on the interview questions and relevant literature (Crabtree & Miller, 1999). Preliminary codes were discussed by the research team and due consideration of

the interview questions and topics informed some of the early decision-making on coding (see table 5.3).

2. **Inductive coding:** The second round of coding involved the researcher engaging in a bottom-up approach to coding where themes were identified directly from within the data.

In keeping with the reflective thematic analysis deductive coding was completed prior to the inductive coding as the researcher was attempting to minimise the added bias of prior theoretical knowledge that would naturally interfere with the interpretation of findings (Braun & Clarke, 2022). In developing the interview schedule extensive searches of literature were conducted to find thematic topics to discuss in the interview. By conducting the deductive approach to the analysis first the researcher is acknowledging that the pre-existing knowledge would otherwise interfere with the inductive analysis. This is an attempt to get the most meaningful understanding of the data from the bottom-up approach. Table 5.3 outlines the expected deductive codes and how they transformed after the inductive coding process. The full coding structure, including the unexpected inductive codes can be found in Figure 5.4.

Figure 5.3

Braun and Clarke's Six-Steps of Reflexive Thematic Analysis (2022)

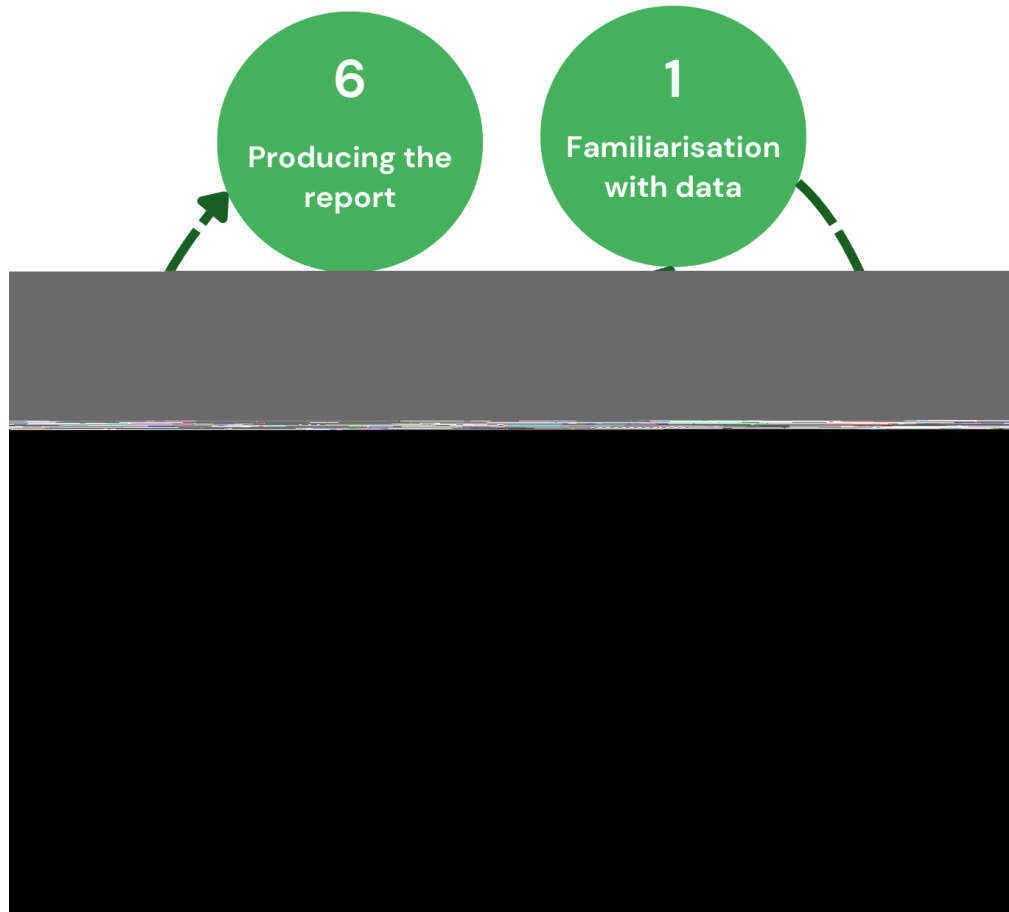


Table 5.3*Deductive Code Transformation*

Expected deductive code	Transformation of code following review post inductive process
Nature	Definition of Nature
Nature Connectedness	Emotions, Identity
Development	Adulthood, Childhood, Parenthood
Attachment	Longing
Affinity	Longing, Emotions
Empathy	Empathy
Knowledge	Familiarity
Trait v State	State v Trait
Place	Household Nature, Local v Foreign, Rural v Urban
Pro-Environmental Behaviour	Concern
Barriers	Barriers
Disconnect from Nature	Disconnect, Risk
Memories	Digital Support, Longing

Once the coding was complete the researcher reviewed the codes to find themes among them before reviewing the themes with other members of the research team. This was not a linear process and involved some iterative movement through steps 2, 3 and 4. Following the review of themes the researcher progressed to the step of defining and

naming them before writing up an initial report (Murphy et al., 2024). Throughout the whole process the researcher kept a reflective journal keeping notes of their experiences and reflections throughout the research journey and to keep track of any potential patterns they identified during the interview. A sample of excerpts from this are shared in Table 5.4 to give some perspective to the reflective process.

Table 5.4

Excerpts from Reflective Journal

Stage of Research	Journal Entry
Interview with an expert.	<i>“That was simultaneously terrifying and exciting. I am so glad I got over the hump of the first official interview. I really hope [they] enjoyed that as much as me. It was so refreshing to talk to someone who felt the same pressure to be a better environmentalist but just does not have the motivation to do so. It was quite reflective for me to have this conversation with another researcher. If this is what every interview will be like then this will be a breeze!”</i>
Interview with an expanded expert.	<i>“WOW! What a privilege to have someone open up about their experiences in the way [participant] did! I feel a lot of emotions after that. I hope I did not influence the flow of conversation too much and still managed to get to the core of the topic. I started to enjoy that conversation too much and momentarily forgot I was doing this for research purposes. It was very crazy to see someone associate nature with such stark moments in their life. I forgot how lucky I am to have had such positive experiences of nature but I guess I can think back to some negative moments also. Remember the insect that bit me on the forehead the night before a presentation? That wasn’t a positive experience.”</i>

Table 5.4 (continued)

Stage of Research	Journal Entry
Interview with an expanded expert.	<i>“I’m sorry to my Uncle Gerard but I may have a new favourite farmer. This man is amazing and such an inspiration. I went into this with a bit of a bias seeing as he is a farmer from[placename]. I just expected the stereotypical conversation I have with most people in farming. I wish I could have spoken to him for another two hours. His views and understanding of the Irish culture and the link to nature is fascinating. I had not even consider the Irish culture to be somewhat indigenous and that intertwined with nature. Maybe he should be doing this PhD? I really hope something similar comes up in another interview. God he really just made me develop a new level of respect for my family and their expertise on the sea and land.”</i>
Interview with an expert.	<i>“I really hope they didn’t notice my red eyes from crying before this one. I have had so many pain free days I truly forgot how bad the pain filled days could be. It was really tough to keep going. But I survived!! The interview did get off to a rocky start but thankfully [participant] was such an open person who seemed to want to tell me everything off the bat without needing to dig any deeper. I’m really lucky. That definitely wasn’t the best interview from my end. I’m actually really disappointed with myself. I feel at times I may have seemed disinterested but I just could not concentrate today. I’m not going to pretend I remember much from this one, I’m just happy I even remembered to press record!”</i>

Table 5.4 (continued)

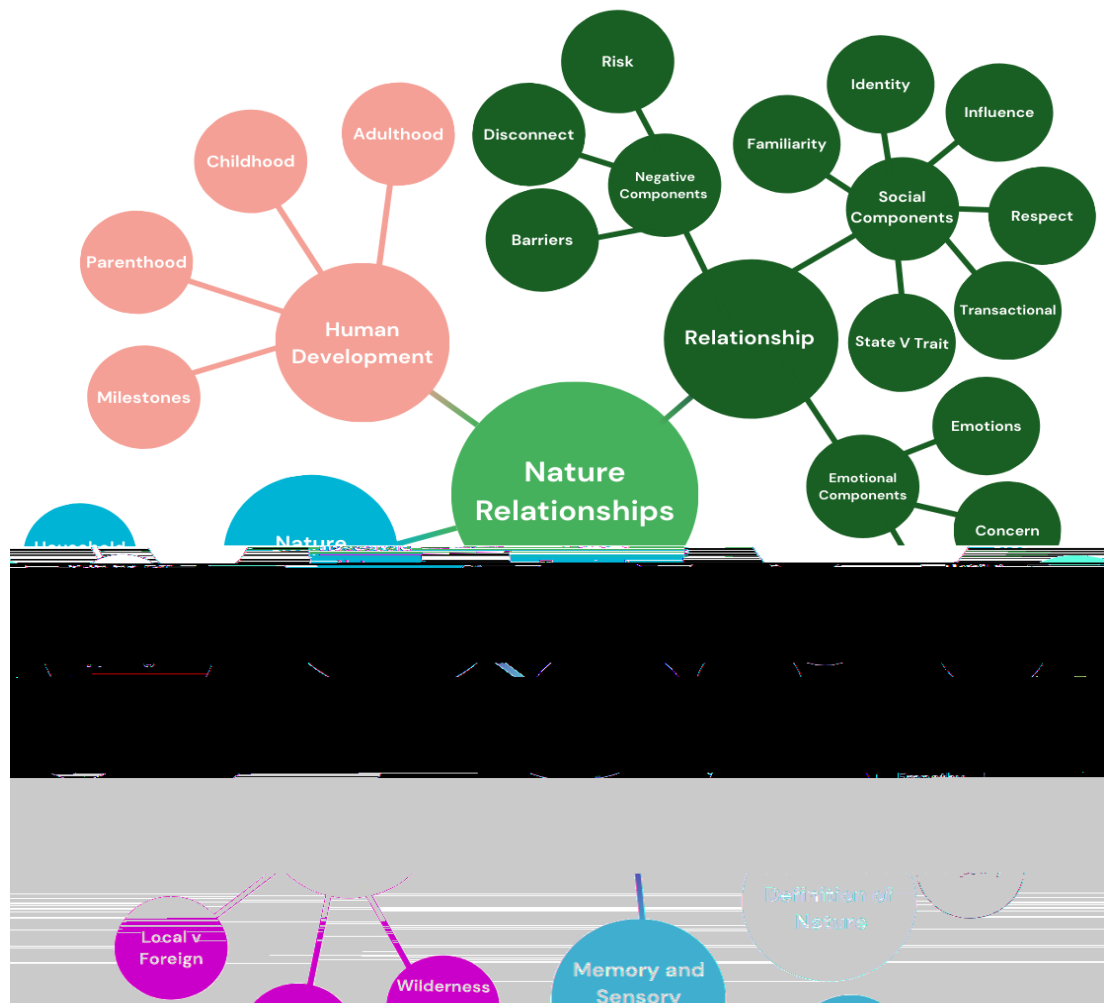
Stage of Research	Journal Entry
Transcription	<i>“I can’t do this anymore. I hate the sound of my own voice! Why do I say ‘ahm’ so much? How are the participants not distracted? I really hope this is the worst part of the PhD!”</i>
Coding	<i>“Seriously what were you at? How have you managed to have a code that says value and values at the same time? And why do they have such different meanings? Maybe it is time to step away for a few days before you go crazy. Some of these codes are really interesting but I don’t think I’m really getting to the heart of what the participant is trying to say. Maybe I need to go back and listen again. I’ve forgot about half of these conversations are about. I’m not going to do justice to my participants’ experiences if I don’t just take a break!”</i>
Reviewing Themes	<i>“It is so cool to see these come together now! Wow - I’m actually really proud of this. God why have we been talking about ‘connectedness’ all this time. That is such an intense statement. It’s in no way reflective of my own experience with nature! I can see myself in these ideas. I wonder if that is a bad thing? But I guess there’s some themes I don’t personally have an experience with. Maybe I’m just so stuck into these that I can’t see anything different now? Or maybe I’m just overthinking this now.”</i>

5.3 Results of Interviews

Following the hybrid thematic analysis of the 23 interviews, five key themes were identified within the data. These were Relationship, Human Development, Typologies, Memories and Nature Definition. The theme of Relationship had three subthemes including: Emotional Components, Social Components and Negative Components. The thematic map can be found in Figure 5.4. The following section will provide detailed accounts of the findings, complemented by illustrative quotes from the interviews.

Figure 5.4

Coding Structure with Key Themes from Participant Interviews



5.3.1 Relationship

The first theme that was identified within the data was the conceptualisation of the connection between humans and the natural world, and the resemblance between a human's relationship with nature and the relationship they build with other human beings. Similar to within human-human relationships, there are multiple layers to the dynamic. It requires contact, mutual understanding and an acknowledgement of the other party's limitations. As discussed in the literature review (see Chapter 2), much of the research on the topic of human-nature connections highlights the positive implications of this phenomenon, however, for the participants in this research that was not the reality all the time. Many identified the number of risks and barriers that exist within the relationship for both the environment and the human. However, the general consensus lay in the similarities to our conceptualisation of human-based relationship, including social and emotional components, with Expanded-Expert 1 even relating it to the concept of attachment: *"But is it, is it an attachment when certain encounters with nature, make you very happy and others make you quite sad?"*

The identification of this relational value existed in both experts and expanded experts. One expert specifically referred to an unpublished study in which they found a similar concept in which we find connection to specific spaces, something they also experience in their own life. While the 'Expanded-Expert outlined the structure of the relationship in which communication, mutual respect and a sense of being equal are vital to the dynamic.

"...one of the papers that I collected data for but never published was about uhm... the relationship we have with nature being in some ways similar to the kinds of relationships we have with people. And, uhm, and I think we sort of imprint on certain landscapes. So for example, I was born in North Carolina and my first camping trips were in the Blue Ridge Mountains and, so there are certain natural environments, the way I talk about it is they make my heart sing." (Expert 5)

"Yeah, I think more on the relationship side... that there's a communication, say, between me and the natural world, which could be plants, which could be animals, which could be, I don't know, a rock formation?! And I think what I've been, when I think of nature or even a relationship where I'm not a part of it, but us as humans and nature on the other side, like I feel it should, like in a normative sense, it should be something where we are all much more equal than we are, and where us as humans don't dominate, which we

completely do. So, in my ideal little universe, you know, we would be much more respectful.” (Expanded Expert 1)

This theme is supported further by the three linked subthemes. The first being the *emotional component* that exists within the relationship. This describes participant’s understanding of the link between emotions and their relationship, but also the dynamic that having empathy for nature and a want to care for nature add to the relationship. The second subtheme refers to social components of the relationship including the transactional dynamic of the relationship and the need to show nature respect, the role this plays in individual’s identity, how familiarity, society, culture and other people can influence the relationship and finally the topical debate around if this a state or a trait for individuals. The final subtheme related to some of the negative components that are present in this dynamic including barrier to accessing and engaging with nature, the concept of disconnection from nature and identifying the risks that exist when engaging with nature. Each subtheme will be explored in some more detail.

5.3.1.1 Emotional Components

The more affective and emotional components of experiencing a relationship with nature were discussed by the participants, many of which are not always positive. With the increased discussions around individuals experiencing a loss of connection with the natural world it was unsurprising to see many experts weigh in on this. One participant offers some insight into the emotions experienced by saying *“you don't really notice the disconnect until you get a taste of being reconnected. And then there's like this grief, loss, sadness response that people have”* (Expert 7). When lacking contact and engagement with others you begin to experience a sense of loss and sadness, not because you suddenly do not like the person or do not feel connected to them, but more so an acknowledgement of the connection you do have with them and the need for interaction

“Just like if somebody you haven't seen for a while, and then you see them and it really makes you realise, yeah, I really do like you. You always liked the person. And you always know that, but it's different when you see them in person. I think of it that way, it's just it's another kind of relationship.” (Expert 2)

Expert 5 also discussed the overlap between these negative emotions and sensations of empathy or concern, specifically when you feel connected to the natural world, *“ you know, think about the pain of animals or the pain of ecosystems, look at a,*

you know, a dried up field or a river that's running dry, and feel like, ooh, that that hurts." The experience you encounter by creating a relationship with the natural world will lead you to feel the pain from the degradation of our spaces and often urging people to take action and protect it. However, the reality of these negative emotions is emphasised through another participant's description of their personal experience of eco-anxiety:

"I can get very distressed and think, 'Oh, my God, what are we doing?' And, you know, I have had times where I find myself in floods of tears thinking, 'Oh, Jesus, like it's all too much. It's hopeless. I'm never gonna be able to make any change. You know, it's too big.' So that is very overwhelming for people and often people are trying to be activists because they're trying to do something and that's fine but they mightn't have actually ehm really integrated that fear or settled that fear in their own system... the environmental movement sometimes can be too much, in my opinion, too much around fear-mongering... It's connection that works, not fear." (Expanded Expert 8)

For others these conversions around the overlap between pro-environmental behaviours and relationships with nature can lead to experiences of emotions that are linked to guilt, and consideration that you are not doing enough for nature, or that nature would be better by eliminating the humans who occupy it.

"I suppose one area which I feel like a hypocrite is I don't think I behave very sustainably... I don't always avoid flying. I don't always make choices that I feel like an environmental psychologist should make. I do quite well at the recycling. But like, there are other things which I fail at. So I suppose that, like, in my personal life, I don't behave like somebody who thinks that the environment is really important, even though it's my job. So I feel like I'm a bad environmental psychologist basically... I probably feel like I relate to nature poorly as an overall concept, but there are things about it that I love, very specific things." (Expert 1)

"I've just tried to sort of comfort myself with the thought that one day larger species like humans will become extinct and the world will be a better place without us." (Expert 7).

While these negative emotional components exist for many, especially given the media coverage and discussions about climate change and environmental destruction, many participants highlighted the more positive emotions that they experience within this dynamic. Another participant demonstrates how the relationship can bring a sense of peace and calm when they state *"I feel that my relationship with nature is cruise altitude, it's kind of calm, it's nice. I enjoyed nothing really intense, except for specific situations.*

But otherwise, it feels like home, it feels really calm” (Expanded expert 11). Other participants from outside academia supported this experience of a sense of calm that comes from the relationship.

“...it's, again, for me, it's that feeling, it's that, it's the calm, it's the serenity that when you're alone, when you're, you know, in that space that there's nothing else and if you can connect with that there really is nothing else cos it's just you and the woods or whatever.” (Expanded Expert 3)

“I could always feel this sense of calmness, leaving the lake that would stay with me for a number of days. And so even unconsciously, I think many of us know, I feel I feel better when I'm engaging with nature.” (Expanded Expert 9)

Throughout the interviews there was reference to feelings of awe and curiosity when immersed in the beauty and power of nature. Oftentimes the positive emotions the participants felt were too powerful for them to fully communicate to the researcher what they experienced.

This showcases the intensity at which a relationship with nature can vary and the variety of emotions you can encounter, similar to the variety of emotions you encounter when forming bonds and relationships with other human beings.

“I feel most connected to nature when there's a sense of curiosity of wonderment. And I know we've seen a lot of research on awe. But there's just such an innate curiosity with being in the woods for me... I just find there's such a natural curiosity that gets invoked when you enter an environment like that, that it's powerful.” (Expanded Expert 9)

“There was this very huge Sandstorm coming towards us... the sky became just as black last night, and then it started pouring with rain at once... So I was, wow. This was so powerful.” (Expanded Expert 11)

“I was on a trail run in the autumn and we're in this gorgeous forest, just south of Newcastle and I said to my friend I was running with and I was like, oh my gosh, this, like, I was just feeling so much joy, like just bubbling over with joy because it was just gorgeous.” (Expert 8)

“it was incredible, I would say it was it just made me so happy. Little Ducks and lily pads, and (slight pause) there was a great sense of achievement... and yeah, it's just, it's really hard to put into words, but it's something that gave me so much pleasure to be in that place, in this blue environment.” (Expert 1)

5.3.1.2 Social Components

Alongside the emotional components participants experienced in nature, many identified complimentary social elements that contribute to this connection. In particular the importance of maintaining a sense of familiarity and level of knowledge about nature is to be highlighted. This is similar to how we develop relationships with other human beings. We cannot create a deep connection with others having little engagement and without gaining knowledge and deepening our understanding about them

“I think that people can feel very connected to nature and have a deep sense of connection to the, beyond human natural world. And have it, ahm, I think it's like a layer on top of it when it's something you're familiar with. I think that adds a whole layer of meaning and familiarity, and probably a real sense of connection to it. Because you are now getting all those other kinds of aspects of home, assuming that one home is a good thing.” (Expert 2)

However, one participant raises the point of how being over familiar with nature may actually cause problems for individuals' relationships: *“...there are certain things that we know are disconnecting people. Knowledge was one. So, you know, focusing purely on facts may potentially lead to that.”* (Expert 4) This raises a question around the proposed use of educational tools to help create connections with nature, and the potential links to eco-anxiety.

This level of familiarity expanded to individual's experiences in nature, specifically when solo. Despite being physically 'alone' in a wide-open space. This bond that is created manifests as a connection between human and nature in which they feel like they are connected to something larger and can become attuned to the signs of life in the space. This brought about a feeling of belonging and safety for the participants. Expert 7 specifically states that *“...it's somewhere that's safe to be in and just comforting and soothing”* while expert 8 highlights that specificity that *“nature doesn't judge.”*

Participants' accounts of this sense of comfort and safety in nature offers resemblance to companionship in human relationships, where individuals can sit together in silence within the same environment yet still experience a sense of connection. Participants suggested by simply existing beside nature that sense of connection and belonging.

"I spend a lot of time on my own in nature... I don't feel lonely when I'm in nature either."

(Expert 7)

"I remember saying that, you know, somebody asked me if I was lonely. And I was like, well, no, I mean, I go for walks in the river valley spend my weekends going for walks in the river valley and there's trees, and they're squirrels and there's rabbits, and there's coyotes..." (Expert 2)

"...the research was about trying to demonstrate that, um, that exposure to nature could fulfil the need to belong." (Expert 5)

When expanding on this idea of feeling like you belong in nature, many participants highlight some opposing views when it comes to finding identity with nature. Despite the commentary in Chapter 2 around feeling a sense of oneness with nature many of the participants identified a struggle with defining nature as part of who they are. For some it was a companion beside them which they shared a variety of moments with, and for others they struggled as they perceived their impact on the environment as negative and struggled to comprehend being a part of something you are actively destroying.

"people consider nature important to them, you know, it's in the same way as I might say, my job is important to me, or my relationships are important to me. But maybe there are people who would disagree with me, because by saying that I'm positioning nature is something that is outside of you, but it matters to you. Whereas some people might say,

no nature is, is within me, I am, I am from the natural environment also. I suspect that is not me, I consider nature something that is separate to me.” (Expert 1)

Similarly, a non-academic participant echoed this view about the extent to which we see ourselves as integral to or distinct from nature.

“I know, there's like, there's a lot of sort of, I suppose, talk around how we should see ourselves as part of nature. But I feel we can't really where we are. Like, I wouldn't consider myself so much as part of nature, I'd be considering myself more contributing to the destruction of nature... it's very difficult to live your life and feel part of nature.” (Expanded Expert 7)

“I would consider myself connected to nature because this is, you know, what I do, like I believe in it, I believe in the value of nature... But I'm not sure that I include nature in my description of self, if that makes sense. So maybe I'm not connected to nature by that sense. I think of nature as something I'm really interested in and a place where I feel happy and often at ease...” (Expanded Expert 8)

These illustrative quotes showcased that there may be a gap in the literature when it comes to the measurement of this concept. For many a feeling of being “connected” is not the same as incorporating nature into one’s self-concept. Participants can value nature, work with it professionally and experience it as emotionally supportive, while still not incorporating it into their own identity. However, for others this idea of nature being connected to your sense of self was still strong. This highlights that it may play a role but is not a defining factor in the conceptualisation of the ongoing relationship.

“I try to include people within my definitions of nature, because I'm very conscious that often when we define it, especially in research studies, we tend to exclude people... quite frankly, kind of really everything is nature... it's very difficult for us to kind of separate ourselves and everything that we do... because we're still natural creatures.” (Expert 4)

"I would define nature now as being much, as more, all encompassing... now nature is the air we breathe, the sky above me, the earth below me... so it's everything. It's the food we eat. It's the weeds that grow in the cracks. Ahm, so it's me. I'm a living being... it's all of us inhabiting. All of us, human and non-human, other than human inhabiting." (Expanded Expert 8)

In developing one's identity it opens the conversation around where we see ourselves within the grand social scheme of the natural world. There has been a shift for society to reject a utilitarianism view of nature, where we only benefit from nature and to adapt a healthier transactional understanding of nature with equal give and take, encapsulating a sense of value and respect for the natural world.

"Almost, nature is something that we gain from rather than we have this relationship with it that's like nearly every relationship, every healthy relationship where you give and take, but we see it, we constantly need to take." (Expanded Expert 1)

"I remember my dad saying to me, you don't cut it from the root, you just cut the leaves so that it grows again, you know, this is a little, this is how this work. So I knew how to recognise the bulbs and you could take the bulbs, but you wouldn't take more than one, etc. So you know, that kind of almost relationship and sustainable relationship with nature rather than - Yeah, completely utilitarian." (Expert 9).

Another element that will influence how we interact and communicate with nature is the external influences. This was a topic that participants consistently returned to throughout the interviews, with many referring back to the role culture plays in our conceptualisation of our nature and the relationship. The Expanded Experts gave examples of the role of language in nature and how this is heavily influenced by culture. Expanded Expert 4 specifically explains how diverse cultures sometimes are not accounted for in the extant research literature.

"...I was at a lecture... about the Irish language. And... when the Irish language was going, the person who was getting the farm, the eldest boy was taught Irish... because that's how the knowledge was passed on. If a cow was sick... it's important that you know

the word to describe what the cow is. So when we lost the Irish, did we lose a lot of that? Because we didn't, after that it was functional.” (Expanded Expert 6)

“we don't embrace it. Ahm we just complain about ‘Oh, the dark evenings are coming in’, as opposed to, and there is some change gradually, slowly coming in around people trying to, even on social media, recognising Samhain, or recognising the Celtic experience of season. And that's helpful. I mean, everything that, you know, starts to, but we don't embrace the wintering or the idea of rest or that this is the season before thing, the birth, you know, the, and understanding that. Ehm, and that that's all okay. We don't need to be on the full speed, full bloom (laughs), all the time.” (Expanded Expert 8)

“There's that Biophilia hypothesis... I would argue that that doesn't necessarily take into consideration culture. So cities have existed for hundreds of years. And there could be people in cities that are very in tune with pigeons... or fishing community... that they're in any less in tune with what is going on in their nature just outside than people living in rural Ireland.” (Expanded Expert 4)

A participant who grew up in Canada spoke about their experience moving to Lima in Peru and how the dynamic of their relationship shifted due to the different expectations for nature. Similarly a participant spent some time living and teaching in Finland after growing up in the UK and discussed the difficulties they experienced in this transition.

“In Lima, there's just less nature to go visit... we lived in a small town [in Canada]. So forest is just there. The coast is just there. And [in] Lima... there is a coast, but I never viewed it as nature, I guess... parks... are all a little bit like manicured... So definitely, it changed with going to Peru.” (Expanded Expert 12)

“students from Hong Kong were saying that they felt quite scared in the Finnish nature, because it was so wild and so remote, and the nature they were used to in Hong Kong was very constrained.” (Expert 1)

Other participants highlighted some wider societal influences with regard to a relationship and bond with nature. In particular politics, the COVID-19 pandemic and the overuse of technology, especially in the day-to-day environment.

“And I think, with sort of all the current existential threat around sort of cost of living crisis, Brexit, COVID, wars, I think people have got other priorities like they've got um their sort of primary needs are not being addressed. So would they then consider

disconnection to nature to be an issue even? Probably not, they're probably more focused on being able to survive.” (Expert 7)

“If we go back to the idea of a social relationship. How do you best develop a good, close social relationship with somebody? You talk to them, you spend time with them. Once that’s established, you might use technology to help connect.” (Expert 2)

Yeah, I would say that, in general, screen time is the enemy. You know, we work, we all work jobs where we have to spend, we’re meant to spend eight hours a day staring at a screen, which it just sucks. And then I’m not on social media but I know a lot of people who are and they’re just constantly in their phones. And I think it is the sort of enemy of being connected to or mindful about anything” (Expert 7)

5.3.1.3 Negative Components

Expert 5 highlighted the true complexity of the phenomena of human relationships by stating that *“I think it’s really important is, so, nature isn’t always our friend, right? So there, there are forces in nature that can harm us. In that they are threatening to our well being.”* This acknowledgement of the negative elements within nature highlights the limitations in our conceptualisation of the relationship. The research has focused primarily on the positive factors but for some individuals they *“basically have a stress reaction, they are not confident that they can deal with this situation that they can, you know, they’re like tense, gonna get wet, I’m gonna be cold,”* (Expert 5)

Attention must be given to the possible hindrance of nature. Like most living beings’ nature is not perfect and involves many risks. Participants argue that we focus too much on ‘the cuddly’ nature or the aesthetically pleasing nature but nature is not always there to please us and can involve fear and disgust. Factors that researchers may associate with a disconnection from nature, however identifying these risks shows a deeper understanding of nature and its complexity. Individuals who identify these risks show respect to nature and understand its limitations.

“ I think being more realistic, I think, ummm, another level of complexity is we're often talking in our world about benign nature, and it being restorative and safe. And I think it is... So I think we need to just – there's a debate to be had about are we always just looking at the cuddly robins and, um, squirrels or is there a place for actually more animals? ... we have to educate the public that nature is not always cuddly, and it's not always lovely, and it's not always benign. ” (Expert 6)

“...there are certain things that we know are disconnecting people... There's also others, you know, feeling like you are superior, or nature is something to be dominated or controlled through that kind of domestic Dominion aesthetic value... and then there's also avoiding nature because it's scary... avoiding certain aspects of nature because it's, it's seen as bad for you... could definitely contribute to a disconnect. ” (Expert 4)

Participants also spoke about the various perceived barriers to nature that may be experienced. This was conveyed in different ways including how our reliance on digital devices has potential to be a barrier as *“you could also ignore nature. I mean, you could be on the top of a beautiful mountain, then if you're staring at your phone. Are you really there?”* (Expert 5). However another participant suggested that the way we describe our relationship with nature is just as much of the issue, as *“when we put these barriers around, like, well, you know, being, accessing nature is good, engaging with nature is better and connecting with nature is the best, we're putting value on that and I think that can end up being a hindrance. ”* (Expert 8)

Both physical barriers to the relationships, ones in which your ability to engage and interact with nature, and wider societal barriers were also discussed by participants. Having a sense of fear or concern can result in isolation from nature with people choosing to avoid it at all costs. However, engaging and educating people on those potential risks is vital to developing strong relational values and developing a deep understanding of nature and your relationship.

“ I actually did have a bad experience going through Phoenix Park on my own when it was dark, and it was not pleasant. And so I think for a lot of people, that is probably a

barrier... If you don't feel safe in that environment, you're not going to go.” (Expanded Expert 1)

“It’s not all beautiful – some of it is dangerous. And again, you know, my kids were growing up, we’re in a forest where we live, they know the dangers of going around in the summer. They know there are snakes... they know the dangers as much as they know the pleasures.” (Expanded Expert 9)

which shape their relationship status at that time. Many identified three specific stages where they noticed shifts: Childhood, Adulthood and Parenthood. Most, if not all participants identified childhood as their period of strongest connection with nature. It was the stage of life in which they could outline more positive experiences and where they believed they had the most engagement with nature.

“...for as long as I could remember, I was one of those kids who just always wanted to be outside and growing up, I had a really awesome backyard that I would spend hours in uhm playing. You know, making up little cities and imaginary worlds... my parents would

"I wasn't in nature much during those years at all. And I felt a big disconnect. So I think that's why when I came back, I needed that back. I needed that piece of myself that I lost."
(Expanded Expert 8).

However, a more positive peak was perceived to happen again in life when individuals enter the phase of parenthood. One participant described it as a *bottom up* approach in which the parents learn from the children and rediscover the relationship they once had through introducing their children to nature.

"I think I'm a firm believer of the bottom up thinking that the kids are mad into these different things you can you get these bug catchers and bat boxes, bird boxes, all these things. And I think that, yeah, the if the parents can see a hunger there, I would say that the children can definitely change the parents kind of perspective on things and win them around." (Expanded Expert 5)

"Ever since I got children that was in back in 2008, I had my first child, I kind of got this emotional connection back again, I wanted to I wanted to provide that to my children."
(Expanded Expert 11)

This reconnect did not only happen to individuals with children, but the peak also occurred at a time of reflection and revaluation for many adults due to a shift in their daily routines. For some this was new work projects, for others it was moving to a different country or identifying signs of burnout and a need to reconnect with nature.

"When I came back to it, it was very conscious. Like, I knew I needed to get out again. I needed the woods, the air. That part of me was missing for years, but I didn't know it until I slowed down... I wasn't well mentally or physically. And it helped me." (Expanded Expert 8)

"When I started doing fieldwork again in my 30s, I had this moment where I thought, God, how did I forget how much I love this? Just being surrounded by all that green and that smell... I think I fell back into it by accident, but it felt like home."
(Expanded Expert 10)

“In Cameroon, I didn’t have much time to think about nature, it was just around me. But when I moved to Europe and started going for walks alone, that was a big shift. I started really seeing nature. I started naming things, noticing.” (Expanded Expert 11)

These accounts reveal that connection to nature is not necessarily a static trait but a dynamic, evolving relationship shaped by contextual factors across the lifespan. Through these perspectives childhood emerges as a foundational period of engagement and discovery within nature, while adulthood often brings competing demands that reduce this engagement, leading to periods of disconnection. However, this sense of disconnection is not permanent with reconnection occurring through parenthood, personal reflection or lifestyle changes that reignited their bond with nature. These patterns highlight the importance of viewing nature connectedness as a process, rather than a fixed state.

5.3.3 Memory and Sensory Engagement

When discussing alternative means of engaging with nature the discussion turned towards digital technology. Expanded Expert 8 stated that *“I think the real thing is better. (laughs) But I do see its place.”* Expert 9 gave examples of ways nature can be integrated into your life through digital means, *“we all have access to a soundscape on YouTube. So, you know, putting on some birdsong and just listening to it and thinking about it and writing about it, or even just doing your maths while you’re listening to it. Ahm there are different benefits, there are different ways to connect.”* However this not the same for everyone. Expanded Expert 8 shared an alternative perspective in that *“if you’re watching a nature documentaries, like Blue Planet, for example, it doesn’t make me feel connected to nature. I mean, I appreciate it. It’s pretty interesting. But it doesn’t make me feel connected to an elephant, for example, or like a, I think jumping spiders are pretty cool. But I think what makes it feel connected if you actually [are] close, or at least, I feel more connected to it through actual encounters...”*. However, these are only substitutes when

a nature experience is inaccessible as with many participants highlight their perceptions of this being a hindrance to simple engagement. Expert 2 stated “*with nature people tend to use, ‘well, then we can look up this app, and we could take a photo of that’ ... I think it mostly just gets in the way.*” The goal with technology as a means of exposure is to heighten the experience, by collecting means to invoke memories of nature experiences or to act as a short term alternative to in-person exposure, not to be used as a permanent substitute,

Alongside the importance of memories, engaging your senses was highlighted as a vital element for many people in creating a relationship with nature. They allude to this sense of safety, grounding and calmness that comes from engaging your senses helping you feel more connected. Interestingly for many participants this description of experience did not happen within nature, but rather as a way of evoking memories of their previous experiences.

“I recently put a jar of sand beside my desk where I work at home, just so I can touch something. So that's, I think, to me, that's my way of connecting with something grounded, which is what that outdoor space does provide for me.” (Expanded Expert 4)

“I would like to calm myself down many times. And one of the things that I do is I try to imagine that experience that I had. It's not a complete experience, like you just brought up for the you know, it's like I'm using it to be at a place which made me feel safe. And I'm not even having any virtual experience around me. It's just my imagination... I sometimes listen to very nice playlist that I made with(eh), with some music that I like, which is piano with sounds of ocean. So that helps, you know, so it's already going in to what you said about adding, well, this is just the sound. And then if you are the visuals, it can work probably even better.” (Expanded Expert 2)

“...I do remember from our kitchen window, you could see the trees of that woodland just swaying and you could hear them. And I remember, that was kind of like, it's the one thing that made me feel safe in my home was that sort of sound and being able to see it, as well. And the sound of the geese flying over every night as well, while I was in bed made me feel really safe.” (Expert 7)

All five senses were spoken about by the participants (Table 5.5). With each proving to be important to engagement. Expanded Expert 12 even stating that all of the senses are important when trying to feel connected: *“uhhh, in as many senses as possible. To feel it, to be barefoot, with your feet in the grass or the dirt. To smell it. Ummm, (pause), to hear it, to see it, of course.”*

Table 5.5

Illustrative Quotes for Each of the Five Senses

Sense	Illustrative Quote
Sight	<i>“I was amazed by how beautiful it was. The colours, the green of the trees, the sky, it was just so alive”</i> (Expanded Expert 11)
Touch	<i>“Sometimes I just need to go and sit on the ground. Like literally just lie in the grass or put my hand on the tree. That kind of contact is grounding for me.”</i> (Expanded Expert 9)
Sound	<i>“being able to hear the sounds of nature, whether that is leaves rustling or insects, or, um, just being able to connect with it”</i> (Expanded Expert 12) <i>“Even just hearing birds in the morning makes me feel calmer... that sort of quiet noise, you know? That’s really comforting.”</i> (Expanded Expert 7)
Taste	<i>“We also grew little chilli peppers... I remember eating one.”</i> (Expert 9)
Smell	<i>“you know the silence the smells the chilly temperature it was cold in the winter so I guess that might be one of my first memories.”</i> (Expanded Expert 11) <i>“Just being surrounded by all that green and that smell...”</i> (Expanded Expert 10)

These accounts reinforce the embodied experience of forming relationships with nature. Both sensory experiences and emotional memory operate as vehicles for present engagement and even recalled experience. These experiences were especially pronounced

in cases where nature was not accessible to the individuals. In these moments, participants creatively engaged memory or digital tools to reimagine their experiences, affirming the lasting psychological imprint that natural environments can leave, similar to the imprints other humans can leave on us. While digital tools and sensory triggers were acknowledged as imperfect replacements for nature, they served as meaningful substitutes for periods of low contact and engagement.

5.3.4 Definition of nature

Many participants described what nature meant to them in their own words. Some participants described humans as part of the overall nature ecosystem, while others described nature as something larger than them. All reported nature definitions are documented in table 5.6.

Table 5.6*Participants' Definition of Nature in Their Own Words*

Participant	Personal Definition of Nature
Expanded Expert 1	<i>N/A</i>
Expanded Expert 2	<i>N/A</i>
Expanded Expert 3	<i>“(exhales) Well, I suppose anything that is existing naturally in the environment without interference from men. Ahm, or men, from humans. Ahm, yeah, I mean there isn't too much more, or yeah, so I suppose living organisms outside of humans. Ahm but not just that either, that's the animal and the wildlife part but yeah, anything then that occurs naturally in the environment.”</i>
Expanded Expert 4	<i>“I would include us in it. But I don't think actual Nature needs us. So ... So I would probably look at what, what, what grows and what lives without our intervention. I will probably include nature, and we try and manage and harness that for our own benefit. I don't know whether we're a plus overall. So I'd nearly exclude the human element. I think we need it more than it needs us. I think It tolerates us.”</i>
Expanded Expert 5	<i>“Well nature is is everything that you nature is the second you step out the door in the morning, you know, when you get hit by the rain, when you hear birds, when you see trees, when you see grass, when you see the hedgerows, when you see the cows or the foxes or the all those other and everything in between. And that's what I would class as nature, whether it's in your garden, whether it's in a forest, whether it's up a mountain... yeah, that's what probably my rounded view of nature will be.”</i>

Table 5.6 (continued)

Participant	Personal Definition of Nature
Expanded Expert 6	N/A
Expanded Expert 7	<i>“I suppose nature for me would be anything. I suppose anything that's wild that has been there for a while or has just developed out of being put there by other nature kind of thing. Because there's a huge difference, I suppose I talk a lot about the environment or environmental things and environment, if you ask me to define, I'd be more, you know, obviously, there's just a whole environment as in the people around us, the buildings around us, but nature I suppose we don't have too much nature around us anymore, you know, so I was talking a lot about the garden. But if you're asking me for a clear cut definition, I wouldn't consider that garden nature. Even though we're trying I suppose to invite nature back into it.”</i>
Expanded Expert 8	<i>“Yeah. Okay. So, I would define nature now as being much, as more, all encompassing. So the change, like I said, from thinking about ‘I will go away to nature for my holidays.’ Ahm so now nature is the air we breathe, the sky above me, the earth below me, so that's doesn't matter where I am in the planet. Ahm so it's everything. It's the food we eat. It's the weeds that grow in the cracks. Ahm, so it's me. I'm a living being. Ahm so yeah, it's a big picture for me. It's all of us inhabiting. All of us, human and non-human, other than human inhabiting. Ahm and where we inhabit... pretty much everything, like I just see it, everything. You know, the desk I'm sitting at is made of wood, you know, whatever. Ehm, yeah, so it's just o- bigger now than what it used to be for me.”</i>

Table 5.6 (continued)

Participant	Personal Definition of Nature
Expanded Expert 9	<i>“Yeah it's I think because of my upbringing, and me really categorising nature as being outdoors. I, ideally in a forest, but also, in an area that does combine green and blue space, I just think we've really amplified the benefits of both... It's having a buffer from urban environments. That's how I really come to nature where even if you're in Parkette, in the middle of a city, when you feel that sense of removal from an urban environment, and you're far enough away from the urban environment to feel that you can sink into that sense of flow almost in that sense of self... I do have a lot of houseplants... but as much as I see that as nurturing, I view it more as horticulture as opposed to nature therapy.”</i>
Expanded Expert 10	<i>“So I probably can give the big answer, or the one that I mean, one of the questions I get asked is what's biodiverse in its samples of life on planet Earth? But the reality, I would think that nature, like there's parts of nature that we just like, as humans ... if you look at planet earth and space, and you think of it as a functioning ecosystem first, and then you go down to all the different habitats, we're no different than the ants, except that we have a more I probably have more influence... so sometimes I go pretty big with it and kind of go, like, you know, nature is, like, is how we experience the natural world around us... All life on planet Earth, I would look at just how it's working and interacting and how we interact with it, and the natural world.”</i>
Expanded Expert 11	<i>“I think it's part of myself and part of everybody. It's something that is not disconnected from us. It's part of our life. I mean, we are, I wouldn't say even part of nature, we are nature, I mean, we are living beings, we have physiological needs, we have, we need to breathe, we need to drink we need to eat. And that all comes from nature, the air we breathe is nature, the water we bring is nature, the food we eat is nature... it's something that is very, very simple, and yet very profound. It's something that I can't imagine life without, because it's, it's part of everything we do, everything we experience somehow.”</i>

Table 5.6 (continued)

Participant	Personal Definition of Nature
Expanded Expert 12	<i>“It's very funny, because I ask my participants that, too... Exactly. And so what I start off with that question, ‘What is nature,’ and a lot of people give me different answers, and kind of the conclusion is, well, it doesn't really matter in the sense that I'm not going to give you a definition of nature. So whatever you've said, is valid. It's true, because it does differ for everyone. Um, and then it's not, getting a definition of nature isn't really helpful or valuable for the session that comes after. But then I do say, but I will give you a definition of ecosystem because that is something that we're going to analyse and work on. So, if you ask me the same question, ummmm. What is nature to me? Ummm (pause) I can probably give you adjectives that describe what it is. So instead of a definition, but like biodiversity, so having a diverse amount of species, vegetation, plants, animals, insects, present at the same time and like coexistence. Ummm (pause) I know that nature, like human beings are part of nature. So I, in the one sense, I do have this almost romanticised idea of nature as something wild undisturbed, far away from human interference, but I know that, realistically, that nature can also be this park where I'm sitting at next door, so.”</i>
Expert 1	<i>So what is, what is nature to me? Ahh. Greenery features very much obviously, ahh, water is really important to me too. I actually only learned to swim a couple of years ago. And so I mean, this is related (laughing). I learned to swim in the sea, ahm and I know, it's one of the best things I ever did. It gave me a different way of interacting with the environment around me and I was always quite kind of scared of large bodies of water because I didn't really know how to interact with them or just paddle around. Now suddenly, I feel a lot more connected to this part of, of nature. So water seems quite important to me at the moment. Ahm, but yeah, kind of when I'm asked to define nature I find it really hard. It's in lots of places and it can be in really small things like a few years ago, I was just walking down the main road in North London and I saw this tomato plant growing out of the pavement. Like I don't know why it was there. Someone had just dropped a tomato.</i>

Table 5.6 (continued)

Participant	Personal Definition of Nature
Expert 2	<i>Anything that isn't built by a human. And that can range from very local and things that you're next to all the time, or we can say that nature is things in a distance that you never see or rarely see. So things like the rainforests, for example, things like oceans, those are also nature. They don't have to be right there next to you, right. And then of course, when we talk about nature, would also say that it includes things that we don't normally see. So that will include things like viruses and bacteria and things which are all around us that the most part we can't see, but that we have overcome. And I suppose if I try to sum that up in three words, it would be something like nature is the ecosystem around us. The caveat to that is that I think that we are part of that ecosystem. And I think that some particularly some scientists would say that we represent something that's different to all of that. But I think that we're part of nature as well. So we, we are part of that. So we can't say that nature is everything around us that isn't us. But in reality, I suspect that we see nature as being as everything around us, but not what we do. So I think it would be fair to say that human structures are not nature. But that doesn't mean that humans as a species are not nature. That would be my definition of what nature is. And succinctly that it's not a human didn't make it. Doesn't mean that a human didn't influence things that are nature, you could say that for example, bird seed is to a degree nature, because that was made by a human and is now going to be used by nature. But what we tend to call nature is something that humans didn't make. That is very different than us creating it.</i>
Expert 3	N/A

Table 5.6 (continued)

Participant	Personal Definition of Nature
Expert 4	<i>I find that a lot of the definitions of nature exclude people. And that's, that's, that's the real problematic thing, I still think there's a real tendency to have these conceptualizations of nature that completely disconnects humans from the rest of the natural world to which we belong, and we are ultimately all natural organisms, we're not, we're not, we are different. But so, so many other species with remarkable abilities and traits, and whatever it might be. So for me, yeah, this is interesting. I remember I put a definition in my PhD thesis that did include, aside from essentially human made creations, you know, these kind of artificial things, that everything else was kind of fair game, in terms of nature, it is tricky, I tend to kind of point toward people to just examples, more so as an easy way of doing it in terms of, you know, it can be areas of green space. So, you know, a small, a small patch of grass looks like a big national park, whatever it might be. It can be areas of blue space, where, you know, see oceans, a little river, whatever, it could be trees, you know, all the kind of fauna and flora, all that kind of stuff. But also people too, and I try to include people within my definitions of nature, because I'm very conscious that often when we define it, especially in research studies, we tend to, exclude people. [...] But yeah, essentially, it is as long as it's not a human made creation, that is kind of, again, it's tricky, artificial. If that makes any sense. That makes sense to me that, yeah, it's hard to kind of disentangle because, quite frankly, kind of really everything is nature. In all honesty, it's very difficult for us to kind of separate ourselves and everything that we do and all our endeavours away from it, because we're still natural creatures. So it's still part of the world, and it still impacts the ecosystems to which we belong. So it's all kind of part of it. But</i>

Participants' definitions of nature revealed a wide variety of interpretations, reflecting the conceptual ambiguity and personal nuance often associated with the term. Both the Experts and Expanded Experts described nature as something that has no human involvement or "*not built by man,*" While others could not separate humans from the natural environment. Some of the participants who came from more biological backgrounds referred to *living systems* and *ecosystems*. Elements from previous themes also appeared in the definitions including emotions and feelings of *freedom* and *unpredictability*.

Both groups highlighted the difficulty in defining nature due to changing perspectives, with some even deciding to avoid fixed definitions. Expert 4 calls attention to these differences by saying "*...there's a real need to look at different cultural understandings of nature, different geographical locations, how they differ... there's a whole host of things that you need to consider in terms of cultural symbolism [and] associations... So I do think culture is a real big issue.*" Taken together, these personal reflections on what nature means suggest that nature is not a universally fixed concept. It is a social construct that is heavily shaped by experiences and contextual cues. This is an important finding in this research as it raises the questions, what is the research measuring? And what is the 'nature' we expect people to build relationships with and feel connected to.

5.3.5 Nature Typologies

Following on from individuals' definitions of nature, the participants also referred to the different typologies of nature they engage with, which explores deeper into the question *What is nature?* One of the main differences' participants identified was between urban and rural nature. The original aim of this research project was to conceptualise

urban nature connectedness. The interviews however highlighted that there was very little to explore when it came to differences.

“I’ll even get riled by some of the arguments we have in this context of you know, this is urban and this is nature. No, urban is nature. It just happens to be our nature and relates to our physiological and biological needs.” (Expert 6)

“because of my upbringing, and me really categorising nature as being outdoors. I, ideally in a forest, but also, in an area that does combine green and blue space, I just think we’ve really amplified the benefits of both... It’s having a buffer from urban environments. That’s how I really come to nature where even if you’re in Parkette, in the middle of a city, when you feel that sense of removal from an urban environment, and you’re far enough away from the urban environment to feel that you can sink into... that sense of flow almost in that sense of self.” (Expanded Expert 9)

“...for me, nature is these small things that may be quite integrated into my everyday environment, which turns out to be the city because that’s where I live... I find this often quite ironic, because... a lot of the research... is showing people pictures... of these very rural, or at least non-urbanised environments... the hills... But that’s not really my everyday experience of nature.” (Expert 1)

With one participant even stating that they do not agree with the belief that rural residents have more of a benefit when it comes to nature engagement: *“...I’ve spoken to people who’ve grown up in rural spaces... I’m not sure that rural populations have any better access to nature.” (Expert 9)*

Participants discussed more of a sense of preference for certain types of nature over a belief that there are distinct differences in wellbeing or ability to find a connection with the specific space. Participants spoke more about getting more benefits when the space is what you are comfortable in and find aesthetically pleasing. This highlights that the benefit of nature exists in all types of nature.

“I would say somewhere that’s umm fairly unmanaged. So you can’t, it’s not obvious the sort of management plan or human interaction, it’s definitely not somewhere agricultural for me, or managed, it’s somewhere that’s unmanaged, semi-wild, has a sort of decent

level of biodiversity, different habitat types. I think that's what nature is to me... Whereas in contrast, the sort of forestry, agriculture, no, (laughs) not nature (laughs).” (Expert 7)

5.4 Discussion

This phase of the research set out to explore the real-world experiences and perceptions of developing a relationship with nature. The findings from this chapter reveal that the human–nature relationship is a multi-faceted phenomena which is deeply influenced by social context, emotional resonance, and even negative experiences. In exploring these themes, the study drew on insights from two groups of individuals working in human-nature relationships. These consisted of experts and expanded experts. This dual perspective of experiences provides a rich basis for interpretation, allowing for the observation of where scholarly and professional understanding diverge or converge with personal experience. The five themes discussed highlight the true complexity of the concept and highlight some gaps that may be present in the research to date.

5.4.1 Summary of Findings

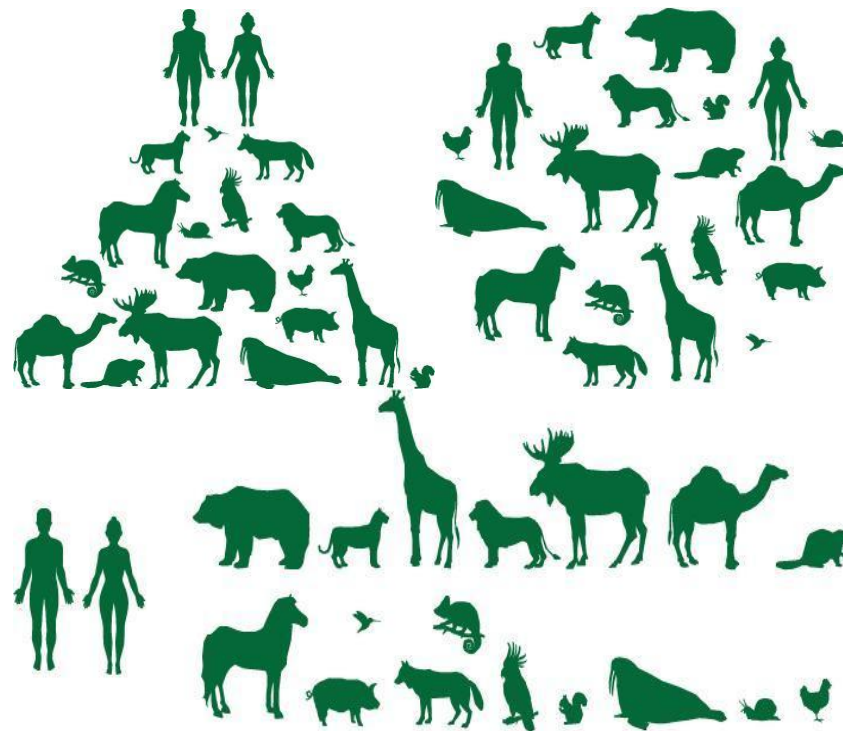
The first important finding of this research is the variability in the definition of nature and participants perceptions. There is no one uniform definition of nature, and the conceptualisation will differ person to person. Findings from this research show that the individuals may even grapple with defining what it means to them, specifically when they begin to consider how others perceive it. These findings support the discussions in the literature in which the role of culture and community is vital to the understanding of definitions of nature (Coscieme et al., 2020; Hartig et al., 2014; Plumwood, 2005). The views of several participants aligned with Naess's (1973) description of deep ecology in which the human describes their position within the ecosystem rather than a more utilitarian viewpoint of being outside of, or even superior to the ecosystem. This was particularly prominent among the expert, research orientated, group. An interesting

comparison can be drawn between the definitions of those in the expert group and the expanded expert group. Experts brought up the conceptual issues and spoke about the nuances of nature, often thinking about how it applied in their research, while expanded experts gave much more definite answers that are personal to them and their experiences. This is an expected finding given a scientific attitude towards nature has existed for quite some time (Kellert, 1993).

Interestingly, no participant identified with a utilitarianist view of nature, however some participants did not align with a deep ecology perspective. Participants seemed to describe an alternative, more united view in which we exist beside nature. A perspective of a *nature adjacent* relationship where they do not see themselves within the ecosystem, but more as a companion to nature. This allows for a more flexible approach in which a person can have both positive and negative experiences or nature, limited contact time and a less spiritual view of the dynamic. Figure 5.5 outlines an illustrative view of this 3rd paradigm within our conceptualisation of nature, relationships and identity.

Figure 5.5

Conceptual illustration of the Human–Nature Relationships



Note. Adapted from the “Ego–Eco” diagram in Lehmann (2019), where the original diagram is attributed to S. Lehmann (2010). Adaptation used under CC BY 4.0.

These differences in individual’s definitions and identities with nature tie in well with the participants’ descriptions of the typologies of nature. Participants highlighted the value of having nature nearby, even in the everyday surroundings (Bratman et al., 2019; Kaplan, 1995; White et al., 2019). This includes elements like houseplants, pets and simply the view of trees from their apartments, all of which are supported by contemporary literature (Jacobs, 2023; Nieuwenhuijsen et al., 2022; Soga et al., 2017). Having this easy access to nature opens opportunities for individuals to increase engagement and interaction with natural spaces.

While understanding how individuals perceive nature is important, we also need to understand the barriers to this contact. Some participants spoke of the complexities of

being in a nature focused career but not behaving in the most nature focused ways. This contradicts Kellert's (1993) moralistic attitude towards nature which states that you have concern for the right and wrong treatment of nature. would be expected from someone actively working in the area. However, it highlights the concern that too much knowledge can be counterproductive to the relationship. Other participants spoke of feelings of being overwhelmed and anxious from being too concerned about the natural world to even engage or act towards protecting it. This is a common finding among research (Clayton, 2020; Clayton et al., 2021; Hickman, 2024), and again an expected result given the conceptualisation of nature connectedness involving the cognitive, affective and behaviour connection to the environment (Nisbet et al., 2009; Mayer & Frantz, 2004; Schultz 2002).

The current findings suggest a deeper interpersonal bond is at play. While much of the research to date has focused on nature as the backdrop to the development of social bonds (Henderson et al., 2024; Jennings et al., 2019) or the process of developing a strong sense of positive connectedness rather than the complexity of building a long lasting, and changeable bond with nature. Developmental, cultural and contextual factors were seen to play a role in this relationship progression (Mayer & Frantz, 2004; Pouso et al., 2021). The construct of nature connectedness represented a somewhat unattainable goal for those who have limited prior nature engagement or exposure, and something that puts individuals under pressure to achieve a highly positive experience within the natural world. As highlighted in the literature early childhood contact and engagement with nature was seen to be important for all participant, with every participant sharing a childhood memory at some stage of the interview process (Cheng & Monroe, 2012; Soga & Gaston, 2016). However, some of these memories variety of risks that they had encountered throughout their engagement. Incidences of biophobia and nature disconnect

have become current topics of interest for researchers (Barrable & Booth, 2022; Jensen et al., 2025), with this study suggesting that this is an area which needs further investigation. Research conducted in the context of human-human relationship explores how understanding risks, rather than simply avoiding them can produce happy relationships (Mikulincer & Shaver, 2007). Further research into the potential transferability of this dynamic in the context of human-nature relationships could provide added benefit and potential for interventions and education.

5.4.2 Implications

These findings offer many practical implications for both research and practice. Understanding this socially rich nature experience allows both researchers and practitioners to reexamine their current practice in relation to human-nature experiences and relationships. The findings suggest that there is a pull towards a more state-like relationship, rather than trait-like. This is an important consideration for practitioners to be aware of when engaging in interventions. While nature connectedness is still the gold standard and end goal of interventions, there needs to be acknowledgement of the conceptual barrier that may be in the way for those who lack, or have a low quality relationship at present.

Similarly there was a clear draw towards the importance of early childhood experiences for establishing an initial bond with nature that could be built on over time and experiences. These early memories were consistently recalled by participants showing their long-term importance for individuals. This emphasises the need for accessible nature for citizens to engage from early ages. The emphasis on the diverse understanding of nature and the acknowledgement of barriers and concerns regarding safety in nature spaces is similarly a vital consideration in urban planning. Natural spaces

need to be accessible, culturally acceptable by nearby residents and deliver an area of solace for local citizens.

5.4.3 Strengths and Limitations

A major strength of this study is the inclusion of the ‘Expanded-Experts’ in this study. This novel approach to the Delphi methodology creates an added layer of depth to our conceptualisation process, that could have been missed had the researchers focused purely on academic professionals. This opened up a rich layer of experiential information and gained insights into perceptions of those who have daily interactions with nature. This dual perspective offered a grounded exploration of the phenomena with consideration of application to real world scenarios (Embregts & Frielink, 2023). Similarly the hybrid analysis process allowed for re-examining the current frameworks, while also exploring deeper, more novel perspectives of the relationship.

A limitation to the research was the overall composition of the sample. While offering diversity in perspectives by broadening the conceptualisation of expertise the sample is still biased by design. By nature of their expertise there would be a predisposition to see value and nature experiences. While many did speak of the negative experiences and results of engagement with nature, a large pool of individuals who find no benefit to nature are excluded from this dialogue worldwide. Similarly there was a reliance on a Westernised, Educated, Industrial, Rich and Democratic (WEIRD) sample (Muthukrishna et al., 2020). The reliance on English as the only language of communication limited the possibilities to communicate with more diverse samples.

The timing of this research could be seen as both a strength and a limitation. Some interviews took place in the early months following the COVID-19 pandemic restrictions being lifted. As highlighted within the results of Chapter 4, this time created a space for

individuals to reconnect with and further develop their relationship. These interviews allow the participants to talk freely about this experience and the impact this has on their own relationships with nature. However, while adding to our contextual knowledge of the relationship it is unclear to know if the sentiments shared during these interviews are long lasting, or a result of temporal conditions alluding to over-exaggeration of the personal experience.

5.5 Conclusions

In conclusion, this study highlighted the complexities that are involved in the human-nature relationship. By exploring human nature interactions through multiple lenses (academic and non-academic) and across multiple themes, we gain a richer understanding of how to initiate and support that relationship. Ultimately, to foster deeper relationships to nature within society we will need to acknowledge the complexity of the relationship. This will require us to move beyond the concept of nature which has endured within the extant literature, largely focused on positive associations and benefits. To view human nature interactions as a relationship goes beyond this and gives a more realistic appraisal of our understanding of the term *nature*.

Ultimately, the discussion not only reflects on the findings of the research but also contributes to a broader dialogue on how humans and nature can thrive together. It highlights that our relationship with the natural world is not simply a static, trait like experience, but instead involves a much more dynamic process. It is clear from the interviews that this relationship begins to develop within childhood yet ends up shaped by the wider cultural and context of the individual. Further research should use this as a foundation for exploring the depths of our relationship with nature, and begin to acknowledge the normal, negative associations people have assigned to the natural

environment. It is only through understanding and acceptance of these complex associations can we work towards illuminating the concept and strengthening the human-nature relationship at a societal level.

This overall research plan will use the findings from this study to influence the next two phases of the research: development and validation of a new measure (Chapter 6 and 7). Continuing on from the modified-Delphi steps outlined in Figure 5.2, the findings of these interviews will be used to transform the associated codes into an item pool which is reflective of the illustrative quotes outlined in this chapter. It is hoped that this new measure will be reflective of the complex features of this relationship, including contextual and affective influences.

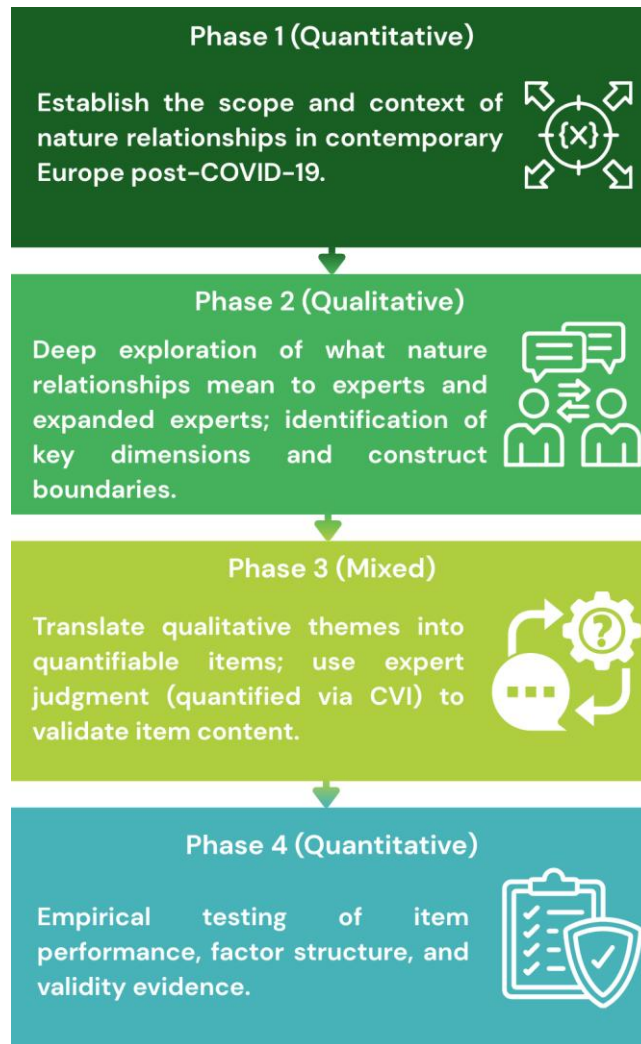
**Chapter 6: Building Consensus with The
Nature Relationship Working Group:
The Development of a New Nature
Relationship Quality Measure**

6.1 Introduction and Rationale for Working Group

This chapter outlines the collaborative working group process that informed the development of the initial item pool for a new measure of human-nature relationship quality. This phase of the research (Phase 3) builds directly upon the qualitative insights captured in the Chapter Five and represents the co-production research phase which acts as a bridge between phase two (Qualitative Interviews) and phase four (Scale Validation). Phase three is positioned as the translation of conceptual and qualitative insights, into accessible measurable items. To support this translation from qualitative quote to scale item, a Nature Relationship Working Group (NRWG) was established to allow for iterative decision-making and to support consensus building through item development. Importantly, phase three is embedded in the modified-Delphi method by continuing with Steps 8, 9 and 10 of the 16-Step process (Figure 6.3).

Figure 6.1

Outline of the Four Phases of the Research Process to Develop and Validate a Measure



Aligned with the overall pluralistic philosophy of this research, knowledge is gained through the integration of information from different levels and areas of expertise (Berger, 2015). Support for this approach is derived from Norström and colleagues (2020) who suggest that research conducted through co-production approaches is most effective in complex research problems related to sustainability. This includes the conceptualising of human-nature relationships. They emphasise the importance of involving both academic and non-academic contributors in order to capture diverse worldviews, lived experiences, and value systems that may be underrepresented in existing literature. This methodological practice is deliberate to ensure the experiential complexity of the human-nature relationship is captured within both the revised construct and the new measure.

Research has called for more transparency and reflexivity in measurement development and reporting (Boateng et al., 2018; Flake & Fried, 2020). Flake and Fried (2020) specifically refer to six questions researchers should address when reporting measurement practices. These questions (Table 6.1) guided the structure of the co-production process, with consideration for how others would use and report on the proposed measure.

Table 6.1

Six Questions to Promote Transparent Reporting of Measurement Practices (Flake & Fried, 2020)

Question	Information to Report
1. What is your construct?	Define the construct Describe theories and research supporting the construct
2. Why and how did you select your measure?	Justify the measure selection Report existing validity evidence
3. What measure did you use to operationalize the construct?	Describe the measure and administration procedure Match the measure to the construct
4. How did you quantify your measure?	Describe response coding and transformation Report the items or stimuli included in each score Describe the calculation of scores Describe all conducted (e.g., psychometric) analyses
5. Did you modify the scale? If so, how and why?	Indicate if modifications occurred before or after data collection Provide justification for modifications
6. Did you create a measure on the fly?	Justify why you did not use an existing measure Report all measurement details for the new measure Describe all available validity evidence; if there is no evidence, report that

This chapter demonstrates how transparent measurement principles were enacted through a collaborative, co-productive methodology to address the following research aims:

Aim 6.1 To translate the themes and dimensions identified in Stage 1 of the Delphi study (Chapter 5) into a comprehensive pool of candidate items for a measure the quality of the human-nature relationship.

Aim 6.2 To develop a pool of items which is representative of the breadth and nuance of the identified dimensions of human-nature relationship quality.

Aim 6.3 Through iterative Nature Relationship Working Group review, refine, modify and remove items which are not representative of quality within human-nature relationships.

6.2 Composition of Working Group

The Nature Relationship Working Group was established through purposeful and snowball sampling methods. Due to the nature of this working group all members were required to have specific disciplinary expertise. Experts were sought from both academic and policy backgrounds. Academics who were recruited were required to have a history of research publications in human-nature relationships, engagement or connection, or a publication involving measurement and scale validation. Policy experts were recruited from national bodies working on nature-engagement based programmes for mental health. All participants were recruited through the research team's professional networks.

Initially the Nature Relationship Working Group consisted of members of the GoGreenRoutes project consortium and the initial research team, however consideration was given to the overall methodology and the progress of the modified-Delphi approach

used in this research. After consideration external members were recruited. The Nature Relationship Working Group was made up of a total of 16 members; four of which were part of the initial research team (PhD student, two supervisors and project manager), ten were academics with a focus on human-nature relationships, four of whom were invited to take part from phase one of the research (Chapter 4 Interviews). The final two members worked on a national level programme which focused on a nature-based intervention for individuals with a lived experience of mental health challenges. These two participants contributed dual expertise in policy implementation and real-world programme delivery, allowing applied relevance to be incorporated into item development. Further participant detail can be found in Table 6.2 which conveys their role in the project where relevant.

Table 6.2*Breakdown of Membership in Nature Relationship Working Group*

Name	Affiliation	Role	Purpose	Citations (h-index)
Cassandra Murphy	Maynooth University	PhD Researcher	Lead of Working Group	12 (2)*
Dr Tadhg MacIntyre	Maynooth University	Academic	Project Supervision	5401 (36)*
Dr Elaine Gallagher	Maynooth University	Academic	Project Supervision	119 (4)*
Professor David Sheffield***	University of Derby	Academic	Subject Matter Expertise	16342 (68)*
Professor Holli-Anne Passmore	Concordia University of Edmonton	Academic	Subject Matter Expertise	6086 (31)*
Dr Eleanor Ratcliffe	University of Surrey	Academic	Subject Matter Expertise	2347 (19)*
Dr Samantha Friedman	University of Edinburgh	Academic	Subject Matter Expertise	314 (7)*
Dr Annalisa Setti***	University College Cork	Academic	Subject Matter Expertise	3231 (30)*
Aleksandra Szproch	ICEP-E	Academic	GoGreenRoutes WP Co-Lead and Psychologist	36 (2)**
Stephen Smith	ICEP-E	Academic	GoGreenRoutes WP Co-Lead and Psychologist	49 (4)**
Dr Deirdre MacIntyre	ICEP-E	Academic	GoGreenRoutes Partner and Clinical Psychologist Expertise	303 (7)**
Kalyn Potter	Maynooth University	Project Manager	Scheduling and Meeting Minutes	5(1)**

Table 6.2 continued

Name	Affiliation	Role	Purpose	Citations (h-index)
Professor Marc Jones	Manchester Metropolitan University	Academic	Scale Validation Expertise and GoGreen Routes Partner	11682 (60)*
Dr Robert Vaughan	Ulster University	Academic	Scale Validation Expertise	1079(17)*
Martin Rogan**	Mental Health Ireland	CEO	Policy and Real World Application	N/A
Niamh Ní Chonghaile	Mental Health Ireland	Nature Project Leader	Policy and Real World Application	N/A

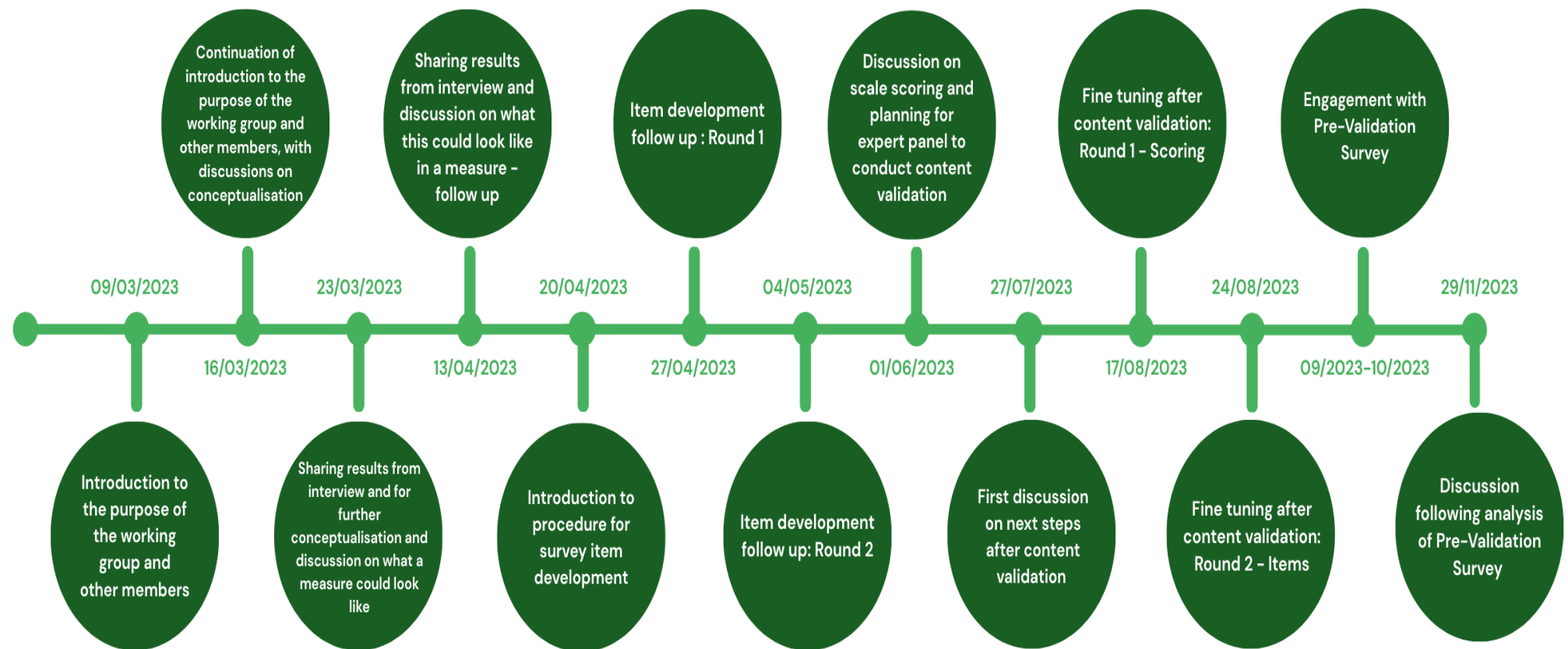
Sourced from Google Scholar ** Sourced from ResearchGate *Project Advisory Board Member*

6.3 Item Development: Process and Progress

In this section of the thesis the process of initial item pool development which was undertaken iteratively through engagement with the Nature Relationship Working Group will be described. A programme of semi-structured meetings (Figure 6.2) were conducted between March 2023 and November 2023 to progress conceptualisation, item refinement, and decision-making regarding measurement structure, content validation and recruitment strategies. The structure of these meetings can be broken up into various phases of item development and refinement. The meetings were not formally transcribed to allow free flowing thought and conversation between members, however the development and refinement of the scale items were documented through each phase through short surveys and shared documentation.

Figure 6.2

Timeline and Purpose of Meetings with the Working Group



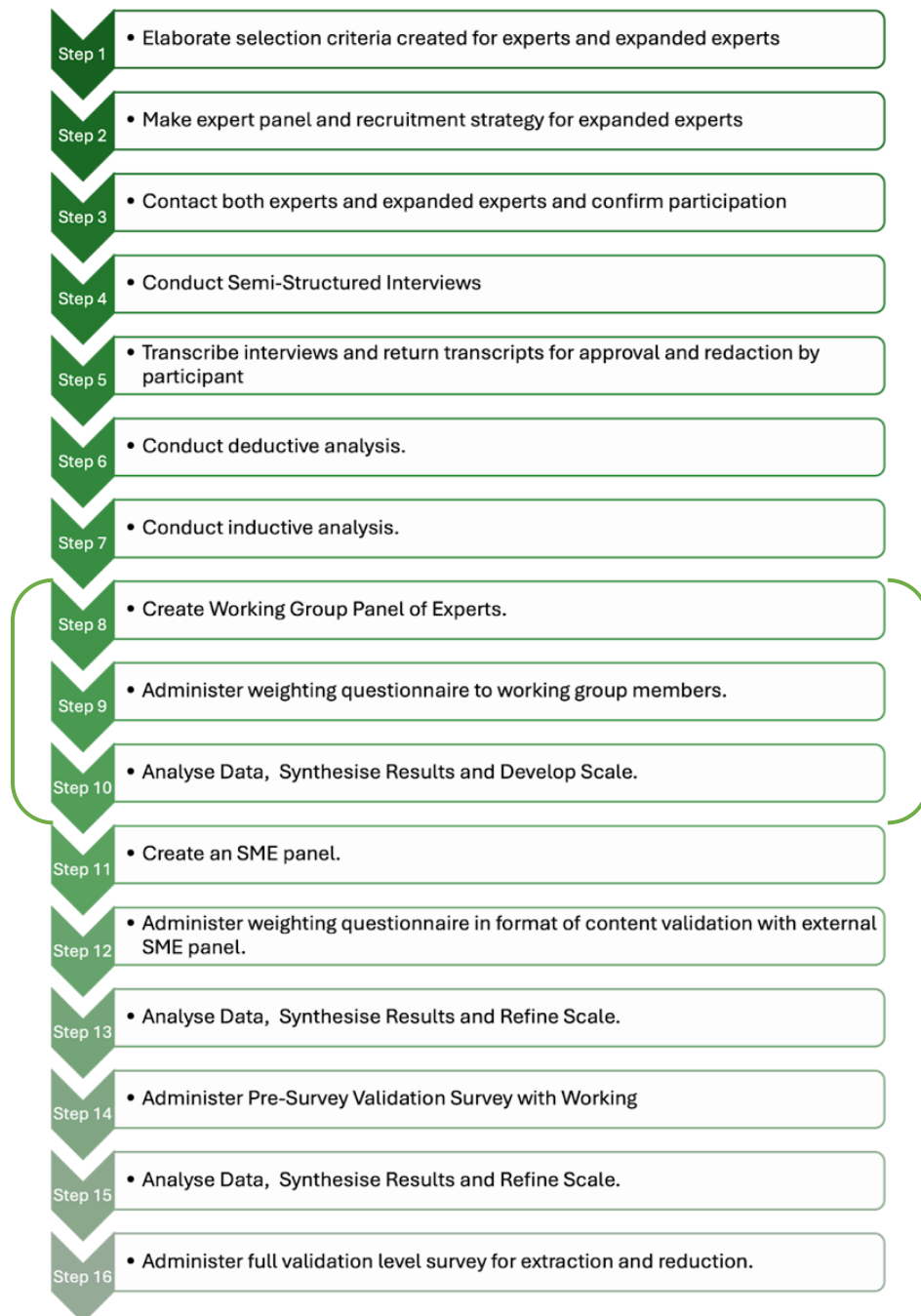
6.3.1 Formation of Nature Relationship Working Group and Construct Consensus

The Nature Relationship Working Group was created over the months of February and March 2023. Initial contact was made with prospective group members in February to engage interest. Once an initial group was established the first meeting was organised. This initial meeting involved establishing areas of expertise and uncovering areas of alignment within the group. During the meeting the overall purpose of scale development was shared with the group to gather thoughts and opinions. Nature Relationship Working Group members were asked to suggest other potential relevant contacts who would fit the inclusion criteria for this project. At this stage it was decided that a selection of interview participants (Phase 2) from the expert group should be invited back to share their thoughts and opinions in-line with the original design of the modified-Delphi study (Murphy et al., 2024). Following invitation, four interview participants agreed to take part.

For the second meeting the full Nature Relationship Working Group was established. During this meeting the initial thematic level findings from the previous phase of the research (Chapter 5) were discussed at a high level so members could conceptualise the larger phenomena of nature relationships. The members discussed the components of what a successful relationship with nature would comprise to help position the forthcoming scale items. Subsequent meetings (23/03/23 and 13/04/23) focused on sharing the illustrative quotes from the interviews. This was to allow the members the opportunity to consider the wider perspective of opinions on the phenomena before considering the relevance the identified themes played in the conceptualisation of nature relationships.

Figure 6.3

Steps of Modified-Delphi Being Discussed in Chapter 6



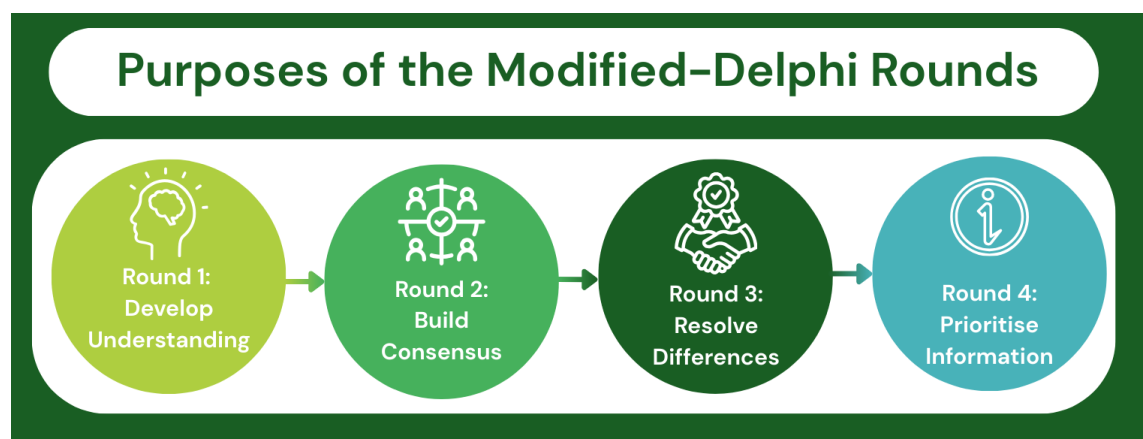
Note. SME refers to Subject Matter Experts.

Following these two meetings the members were asked to rate the relevance of each of the 27 subthemes to their conceptualisation of nature relationships. This was in-line with Steps 9 and 10 in the overall modified-Delphi approach (Figure 6.3). This was to allow the Nature Relationship Working Group to build consensus of the concept the

developed items would be measuring (Hsu & Sandford, 2007). The Nature Relationship Working Group was sent an anonymous survey link asking them to take part in two activities. The first was to rate the subthemes in relation to their relevance to the concept of human-nature relationships on a 5-point Likert scale from strongly disagree to strongly agree. The second was to suggest the phrasing of a potential item which represented the different themes from phase 2 (Chapter 5). This was the first step in item development. The initial research team (PhD and two supervisors) were excluded from this activity as they were too closely familiar with the data and would bring too much bias. Eight Nature Relationship Working Group members took part in this activity (62% of the valid sample). For the final block of six typology-based subthemes (Household Nature, Local v Foreign, Nature Definition, Rural, Urban, Wilderness v Maintained), ratings were provided by seven panel members; data from one participant were missing for this block and was not included in the calculations for those items.

Figure 6.4

Purpose of Each Modified-Delphi Round



For the first activity an agreement rate of $\geq 80\%$ and an Interquartile Range (IQR) of ≤ 1 was used in this section of the research (Diamond et al., 2014; Lange et al., 2020; Yan & Chuang, 2023). The agreement rates can be seen in Table 6.3 below. An agreement

rate of $\geq 80\%$ and an IQR of ≤ 1 indicated that there was a strong consensus among participants. Those below the agreement rate were considered for refinement in future meetings.

Table 6.3*Breakdown of Working Group Consensus Building Agreement Rates*

Item	Disagreement %	Agreement %	Mean	SD	Median	IQR
Adulthood	12.5	87.5*	4.25	1.39	5	1
Childhood	12.5	87.5*	4.38	1.41	5	0.25
Parenthood	12.5	75	3.88	0.99	4	0.5
Milestones	12.5	75	3.88	0.99	4	0.5
Digital Support	12.5	75	3.62	1.19	4	0.25
Longing	12.5	87.5*	4.12	0.99	4	1
Multisensory	12.5	87.5*	4.12	1.36	4.5	1
Technological	12.5	75	3.62	1.19	4	0.25
Barriers	25	75	3.75	1.49	4	1.5

Table 6.3 (continued)

Item	Disagreement %	Agreement %	Mean	SD	Median	IQR
Concern	0	100*	4.62	0.52	5	1
Disconnect	0	75	4.12	0.83	4	1.25
Emotions	0	75	4.25	0.89	4.5	1.25
Empathy	0	100*	4.62	0.52	5	1
Familiarity	0	75	4.25	0.89	4.5	1.25
Identity	0	100*	4.5	0.53	4.5	1
Influence	0	75	4	0.76	4	0.5
Values	0	75	4	0.76	4	0.5
Respect	0	75	4.25	0.89	4.5	1.25
Risk	12.5	87.5*	3.75	0.71	4	0
Trait v State	0	100*	4	0	4	0

Table 6.3 (continued)

Item	Disagreement %	Agreement %	Mean	SD	Median	IQR
Transactional	0	87.5*	4.5	0.76	5	1
Household Nature	0	100*	4.43	0.53	4	1
Local v Foreign	0	85.71*	4.29	0.76	4	1
Nature Definition	0	85.71*	4.71	0.76	5	0
Rural	14.29	85.7*	4.14	1.07	4	1
Urban	14.29	85.71*	4.14	1.07	4	1
Wilderness v Maintained	0	85.71*	4.43	0.79	5	1

Note. * indicates $\geq 80\%$ agreement and an $IQR \leq 1$ among participants is achieved.

Across the 27 items, mean ratings ranged from 3.62 to 4.71. Agreement (percentage of ratings ≥ 4) was generally high across all subthemes, all ranging from 75% to 100%. Several items (e.g. Concern, Empathy, Identity, Trait v State, Household Nature) achieved 100% agreement. Disagreement levels (percentage of ratings ≤ 2) were low across the sub-themes. In some cases, items showed agreement of 75% with 0% disagreement, indicating that some panellists selected the neutral category (3) rather than disagreement.

The following themes remained: Adulthood, Childhood, Longing, Multisensory, Concern, Empathy, Identity, Risk, Trait v State, Transactional, Household Nature, Local v Foreign, Nature Definition, Rural, Urban and Wilderness v Maintained. Other themes were considered for refinement.

6.3.2 Item Generation and refinement

As discussed in section 6.3.1, alongside the consensus building activity, participants were asked to suggest items which represented each code. Table 6.3 indicates the initial item pool developed. A total of 60 items were developed across all subthemes. Each subtheme had a minimum of one suggested statement or question while the majority had a variation of up to three.

Table 6.4

Full Item Pool Following Item Generation by Nature Relationship Working Group Members

Theme and Subthemes	Suggested Item
Development	
Adulthood	How much has your connectedness to nature changed during different times of your life as an adult? pretty stable ... to changed a lot, This is worded horribly but hopefully we can work on the idea as a group. Could compare adult to child. My experiences as an adult have impacted my relationship to nature. To what extent do you think that your experiences and life choices in adulthood have impacted the closeness of your relationship with nature? (1- not all, 5- extremely so) Nature plays an important role in my daily life (Likert scale question)
Childhood	Time spent in nature reminds me of my childhood

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
	To what extent do you think that your experiences and memories from your childhood have impacted the closeness of your relationship with nature? (1- not all, 5- extremely so)
	When I think of happy experiences in my childhood, they often involve nature (Likert)
Parenthood	
	Something about to what degree has parenthood changed your NC? or to what degree do you consider NC with respect to being a parent / having kids?
	How significantly do you believe the quality of your parent(s)/guardian(s)'s relationship shaped and impacted the manner in which you relate to the natural world? (1-5)
	Becoming a parent has impacted my relationship with nature (Likert)
Milestones	
	There are key moments I recall that have impacted/shaped my -relationship to nature OR strong emotions and experiences have shaped my relationship to nature.

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
	There are key moments I recall that have impacted/shaped my -relationship to nature OR strong emotions and experiences have shaped my relationship to nature.
Memory	
Digital Support	
	I engage with digital support (nature documentaries, etc) that have positively impacted my relationship to nature
	To what extent does access to/ the use of supportive digital experiences/resources regarding nature-based topics help to enhance the sense of closeness and meaning within your relationship with the natural world?
	I frequently use technology to engage with nature
Longing	
	I tend to phrase things like Do you find yourself longing for nature if you haven't been immersed in it for sometime? not at all a bit somewhat a lot -- that type of scale response 1 to 5 kind of thing
	Do you regularly experience a sense of longing for a particular space within nature from your memories?

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
	Also potential to explore whether extended periods away from nature prompt a sense of longing - "To what extent does an extended scarcity of access to nature-based stimuli/nature spaces bring about a sense of longing for nature-based contact/experiences within you?" When I'm not in nature, I feel a longing to be in natural spaces or around natural things.
Multisensory	To what extent does multisensory contact with nature-based spaces and stimuli impact your relationship with nature? One of the best parts of being in or around nature is the sensory experience
Technology	I regularly use technology as an aid when I spend time in nature or to access virtual nature. To what extent does exposure to, and engagement with technological nature (e.g., nature documentaries/virtual reality) impact your relationship with nature? I feel that technology can improve my relationship with nature

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
Relationship	
Barriers	
	Can you identify any barriers which prevent you from forming a positive relationship with nature and your local environment?
	I spend less time in nature than I would like because of barriers in access.
Concern	
	What level of influence does your concern for nature and the environment exert over the quality of your relationship with nature?
	My well-being is negatively impacted when I see or hear about bad things happening to nature/climate
Disconnect	
	Can you identify any reasons or occurrences that might promote a sense of distance or disconnect in your relationship with nature?
	I feel that my connection to nature has ebbed and flowed across my life so far.

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
Emotions	
	To what extent do you feel that your personal emotions impact the quality of your relationship with nature?
	I feel my well-being benefits from being around nature.
Empathy	
	To what extent is your relationship with nature influenced by the empathy you feel toward the natural environment?
	When I see or hear about natural spaces or creatures being harmed, I feel personally impacted.
Familiarity	
	To what extent does your familiarity with a given nature site influence your relationship and connection to the natural environment?
Identity	
	To what extent is your relationship with nature linked to your own personal sense of identity and sense of self?
	I feel that nature is part of my personal identity.

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
Influence and Values	
	My culture or local societal norms help shape my relationship with nature
	How closely linked is your relationship with nature to your own personal values and worldview?
	I believe there is value in having a relationship with nature.
Respect	
	To what extent do you believe your relationship with nature to be rooted in a sense of respect for the natural world and a recognition of the human race being part of nature?
	I believe it's important to respect nature and demonstrate that I care for it.
Risk	
	Being in nature can be scary or can involve risks
	To what extent is your relationship with nature influenced by the sense of adventure and risk that can be obtained through certain nature-based activities (e.g., skiing, surfing, wild camping, etc.)

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
Trait v State	To what extent do you believe your relationship with nature to be innate, fixed, and constant over time? To what extent do you believe your relationship with nature to be changeable across time, context-specific and malleable? I always feel the same level of connection to nature, and this is not impacted by my experiences, time spent in nature, or other variables.
Transactional	I believe I get as much out of my relationship with nature as I give to nature.
Typologies	
Household	To what extent is your relationship with nature shaped by the presence of household nature within your life (e.g., gardens, houseplants, pets, etc.)? I integrate elements of nature into my home environment.

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
Local v Foreign	To what extent do you feel a greater sense of connection to familiar, local nature sites as opposed to those that may be accessed beyond your local area? I value nature which is close by to me equally to nature which is far away.
Rural	To what extent is your sense of connection to nearby nature influenced by the context of the nature site (e.g., rural vs. urban nature settings)? I believe living in a more rural area would increase my connection to nature.
Urban	To what extent is your sense of connection to nearby nature influenced by the context of the nature site (e.g., rural vs. urban nature settings)? I believe living in an urban setting would make connecting to nature more difficult.

Table 6.4 (continued)

Theme and Subthemes	Suggested Item
Wilderness v Maintained	
	I prefer wild nature over maintained nature
	To what extent is your sense of connection to nearby nature influenced by the characteristics of the nature site (e.g., wilderness vs maintained nature settings)?
Nature Definition	
	There could be items describing different "nature" and people could rate them from 1-5 how much they consider that "item" to be included in their definition of "nature".
	In the context of your daily life, how would you define the concept of nature as it applies to you?
	I consider nature to be a physical space, separate from humans but able to be experienced or interacted with.

On the 20th of April 2023 the Nature Relationship Working Group met to further discuss how to progress from item generation phases to the item refinement phase. Members agreed to partake in meetings in which the different suggested scale items were presented to the full working group. These meetings happened over two dates, lasting a total of 5 hours. Members took part in an open discussion moderated by the PhD researcher where members suggested changes and rewording of individual items, as well as areas in which suggested items could be combined. Some members who did not take part in the original survey had the opportunity to contribute their perspectives on the questions also. The newly refined items were captured in a Google Sheets document by the research team. Following refinement by the research team the Google Sheets file was shared with the Nature Relationship Working Group allowing them to add any extra suggestions and comments to the file. The full list of questions including comments can be found in Table 6.4.

Table 6.5

List of Items Developed in the Initial Item Generation Process by Nature Relationship Working Group with Suggested Changes

Suggested Questions	Comments and Suggested Changes
Development	
Adulthood	
How much has your connectedness to nature changed during different times of your life as an adult? pretty stable ... to changed a lot, This is worded horribly but hopefully we can work on the idea as a group. Could compare adult to child.	<i>Change over time is interesting but be aware not for kids</i>
My experiences as an adult have impacted my relationship to nature.	
To what extent do you think that your experiences and life choices in adulthood have impacted the closeness of your relationship with nature? (1- not all, 5- extremely so)	

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Nature plays an important role in my daily life (Likert scale question)	<i>Mutual positive agreement by members. Simple and to the point</i>
Childhood	
Time spent in nature reminds me of my childhood	
To what extent do you think that your experiences and memories from your childhood have impacted the closeness of your relationship with nature? (1- not all, 5- extremely so)	<i>Need to acknowledge negative experiences - or lack of experiences in childhood and what that could mean.</i>
When I think of happy experiences in my childhood, they often involve nature (Likert)	<i>A combination of Q2 and Q3 would be good - My experiences of nature in childhood are happy.</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Parenthood	
Something about to what degree has parenthood changed your NC? or to what degree do you consider NC with respect to being a parent / having kids?	<i>Could this be a subscale - not everyone experiences it. Also possible to look the other way around - your parent's influence on you !</i>
How significantly do you believe the quality of your parent(s)/guardian(s)'s relationship shaped and impacted the manner in which you relate to the natural world? (1-5)	<i>How does your relationship with nature have implications for your children?</i>
Becoming a parent has impacted my relationship with nature (Likert)	<i>Becoming a parent has [improved] impacted my relationship with nature (Likert)</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Milestones	
There are key moments I recall that have impacted/shaped my -relationship to nature OR strong emotions and experiences have shaped my relationship to nature.	<i>There are key moments I recall that have [deepened] impacted/shaped my [connection] relationship to nature OR strong emotions and experiences have shaped my relationship to nature.</i>
To what extent do you believe significant events/milestones within your life influence and impact the quality of your relationship with nature? (1-5)	<i>If they do not have any, are they less connected?</i>
Memory	
Digital Support	
I engage with digital support (nature documentaries, etc) that have positively impacted my relationship to nature	<i>Does this add to the strength of the relationship or is it a profile element?</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
To what extent does access to/ the use of supportive digital experiences/resources regarding nature-based topics help to enhance the sense of closeness and meaning within your relationship with the natural world? I frequently use technology to engage with nature	<i>Good to show we do not just need physical contact to connect.</i>
Longing	
I tend to phrase things like Do you find yourself longing for nature if you haven't been immersed in it for sometime? not at all a bit somewhat a lot -- that type of scale response 1 to 5 kind of thing Do you regularly experience a sense of longing for a particular space within nature from your memories?	<i>Longing for a particular space, romanticisation of a space, not living up to expectations.</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Also potential to explore whether extended periods away from nature prompt a sense of longing - "To what extent does an extended scarcity of access to nature-based stimuli/nature spaces bring about a sense of longing for nature-based contact/experiences within you?"	
When I'm not in nature, I feel a longing to be in natural spaces or around natural things.	
Multisensory	
To what extent does multisensory contact with nature-based spaces and stimuli impact your relationship with nature?	<i>To what extent do you use your senses to connect with nature?</i> <i>Bodily experience?</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
One of the best parts of being in or around nature is the sensory experience	<i>Do you connect with nature for it's [multisensory benefits] because it engages all my senses?</i> <i>To what extent does the multi-sensory experience of nature make you fell more immerses/present in the environment?</i>
Technology	
I regularly use technology as an aid when I spend time in nature or to access virtual nature.	<i>Scaffolding - do you use apps in or outside of nature to connect?</i>
To what extent does exposure to, and engagement with technological nature (e.g., nature documentaries/virtual reality) impact your relationship with nature?	<i>Split into two -or more - profile question which could include poetry/books/documentaries</i>
I feel that technology can improve my relationship with nature	

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Relationship	
Barriers	
Can you identify any barriers which prevent you from forming a positive relationship with nature and your local environment?	<i>Space to ask about opportunities?</i>
I spend less time in nature than I would like because of barriers in access.	<i>Mutual positive agreement by members.</i>
Concern	
What level of influence does your concern for nature and the environment exert over the quality of your relationship with nature?	
My well-being is negatively impacted when I see or hear about bad things happening to nature/climate	

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Disconnect	
Can you identify any reasons or occurrences that might promote a sense of distance or disconnect in your relationship with nature?	<i>Could there be different types of disconnect?</i>
I feel that my connection to nature has ebbed and flowed across my life so far.	<i>Mutual positive agreement by members.</i>
Emotions	
To what extent do you feel that your personal emotions impact the quality of your relationship with nature?	<i>When I am happy I go to nature. (Spectrum - not just happy v sad)</i>
I feel my well-being benefits from being around nature.	<i>This isn't necessarily about emotions but wellbeing</i>
Empathy	
To what extent is your relationship with nature influenced by the empathy you feel toward the natural environment?	<i>Maybe something on how much empathy you feel towards nature?</i>
	<i>How does empathy impact your behaviour in nature?</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
When I see or hear about natural spaces or creatures being harmed, I feel personally impacted.	
Familiarity	
To what extent does your familiarity with a given nature site influence your relationship and connection to the natural environment?	<i>Nature Features Question?</i> <i>Longing for nature?</i> <i>Something about being in unfamiliar spaces impacts the strength of your relationship</i>
Identity	
To what extent is your relationship with nature linked to your own personal sense of identity and sense of self?	
I feel that nature is part of my personal identity.	

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Influence and Values	
My culture or local societal norms help shape my relationship with nature	<i>What about Bronfenbrenner layers?</i>
How closely linked is your relationship with nature to your own personal values and worldview?	
I believe there is value in having a relationship with nature.	<i>Mutual positive agreement by members.</i>
Respect	
To what extent do you believe your relationship with nature to be rooted in a sense of respect for the natural world and a recognition of the human race being part of nature?	<i>Negative side needed - dangers in nature</i>
I believe it's important to respect nature and demonstrate that I care for it.	<i>Mutual positive agreement by members.</i>
Risk	
Being in nature can be scary or can involve risks	<i>What about Urban risks not associated with nature but overflow into nature?</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
To what extent is your relationship with nature influenced by the sense of adventure and risk that can be obtained through certain nature-based activities (e.g., skiing, surfing, wild camping, etc.)	
Trait v State	
To what extent do you believe your relationship with nature to be innate, fixed, and constant over time? To what extent do you believe your relationship with nature to be changeable across time, context-specific and malleable?	<i>My relationship with nature varies depending on day/season/time of year? - Different factors</i>
I always feel the same level of connection to nature, and this is not impacted by my experiences, time spent in nature, or other variables.	
Transactional	
I believe I get as much out of my relationship with nature as I give to nature.	<i>Mutual positive agreement by members.</i>
	<i>Do you feel you need to give back to nature? // What do I need from nature and what does nature need from me right now?</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Typologies	
Household	
To what extent is your relationship with nature shaped by the presence of household nature within your life (e.g., gardens, houseplants, pets, etc.)?	
I integrate elements of nature into my home environment.	<i>Mutual positive agreement by members.</i>
Local v Foreign	
To what extent do you feel a greater sense of connection to familiar, local nature sites as opposed to those that may be accessed beyond your local area?	<i>Mutual positive agreement by members.</i>
I value nature which is close by to me equally to nature which is far away.	<i>Does not really answer the question for us. Just because you place more value on foreign nature doesn't mean you're less connected.</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Rural	
To what extent is your sense of connection to nearby nature influenced by the context of the nature site (e.g., rural vs. urban nature settings)?	
I believe living in a more rural area would increase my connection to nature.	
Urban	
To what extent is your sense of connection to nearby nature influenced by the context of the nature site (e.g., rural vs. urban nature settings)?	<i>When I am in the city I am able to connect with nature // When I am in a natural environment I am able to connect with nature.</i>
	<i>When there are more elements of nature around me I feel more connected to nature.</i>
I believe living in an urban setting would make connecting to nature more difficult.	<i>Priming and creating a separation between nature and urban spaces</i>

Table 6.5 (continued)

Suggested Questions	Comments and Suggested Changes
Wilderness v Maintained	
I prefer wild nature over maintained nature	Profile Question
To what extent is your sense of connection to nearby nature influenced by the characteristics of the nature site (e.g., wilderness vs maintained nature settings)?	
Nature Definition	
There could be items describing different "nature" and people could rate them from 1-5 how much they consider that "item" to be included in their definition of "nature".	
In the context of your daily life, how would you define the concept of nature as it applies to you?	
I consider nature to be a physical space, separate from humans but able to be experienced or interacted with.	

Over nine weeks this process was repeated following further refinement by the research team based on the comments outlined in Table 6.4. A first full draft of a potential scale was developed (Table 6.5) and shared with the Nature Relationship Working Group for another round of refinement. While this refinement process was underway the Nature Relationship Working Group met to discuss the expected factor structure of the measure and the scoring expectations.

Table 6.6

First Draft of Scale with Associated Comments from Nature Relationship Working Group Members

Scale Item	Comments and Recommended Changes
<u>Instructions:</u> For each of the following, please rate the extent to which you agree with each statement, using the scale from -2 to +2 as shown below. There are no right or wrong answers to these questions so please respond as you really feel, rather than how you think “most people” feel.	I wonder if we need to define what we mean by nature before people complete the questionnaire - or does that cause more problems? Sorry, I can't remember what we decided on for a – to + scale. I think that's a bit confusing still – not sure why we don't just have the a standard 1 to 5 scale. I still think that love on NC isn't the same as actually disliking or actively avoiding nature. I think that is a separate scale and project altogether. ? – [response] It is 1-5 (possibly 1-7 up for debate) we had agreed on.
Nature plays an important role in my life.	
I can recall key moments that have positively shaped my relationship with nature.	looking forward to discussion on these again -seems more like profiling
I can recall key moments that have negatively shaped my relationship with nature.	looking forward to discussion on these again -seems more like profiling

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
When I am in places where there is not much nature present or nature is hard to access, I long to be in nature instead.	I feel that we need a temporal anchor here, but for a while may be too generic
When I am in places where there is not much nature present or nature is hard to access, I wish to be in nature instead.	
I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.	
My wellbeing is negatively impacted when I see or hear about bad things happening to nature.	
I feel that nature is linked to my personal identity.	
When I see or hear about natural spaces or creatures being harmed, I feel personally impacted.	I wonder whether we need 'or creatures' here. It introduces an element that is not included in any other items and maybe is tapping into something different. Maybe habitats? As it alludes to animals without explicitly stating it
I believe there is value in having a relationship with nature.	

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
I believe it's important to respect nature.	
I care for nature.	
I understand there are risks in nature.	Would this item load positively on nature connection (i.e., being aware of risks in nature means being more connected?) or would it be seen as a sign of being less connected? Is this a positive or a negative item?
I find nature to be scary.	reverse coded OR part of a separate "hate/avoid" nature scale - this is also hard as this may very much depend on context - looking forward to discussion
I am uncomfortable in nature.	reverse coded OR pulled out for a separate "hate/avoid" scale- be interesting to see correlations between two such scales
I feel that I need to give back to nature.	
Nature exists for humans to use.	maybe part of a negative scale?

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
I find nature to be boring.	maybe part of a negative scale?
I do not care about natural spaces or habitats.	maybe part of a negative scale?
Being in nature makes me feel exposed.	maybe part of a negative scale?
I find nature to be inherently cruel.	maybe part of a negative scale?
I do not care when nature is harmed.	
I seek out routes with nature when commuting.	
Nature has nothing to offer me.	great for a negative scale
I see beauty in nature.	
Nature brings me joy.	
I avoid routes with nature on my commute.	

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
I am most connected to nature when in spaces that are familiar to me.	I am not sure what we are getting at here - are we tapping into the past experiences of nature or is it that I do not get bored of the 'same nature' or else? Not sure if one disagrees what it means by just reading the item Think the distinction is about 'nature I like and choose to be in' versus 'any nature' Some good work here pulling this together. I agree with the other helpful comments too. At this stage it is better to err on inclusivity and we can see how the items load onto the final score. I was also wondering if we should have items that tap into some of the main explanations for why people engage in nature (e.g., social, stress reduction, restoration). Although perhaps not as what that would do is confuse the process (being connected with nature) with the outcome. As above, would agreement with this item be reflective of a 'better' score? – [response] agree - perhaps part of a profiling question but not a general connectedness scale
My experiences of nature in childhood were mainly positive.	
My relationship significant people in my life have had with nature has shaped my relationship with nature.	Maybe 'has shaped my own relationship with nature'?

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
I engage with nature through:	Indirectly (e.g., looking out of the window, having houseplants?)
Physical Spaces	Does this include e.g. gardening?
Digital Means (Gaming/VR/apps)	
The Arts (Art/Shows/Books/Poetry/Music/Documentaries)	
Work	
Any other suggestions?	

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
I regularly experience a sense of longing for a particular space within nature.	Do we care about this if we do not know why and it is not in the context of a specific location?
<u>If so what space?</u>	
Blue spaces, e.g., sea, lakes, rivers	consider splitting these up into subcategories - for me a lake is very different than the ocean or a river - (sea might be phrased as sea/ocean)
Forest or woodland	
Grassland	
Public Park	urban park? not sure what public park means
Desert	
City	
Mountains	not really a space - perhaps could have a category of 'weather' or natural aspects - snow, rain, sun, ?
Garden	
Snow	
Farmland	

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
I spend my time in nature engaging all of my available senses.	very similar to short Q6
I spend less time in nature than I would like.	
I go to nature when I am:	Need more positive / neutral emotions as leaning too much to the negative
Happy	
Sad	
Anxious or stressed	I wonder if a lay reader would get this or interpret it consistently.
Bored	
Grieving	Perhaps these two could be combined into 'distressed' or 'in need of comfort/solace'
Dysregulated[2] [3]	
<i>Any other suggestions?</i>	
My relationship with nature has changed positively over time.	

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
My relationship with nature has changed negatively over time.	
My relationship with nature changes depending on:	this makes me think about relationship in a practical way, the others more in a psychological way
The seasons	
The weather	
Time of day	The people I am with? Or, is this question trying to understand effects of non-social factors?
Day of the week (weekend v weekday)	
Location	
My Work/School Schedule	
The people I am with	
<i>Any other suggestions?</i>	

Table 6.6 (continued)

Scale Item	Comments and Recommended Changes
I get as much out of nature as I give to nature.	this could go both ways if I agree - I think I should give more or I think nature should give me more; perhaps some directionality would be useful. Of what I give to nature I get as much or more in return, bit convoluted :-)
I integrate elements of nature into my home.	
I feel connected to nature in the city: • Always because it is part of who I am. • there is nature around me (parks, trees, plants, lake, river) I feel connected to nature in the wilderness.	I would be curious to know under what circumstances: • always, because nature is part of who I am • if there is urban nature available (park, trees, plants) I'd be curious to know if some people feel connected to nature only if there is wilderness

6.3.3 Proposed Measurement Structure and Scoring Strategy

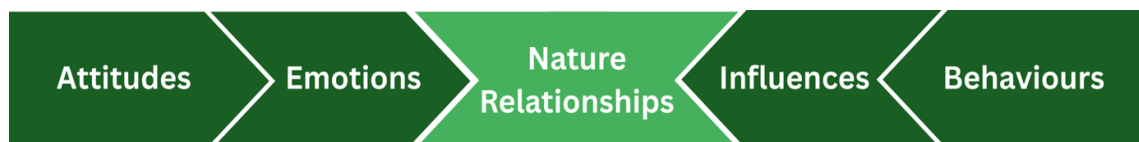
6.3.3.1 Proposed Factor Structure and Profiling Function

During the previous meetings the potential to create a profile building tool designed to identify individuals' nature-orientation styles, including preferences for natural environments, modes of engagement, and pathways for restorative benefits was discussed (Hyvönen et al., 2018). Hyvönen et al. (2018) operationalised “profiles” of nature exposure using a set of profile-building indicators rather than a single composite score. The PhD researcher met Hyvönen and colleagues to discuss the practicalities of this style of tool. It was decided that this was an element which could be adapted to the measure in the form of a ‘long version’ measure as seen in Table 6.5. For the purposes of the present phase of development, however, the priority was to establish a robust factor structure for the short version of the measure, before expanding into longer form applications or profiling outputs.

However, this discussion turned to the Nature Relationship Working Group's expectations of the potential factor structure of the draft measure. The Nature Relationship Working Group undertook a mapping activity in which members attempted to associate each item to an associated theme. As seen from Figure 6.5 Nature Relationship Working Group members agreed to four specific dimensions, which they considered to contribute to the new measure. These were: Attitudes, Emotions, Influences and Behaviours.

Table 6.7*Conceptualisation of Dimensions*

Dimension	Conceptualisation
Attitudes	The cognitive component of the relationship including one's beliefs and judgements about nature.
Emotions	The affective component of the relationship. This includes both the positive and negative feelings an individual experiences in their relationship with nature.
Influences	The contextual component of the relationship. This includes the social, cultural and familial influences which have shaped a person's relationship with nature.
Behaviours	The observable or habitual actions a person takes that contributes to their relationship with nature.

Figure 6.5*Original Factors Expected*

Following this activity, the research team met with members of the Nature Relationship Working Group who were recruited for their expertise in scale development and validation. The practicalities of the validation process were discussed. The decision to follow an inductive approach to factor analysis was decided on as it was more aligned with the overall inductive and pragmatic approach of the research (Jebb et al., 2017). This allowed for the empirical structure of the measure to emerge from the participants' responses rather than imposing a predefined factor model. Given the exploratory nature of this measure's development, and the conceptual breadth of the human–nature

relationship identified during expert consultation, the Nature Relationship Working Group agreed that an inductive Exploratory Factor Analysis would be most appropriate next step.

Furthermore, while the four proposed dimensions, Attitudes, Emotions, Influences, and Behaviours provided a grounding for item mapping, these were deemed provisional and not yet suitable for confirmatory modelling. The Nature Relationship Working Group identified that as this project involved the conceptual expansion of established constructs (see Chapter 2), it justified the need to examine whether the expected four-factor structure was statistically supported or whether additional or alternative factors emerged. For example, the grouping activity revealed overlap between items representing emotional responses to nature and items reflecting the external influences in our development of relationships with nature. This suggests that there may or may not be distinct factors once tested empirically.

6.3.3.2 Scoring

Throughout the development process the topic of scoring continued to come up in discussions as the Nature Relationship Working Group developed items. Multiple variations of scoring were considered. The members reached early agreement that a Likert-type response format was most appropriate (Badenes-Ribera et al., 2020; Hinkin et al., 1997; Kyriazos, 2018; McNeish & Wolf, 2020). Initial discussions made the assumption of a unidirectional measure focusing on a neutral starting point with increments representing a most positive relation. However, given the conceptualisation of a nature adjacent relationship (Chapter 5) members discussed the potential for a bidirectional measure (Aiken, 1985). This would allow for the capture of both positive and negative orientations toward nature, rather than positioning the relationship solely along a continuum of “more or less positive.” Conceptually, this aligned with the

qualitative findings which indicated that some individuals may have experiences which are more relationally negative, they may experience emotional discomfort, or even a distancing within nature interactions. During the first few draft variations of the measure a bidirectional approach was considered.

At this stage, however, a unidirectional measure was considered the most appropriate. Within the context of the current measure, the unidirectional format enables the measure to be interpreted in terms of an increase in depth and positive relationship quality. The Nature Relationship Working Group discussed the practicalities of this choice and acknowledged that an absence of positive relationship quality does not necessarily equate to a negative relationship. Individuals who score low may simply be neutral, disconnected, or unengaged, rather than actively rejecting or resisting connection with nature. With recent empirical developments and forthcoming measurement developments in nature disconnect (Barrable & Booth, 2022) it is clear to see that this is a distinct construct which reflects an alternative concept to what the Nature Relationship Working Group was trying to achieve.

The Nature Relationship Working Group noted that, once the psychometric structure of the scale is established, future refinements may return to the bidirectional scoring concept. Particularly if subsequent analysis shows that there is a meaningful negative or avoidant dimension to this concept. For this version of the measure, a 7-point Likert scoring format was adopted, ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). This scoring was selected to allow greater sensitivity in responses while remaining reliable and better captures subtle gradations in relationship quality (DeCastellarnau, 2018). This option also reduces ceiling effects (Chyung et al., 2020). Individual items are summed and then averaged to produce a total score. A lower score reflects a less developed, or more distant relationship with nature while a higher score

reflects a deeper integration of nature into one's life and an overall emotionally engaged relationship.

6.3.4 Final Item Refinement via Modified-Delphi Rounds

During the months of July and October 2023 the Nature Relationship Working Group met four times to reflect on the findings from the content validation process. This was to allow for further refinement of the measure using subject matter expert's knowledge to further guide the development of the measure. The process and findings from the overall validation process (Phase 4) will be discussed in Chapter 7. This process was aligned with the steps of the modified-Delphi and recommendation for best practice in scale development and validation (Almaiah et al., 2022; Belton et al., 2019; Boateng et al., 2018; Hsu & Sandford, 2007).

6.4 Outcomes of Working Group

There are two major outcomes of the working group. The first being the conceptualisation of the construct human-nature relationships, and the second is the reduction of items from 60 initial pool to a manageable total of 29 items which progressed to content validation (Table 6.8).

Through the Nature Relationship Working Group process of interdisciplinary dialogue and co-productive methods including consensus building the conceptualisation of the human-nature relationship revealed the complexity of the construct. Through the consensus building activity a number of subthemes were deemed important to the construct. These items mirror the aforementioned factor structure proposed by the Nature Relationship Working Group. This process suggests that the nature relationship is a complex and multidimensional construct. It requires consideration of individuals

perceptions, emotions and interactions to the natural world and the wider societal and experiential factors which influence this. A major development in this conceptualisation is that these elements may not always be positively framed. Negative emotions, perceptions, experiences or behaviour towards the environment do not necessarily equate to a disconnect, but rather a lower quality relationship with the individuals concept of nature.

With this conceptualisation in mind the 29 items displayed in Table 6.8 represent a measure of human-nature quality rather than a sense of connectedness, relatedness or identity as many current measures represent. An important element to consider in this measurement is an individual's own understanding of nature. With this in mind the decision to include one qualitative question phrased “*In your own words please describe what the term nature means to you.*” There is no scoring metric associated with this question, rather it is designed for more practical uses such as in interventions such as nature-based therapy where an individual’s conceptualisation of nature will influence the effect and the efficacy of the intervention. For research purposes this question can be substituted for a definition of nature decided on by the individual researcher.

Table 6.8

29 Items Sent for External Content Validation

Item #	Item Wording
Item 1	Nature plays an important role in my life.
Item 2	I can recall key moments that have positively shaped my relationship with nature.
Item 3	I can recall key moments that have negatively shaped my relationship with nature.
Item 4	When I'm not in nature, I feel a longing to be in natural spaces or around natural things.
Item 5	When I am in places where there is not much nature present or nature is hard to access, I long to be in nature instead.
Item 6	I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.
Item 7	My wellbeing is negatively impacted when I see or hear about bad things happening to nature.

Table 6.8 (continued)

Item #	Item Wording
Item 8	I feel that nature is linked to my personal identity.
Item 9	When I see or hear about natural spaces or habitats being harmed, I feel personally impacted.
Item 10	I believe there is value in having a relationship with nature.
Item 11	I believe it's important to respect nature.
Item 12	I care for nature.
Item 13	I enjoy the risks that I experience in nature.
Item 14	I find nature to be scary.
Item 15	I feel that I need to give back to nature.

Table 6.8 (continued)

Item #	Item Wording
Item 16	I am most connected to nature when in spaces that are familiar to me.
Item 17	I am uncomfortable in nature.
Item 18	Nature exists for humans to use.
Item 20	I find nature to be boring.
Item 21	I find nature to be inherently cruel.
Item 22	I do not care about natural spaces or habitats.
Item 23	Being in nature makes me feel exposed.
Item 24	I seek out routes with nature when commuting.
Item 25	Nature has nothing to offer me.

Table 6.8 (continued)

Item #	Item Wording
Item 26	I see beauty in nature.
Item 27	Nature brings me joy.
Item 28	I avoid routes with nature on my commute.
Item 29	I engage with nature through digital technology.

6.5 Concluding Discussion on Item Development Process

This chapter highlights the co-productive item development process involving an expert working group. Using the qualitative findings from round 1 of a modified-Delphi, the Nature Relationship Working Group developed and reduced an item pool of 60 potential candidate statements to a coherent set of 29 items to measure human-nature relationship quality. To complement the measure development the working group expanded the conceptualisation of what factors contribute to the human nature relationship.

6.5.1 Breadth and content coverage

The item pool demonstrates careful attention to contextual and experiential factors based on findings from the previous studies to prepare for content validity (Boateng et al., 2018). While the experts in the Nature Relationship Working Group come from similar disciplinary backgrounds, the use of previous qualitative findings allowed for a more diverse and experiential representation within the measure's items. By including members from the original expert panel (Chapter 5) it allowed for continuity within the operationalisation of what the code means, and how they were reframed into potential items.

The acknowledgement of the importance of recognising the more negative, but context shaping elements of nature relationships was important to the development of this scale (Barrable & Booth, 2022; Oostvogels et al., 2024). While confusion remained around the potential scoring of these items, the end result is a comprehensive draft measure which covers the full domain of human-nature relationship quality. Where an item was clear yet meaningful there was unanimous agreement to keep it in for content

validation. Simultaneously, items that overlapped in meaning were merged into one. Throughout these meetings the Nature Relationship Working Group continually assessed whether the evolving pool still represented the end goal and the construct in which this measure was being developed. In sum, the iterative drafting and in-group rating process successfully generated a coherent, content-valid item pool aligned with the identified dimensions.

6.5.2 Item refinement criteria

By integrating the modified-Delphi rounds into the scale development it helped to fully consider which items were retained, revised or removed by setting clear agreement criteria. Maintaining clarity of wording, and thematic relevance were prioritised, allowing the group to revise the phrasing at each stage. The group members combined multiple overlapping questions into single clearer items to lessen the burden and potentially unnecessary ‘long item’ measure. These decisions reflect the best practice guidelines that were adapted to shape this process. Specifically the focus on using by expert judgment panels to remove redundant or irrelevant items (Boateng et al., 2018).

6.5.3 Strengths and Limitations of the Co-Productive Model

The co-productive working group model had clear strengths in design. The Nature Relationship Working Group integrated multiple perspectives: Expert’s insights from academics, policy insights from members of a charity organisation and the lived-experience perspective from including interview participants from the previous phase of research. This allowed for diverse worldviews to be taken into perspective as recommended by Norström *et al.* (2020).

A limitation of the study however is the focus on environmental psychology expertise in the working group. The inclusion of more diverse academic perspectives

could have broadened the perspective and brought to light more diverse gaps or potential uses of the proposed measures among different disciplines. There was a risk of bias towards environmental psychology perspectives and theoretical underpinnings.

A final limitation was the length of the process. Maintaining engagement within a group of primarily academics over a 9-month period proved challenging and required careful coordination. Likewise, managing expectations within the group was a struggle. The breadth of perspectives, while a strength, sometimes made refinement difficult. Connected to the previous mention of biases, there were times where negotiations needed to be made between the research team and working group member as suggestions of highly specific or theoretically framed items were suggested but did not align with the overall perspective of the research.

6.5.4 Methodological Reflexivity

As a working group we have strived for transparency about the choices that were made at each stage of item generation and refinement, in line with calls for reflexivity in measurement development (Rowan & Wulff, 2015). Every decision and associated comment was explicitly documented to provide clear rationale for each decision. An example of this is the “what nature means to you” stemming from group discussion about how to include this complex finding from the qualitative study (Chapter 5). While we acknowledge that this item is unusual for a quantitative measure, we retained it for its practical utility in applied settings. Given the combination of findings from literature (Boateng et al., 2018; Dima, 2018) and the qualitative study it was clear that no one definition of nature is universally accepted. This open question allows for more adaptability and accessibility of the future measure, and allows the user to get a deeper understanding of the participants' relationship with ‘their’ nature.

Rowan & Wulff (2015) note that when using qualitative data to develop measures it is important to detail the early stages as it can highlight the convergence or divergence of individual assumptions and theoretical assumptions. By keeping detailed logs of the discussion and making our item development process explicit, we have not only followed best practices for scale documentation but also increased our awareness of possible biases. We hope that this reflexivity strengthens the validity of the final scale, as future users can understand the origins and limitations of each item.

6.5.5 Implications for Future Phases

The output of this phase sets the stage for rigorous validation (Chapter 7) for practical application. The next steps will include content validation with an external expert panel, pilot testing with the Nature Relationship Working Group and finally large-scale validation for item reduction and extraction, as recommended in scale-development frameworks.

Based on the findings of the factor analysis (Chapter 7), further item reduction or restructuring. Importantly, the pluralistic insights gained in this research imply the scale may have subscales for specific contexts (e.g. psychotherapy or research specific settings). The aforementioned inclusion of an open-ended question suggests an avenue for use in interventions, allowing providers to personalise the intervention. However, for general research use this could be replaced with a concise and a discipline definition of “nature” as needed.

The main implication of this research is a new perspective on scale development. The co-productive item-development phase, integrated with the modified-Delphi approach provides guidance for future studies to consider the inclusion of qualitative methods into the design process. By documenting the progression through a large item

pool including group decisions and discussions can serve as a model for other mixed-methods measurement projects (Bishop, 2015; Creswell & Clark, 2017; Koller et al., 2017). This process promotes transparently and reflexively building a strong foundation for the scale's future use in both research and practice.

Chapter 7: Validation of the Nature Relationship Quality Measure

7.1 Introduction

Much of the empirical research to date has explored human-nature relationships in the context of the positive levels of connectedness an individual feels with the natural world and how that can act as a predictor of wellbeing and pro-environmental behaviour (Capaldi et al., 2014; Lumber et al., 2017). Constructs like *nature relatedness*, *inclusion of nature in self* or *nature connectedness* capture how individuals perceive their positive interactions with nature as contributing factors to their affective, cognitive and behavioural identity within nature (Clayton & Opatow, 2003; Mayer & Frantz, 2004; Nisbet et al., 2011; Schultz, 2002; Tam, 2013).

Despite the increase in nature connectedness and relatedness scales over the past two decades, conceptual and methodological gaps persist in the literature, collectively justifying the exploration and development of a new instrument (Keaulana et al., 2021; Ives et al., 2017). Specifically, current measures over-emphasise connectedness as a general trait-based affinity towards nature which under-represents much of what was presented in the results of Chapter 5 of this research. There appears to be a lack of acknowledgement of the complexity involved in the dynamic.

Relational Models Theory (Fiske, 1991), however, has been seen to inform the conceptualisation and understanding of human-nature relationships in practice (Petersen et al., 2019). Fiske (1991, 2004) views social interactions as based on four models: Communal Sharing which involves experiencing a shared identity; Authority Ranking in which hierarchal ordering of those involved occurs; Equality Matching where you strive for equal treatment of all involved; and Market Pricing in which interactions are evaluated based on the give and take, or cost-benefit of the interaction. Many of the items developed

by the Nature Relationship Working Group in Chapter 6 align with this style of thinking, however little to no research exists that empirically supports this as of yet.

Following established scale-development frameworks, this chapter reports three sequential studies, which follow the sequence of activities laid out in Figure 7.1, the steps of the modified-Delphi study. Following the guidelines set out by Boateng et al.'s (2018) paper on best practices in scale development a number of steps were taken to produce a valid and reliable measure. This chapter will be divided up into three separate studies. First, a panel of subject-matter experts (N=5) rated an initial pool of 29 items for relevance to construct. In Study 2, the Nature Relationship Working Group provided further input on the remaining items following refinement from Study 1. Finally, Study 3 used a larger survey sample (N=214) to conduct Exploratory Factor Analysis and Confirmatory Factor Analysis, alongside reliability and validity analyses.

The overall goal of this collection of studies is to establish a valid and reliable measure of human-nature relationship quality. In the following sections, the methods and the results of each study will be presented, followed by a discussion of the findings and the implications this measure has for research and practice. This research has a number of research aims:

Aim 7.1: To evaluate the preliminary Quality of Human-Nature Relationship Scale item pool via a Subject Matter Expert Panel to ensure items are relevant and representative of the Human-Nature Relationship construct.

Aim 7.2: To refine Quality of Human-Nature Relationship Scale items as appropriate for inclusion in a subsequent validation study.

Aim 7.3: To identify the underlying factor structure of the Quality of Human-Nature Relationship Scale and assess model fit for that structure.

Aim 7.4: To assess the internal consistency of the Quality of Human-Nature Relationship Scale for the total scale and any potential subscales.

Aim 7.5: To explore the Quality of Human-Nature Relationship Scale's convergent, discriminant and concurrent validity.

Figure 7.1

Steps of Modified-Delphi Being Discussed in Chapter 7



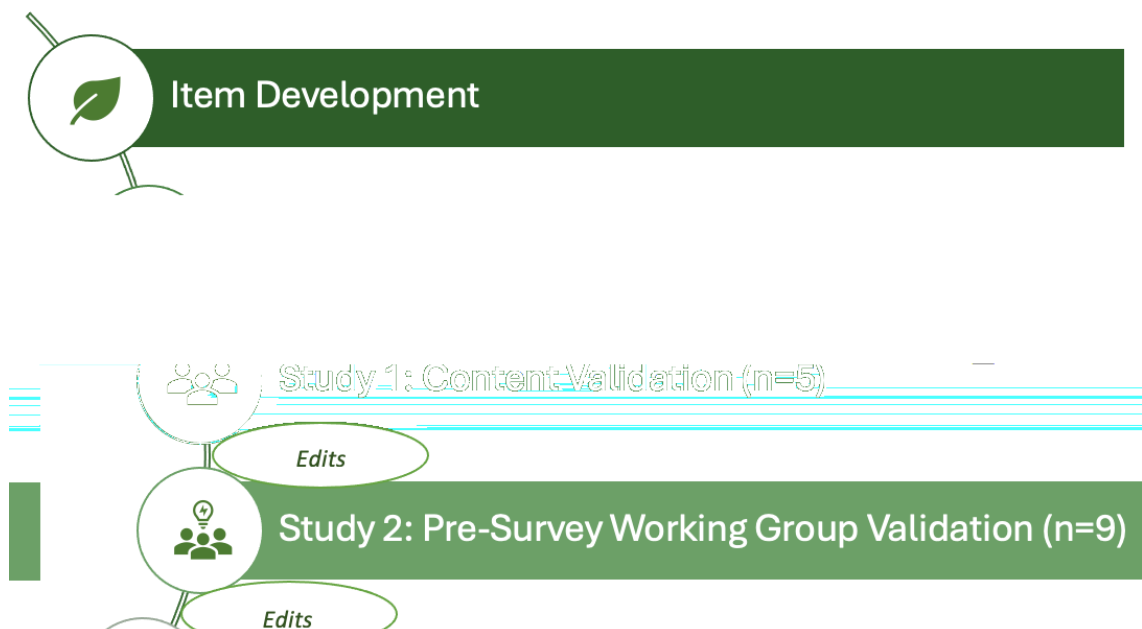
Note. SME refers to Subject Matter Experts.

7.2 Methods

The following sections will outline the 3-study process involved in validating the new measure of Quality of Human-Nature Relationships (QHNR). Ethical approval was obtained for the three studies under the same ethics application: SRESC-2023-36583. The 3 studies follow the best practice guidelines for scale development and validation as laid out by Boateng and colleagues (2018). In line with these guidelines, Study 1 outlined the process of content validation using an external panel of subject matter experts, Study 2 refers to the Nature Relationship Working Group Pre-Survey Validation process in which the working group reviewed and refined items based on the results of the external content validation, and finally Study 3 examined the scale's factor structure, reliability, and external validity in a larger sample.

Figure 7.2

Flow of Scale Validation Process



7.2.1 Study 1: Content Validation (Delphi Round 3)

7.2.1.1 Participants

Subject matter experts (SMEs) were recruited to evaluate the content validity of the items proposed in the Quality of Human-Nature Relationship Scale. Subject matter experts were selected based on their history of having published research on topics related to human nature connection, human nature relationships or nature engagement. A panel of 10 potential subject matter experts was proposed by the Nature Relationship Working Group. These panel members were individual who had not been a participant of this research project to date (Phase 2 or 3). This ensured that all opinions were coming from external bodies. All panel members were contacted by the researcher following a systematic search of recently published peer reviewed articles in environmental psychology. Five (50%) took part in the validation process. No demographic information was collected from the participants. A total of five subject matter experts took part, which meets the requirement for content validation (Lynn, 1986; Polit et al., 2007).

7.2.1.2 Design

Study 1 employed the modified-Delphi design to establish content validity of the new Quality of Human-Nature Relationship Scale items. In a Delphi process, experts rate items and provide feedback iteratively to achieve consensus. This was the third round of the modified-Delphi following a qualitative round to gain understanding into the concept of human-nature relationships. The results of that study were then shared with an external working group (See Chapter 6) to rate their relevance to the overall concept. This round focuses on resolving any differences in conceptualisation from round 2. This includes steps 11-13 of the modified-Delphi study (Figure 7.1).

7.2.1.3 Measures

The measure under review was the 29-item Quality of Human-Nature Relationship Scale draft questionnaire, developed from a combination of the qualitative work from Chapter 5 and the co-production work in Chapter 6. Each item was a statement about one's relationship with nature (see Table 7.1) to be rated for relevance to the construct.

Table 7.1*29 Items Sent for External Content Validation*

Item #	Item Wording
Item 1	Nature plays an important role in my life.
Item 2	I can recall key moments that have positively shaped my relationship with nature.
Item 3	I can recall key moments that have negatively shaped my relationship with nature.
Item 4	When I'm not in nature, I feel a longing to be in natural spaces or around natural things.
Item 5	When I am in places where there is not much nature present or nature is hard to access, I long to be in nature instead.
Item 6	I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.
Item 7	My wellbeing is negatively impacted when I see or hear about bad things happening to nature.
Item 8	I feel that nature is linked to my personal identity.
Item 9	When I see or hear about natural spaces or habitats being harmed, I feel personally impacted.
Item 10	I believe there is value in having a relationship with nature.
Item 11	I believe it's important to respect nature.
Item 12	I care for nature.

Table 7.1 (continued)

Item #	Item Wording
Item 13	I enjoy the risks that I experience in nature.
Item 14	I find nature to be scary.
Item 15	I feel that I need to give back to nature.
Item 16	I am most connected to nature when in spaces that are familiar to me.
Item 17	I am uncomfortable in nature.
Item 18	Nature exists for humans to use.
Item 19	I do not care when nature is harmed.
Item 20	I find nature to be boring.
Item 21	I find nature to be inherently cruel.
Item 22	I do not care about natural spaces or habitats.
Item 23	Being in nature makes me feel exposed.
Item 24	I seek out routes with nature when commuting.

Table 7.1 (continued)

Item #	Item Wording
Item 25	Nature has nothing to offer me.
Item 26	I see beauty in nature.
Item 27	Nature brings me joy.
Item 28	I avoid routes with nature on my commute.
Item 29	I engage with nature through digital technology.

7.2.1.4 Procedure

The subject matter experts were asked to rate 29 Quality of Human-Nature Relationship Scale items in a questionnaire. They were asked to rate how relevant they thought each question was to the overall construct of human-nature relationship quality. They were provided with a five-point Likert rating scale (0 = *unsure*, 1 = *not relevant*, 2 = *somewhat relevant*, 3 = *relevant*, 4 = *extremely relevant*). Following guidelines, ratings of 3 or 4 were established as representing relevance. Higher scores indicated greater relevance (Polit et al., 2007).

7.2.1.5 Analysis

Item Level Content Validity Index (I-CVI) was calculated for each individual item. Items with an I-CVI of .80 were retained for further analysis as per best practice guidelines (Boateng et al., 2018; Lynn, 1986; Polit et al., 2007). As there were five experts, an I-CVI of 0.80 corresponds to four of five experts endorsing relevance. At the time of this study the Nature Relationship Working Group were considering producing a profile building measure (see Chapter 6), however these results do not provide relevance to the final measure being reported upon in this study so will not be reported on in this thesis. Because of this, the subject matter experts were also asked to decide if the items fit a positive scale, a negative scale or a profile building scale. Finally, all participants were given an open text option for each item to provide suggested feedback which fed into the Nature Relationship Working Group co-production process outlined in Chapter 6.

7.2.2 Study 2: Pre-Validation Survey (Delphi Round 4)

7.2.2.1 Participants

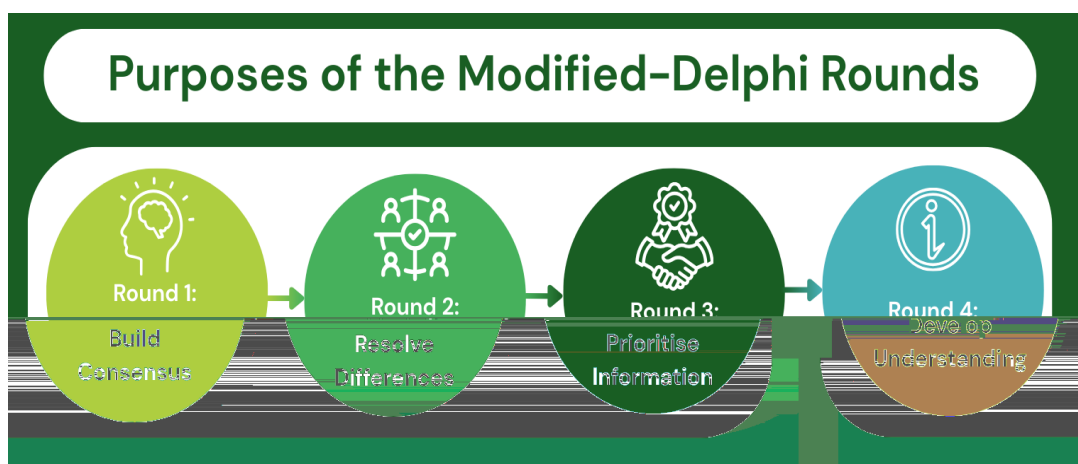
The pre-validation survey was distributed to the Nature Relationship Working Group described in Chapter 6. All members of the Nature Relationship Working Group were invited via email; those who provided consent ($N = 9$) participated in the survey. There was no overlap between participants in Study 1 and Study 2.

7.2.2.2 Design

This study was the fourth and final round of the modified-Delphi method (steps 14 and 15 on Figure 7.1), serving as means to prioritise information (Figure 7.3). This was categorised as a pre-testing phase to refine the item pool one last time before large-scale data collection and after receiving feedback from the previous subject matter expert panel. This stage helped ensure the items were understandable and acceptable to practitioners and researchers in the field.

Figure 7.3

Purpose of Each Modified-Delphi Round



7.2.2.3 Measures

The survey included the revised Quality of Human-Nature Relationship Scale items that remained after the results of Study 1 (17 items in total). The participants were asked to choose between two options, 1 = *I'm happy with this item* or 2 = *Suggested change*. For those who chose option 2 they were asked to fill out the open text box with a suggested change for the item. No formal quantitative analysis, such as CVI calculations, was performed at this stage, simply just a percentage agreement rate. The goal was to prioritise information and confirm that the items were acceptable for the purpose of research and practice use. As this was the final round of the modified-Delphi process, an agreement rate of 65% was used pragmatically to indicate item acceptability at this refinement stage. This threshold was selected to support prioritisation rather than to establish final consensus.

7.2.2.4 Procedure

An online questionnaire was distributed to the full working group email list. Members were given two weeks to review and provide feedback. Based on this input, minor item refinements were made before the final measure was created.

7.2.3 Study 3: Factor Analysis, Reliability and Validity

Both exploratory and confirmatory factor analyses were conducted on the data set of 214 participants. Due to the available sample size, the Exploratory Factor Analysis and Confirmatory Factor Analysis were conducted on the same dataset. The researcher acknowledges that this is not best practice (Badenes-Ribera et al., 2020; Boateng et al., 2018) and as such the Confirmatory Factor Analysis is interpreted as an assessment of the model fit within this sample rather than as a fully independent cross-validation. Further

validation of this scale must be conducted before use. The product of this study should be seen as a pilot validation.

7.2.3.1 Participants

A total of 214 participants took part in the final validation study (age range 18–69 years, $M = 36.25$, $SD = 12.56$). Most participants identified as female (79.4%), while 17.3% identifying as male and 1.9% as non-binary. A total of 0.9% preferred not to identify their gender, and 0.5% self-identified using another label. The majority reported English as their first language (71.0%).

Participants were recruited via student populations at working group partner universities, social media posts (e.g., Instagram, Facebook, Reddit) and online survey platforms (Survey Circle and Survey Swap). The survey recruited student and academic staff populations as per the ethical application form approved by Maynooth University SRESC-2023-36583. 23.8% of participants were students, 36.4% were in full-time employment, 8.9% were in part-time employment, and 30.8% stated they were simultaneously students and employees. This sample size yields just under a 12:1 respondent-to-item ratio for this 18-item scale, satisfying the recommendation of at least 10 participants per item for factor analysis. All participants provided informed consent and completed the survey completely anonymously.

7.2.3.2 Design

Study 3 used a cross-sectional correlational design. Participants completed an online questionnaire containing the final 18-item Quality of Human-Nature Relationship Scale measure alongside additional measures (outlined below) for validity testing. Data collection and entry were managed in Qualtrics survey software and subsequently exported to SPSS and R for analysis. The primary analyses were Exploratory Factor

Analysis and Confirmatory Factor Analysis to assess the dimensional structure of the Quality of Human-Nature Relationship Scale. Firstly, item reduction and factor extraction were completed, and subsequent tests of dimensionality were conducted following Boateng et al.'s (2018) framework. Internal consistency (Cronbach's α), construct validity analyses and concurrent validity analyses completed the evaluation (Badenes-Ribera et al., 2020; Murphy et al., 2024).

7.2.3.3 Measures

The survey began with a number of demographic questions (Appendix L) followed by a number of measures used to test for validity and reliability. Each will be described in terms of the number of items, their reliability measure and their purpose in this study.

- 1. Quality of Human-Nature Relationship:** Participants responded to the final set of Quality of Human-Nature Relationship Scale items (18 statements, Table 7.7) on a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). Items assessed aspects of emotional connection to nature, identity formation and nature, and concern for nature. Higher scores indicate a higher-quality human-nature relationship. This was the measure which was being validated in this study.
- 2. Nature Relatedness:** The NR-6 scale (6 items) developed by Nisbet and Zelenski (2013) was used as a measure of trait nature connectedness with a Cronbach's α which ranged from .83 and .86 (Nisbet & Zelenski, 2013). The longer version was considered however maintaining participants attention and not overloading them with measures was an important consideration for this study. Participants rate items like "*My relationship to nature is an important part of who I am*" on a 5-point Likert scale from 1 = *disagree strongly* to 5 =

agree strongly. This was used to test for convergent validity to explore if the Quality of Human-Nature Relationship Scale is measuring the same construct (Indu et al., 2025). Within this study NR-6 had a Cronbach's α of .75.

3. **Empathy:** The Toronto Empathy Questionnaire (TEQ; Spreng et al., 2009) is used to measure general interpersonal empathy. This is a 16-item self-report measure which assesses emotional empathy ("*I can often understand how other people are feeling even before they tell me.*"). The measure has a Cronbach's α of .85. TEQ was included as a means to test for convergent validity as the new conceptualisation of Human-Nature Relationships suggest that it should reflect experiences and emotions similar to those in human-human relationships. Empathy was chosen as it reflects shared experiences and emotions, similar to the ideas highlighted in Chapter 5. Within this study TEQ had a Cronbach's α of .88.
4. **Internet Addiction:** The Internet Addiction Test (IAT; Young, 1998) is a 20-item scale measuring excessive internet use and dependency. It is rated using a 6-point scale ranging from 0 = *not applicable* and 5 = *always*. It has a Cronbach's α of .91 (Young, 1998). It is anticipated that there would be low or no correlation with IAT would support discriminant validity, as it refers to a completely independent and unrelated construct. Within this study IAT had a Cronbach's α of .93.
5. **Well-Being** Wellbeing was explored using the WHO-5 Well-Being Index (5 items) to assess psychological well-being The WHO-5 asks participants to rate positive well-being statements ("*I have felt cheerful and in good spirits*") over the past two weeks on a 6-point Likert scale from 0 = *at no time* to 5 = *all of the time*. WHO-5 has a Cronbach's α between .81 and .90 among different samples (Topp et al., 2015). WHO-5 was used to test for concurrent validity

with the Quality of Human-Nature Relationship Scale. It was hypothesised that Quality of Human-Nature Relationship Scale would be associated with higher well-being. Within this study WHO-5 had a Cronbach's α of .85.

- 6. Pro-Environmental Behaviour:** Pro-environmental behaviour was measured using the Pro-Environmental Behavior Scale (PEBS) developed by Larson et al. (2015). The scale contains 13 self-report items covering four domains of PEB: conservation lifestyle (recycling; conserving water), land stewardship (actions to support wildlife habitat), social environmentalism (engaging with others about environmental issues), and environmental citizenship (civic behaviours such as voting, donating). Participants rated how often they engaged in each behaviour on a 5-point frequency scale (1 = *never* to 5 = *very often*) with a sum score calculated at the end. The original study reported the Cronbach's α for each independent subscale. Conservation Lifestyle was .79, Land Stewardship was .64, Social Environmentalism was .78 and Environmental Citizenship was .84. Within this study the full PEBS had a Cronbach's α of .84.

7.2.3.4 Procedure

Following recruitment, a large scale survey including all aforementioned measures was administered via Qualtrics online survey platform where participant anonymity was maintained. An embedded attention check (Item 9, with "*Disagree*" as the instructed response) was used to identify inattentive responding. A total of 15 participants (6.9%) answered this item incorrectly; however, including or excluding these participants did not materially change the pattern of results, so the full sample (N = 214) was retained for the primary analyses.

7.2.3.5 Data Analysis

Prior to factor analysis, we examined data suitability using the Kaiser–Meyer–Olkin measure and Bartlett’s test of sphericity. For the Exploratory Factor Analysis, principal-axis factoring with oblimin rotation was used. Eigenvalues (>1) and a scree plot (Figure 7.4) were reviewed to decide the number of factors, retaining items with primary loadings $\geq .40$ and minimal cross-loadings (Indu et al., 2025). After identifying a provisional factor structure, a Confirmatory Factor Analysis was conducted in order to test model fit of the proposed factor structure. Model fit was evaluated using multiple indices: χ^2 , Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR; Boateng et al., 2018).

Analysis for internal consistency (Cronbach’s α) for the total scale and subscales was conducted, and item–total correlations were explored. Convergent, discriminant, and criterion validity were assessed via Pearson correlations between Quality of Human–Nature Relationship Scale scores and the external measures listed above. Exploratory Factor Analysis was conducted using SPSS statistical software, while Confirmatory Factor Analysis, reliability and validity analyses were conducted using R (lavaan package). The change in software was due to constraints in access to SPSS external software to run Confirmatory Factor Analysis.

7.3 Results

Each of the results from the three studies will now be presented independent of each other.

7.3.1 Results from Study 1: Content Validation

Results will be presented from both the quantitative results and the qualitative data in this study. As outlined in the section 7.2.1 this study involved calculating I-CVI scores with those attaining $\geq .80$ were retained. Table 7.2 showcases the individual items (N=29) and their I-CVI score.

Table 7.2*Item-Level Content Validity Index Analysis Table for Scale Items*

Item	Phrasing	I-CVI	Decision
Item 1	Nature plays an important role in my life.	1	Keep
Item 2	I can recall key moments that have positively shaped my relationship with nature.	1	Keep
Item 3	I can recall key moments that have negatively shaped my relationship with nature.	0.6	Remove
Item 4	When I'm not in nature, I feel a longing to be in natural spaces or around natural things.	1	Keep
Item 5	When I am in places where there is not much nature present or nature is hard to access, I long to be in nature instead.	0.6	Remove
Item 6	I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.	0.8	Keep
Item 7	My wellbeing is negatively impacted when I see or hear about bad things happening to nature.	0.8	Keep
Item 8	I feel that nature is linked to my personal identity.	0.8	Keep
Item 9	When I see or hear about natural spaces or habitats being harmed, I feel personally impacted.	0.6	Remove
Item 10	I believe there is value in having a relationship with nature.	0.6	Remove
Item 11	I believe it's important to respect nature.	0.8	Keep

Table 7.2 (continued)

Item	Phrasing	I-CVI	Decision
Item 12	I care for nature.	0.8	Keep
Item 13	I enjoy the risks that I experience in nature	0.4	Consider*
Item 14	I find nature to be scary.	0.2	Consider
Item 15	I feel that I need to give back to nature.	0.8	Keep
Item 16	I am most connected to nature when in spaces that are familiar to me.	0.6	Remove
Item 17	I am uncomfortable in nature.	0.6	Remove
Item 18	Nature exists for humans to use.	0.2	Consider
Item 19	I do not care when nature is harmed.	0.4	Remove
Item 20	I find nature to be boring.	0.6	Remove
Item 21	I find nature to be inherently cruel.	0.4	Remove
Item 22	I do not care about natural spaces or habitats.	0.4	Remove
Item 23	Being in nature makes me feel exposed.	0.2	Consider
Item 24	I seek out routes with nature when commuting.	0.8	Keep

Table 7.2 (continued)

Item	Phrasing	I-CVI	Decision
Item 25	Nature has nothing to offer me.	0.2	Consider
Item 26	I see beauty in nature.	0.8	Keep
Item 27	Nature brings me joy.	0.8	Keep
Item 28	I avoid routes with nature on my commute.	0.4	Remove
Item 29	I engage with nature through digital technology.	0.6	Remove

Note. * Considered in the refinement activity due to qualitative comments from content validation process.

Following the analysis seven items had a score of 1 while eight items received a score 0.75 agreement. This left a total of 13 items (Item 1, Item 2, Item 4, Item 6, Item 7, Item 8, Item 11, Item 12, Item 15, Item 16, Item 24, Item 26 and Item 27) to undergo further validation.

Items which had the lowest score of 0.20 (Item 14, Item 18, Item 23 and Item 25) were brought to the working group members following revaluation using the qualitative comments from the subject matter experts. Item 13 was also brought to the working group given the qualitative comments received by the expert group referring to the item as interesting but dependent on the context. Given the emphasis on the more negative elements of nature in the qualitative interview phase of which these items attempted to highlight the more adverse elements of nature, there is potential that the panel, which was made up of researchers in the area, will have an element of bias towards the pre-existing literature on this topic. For this reason, a lower acceptance rate for this category is considered for further exploration given the novelty of this element.

Table 7.3 outlines the qualitative results from the open text option for each scale item. This allowed all subject matter experts to provide further context to their ratings and make suggestions regarding the phrasing. These qualitative results were shared with the Nature Relationship Working Group for further refinement before full validation.

Table 7.3*Qualitative Responses from Content Validation Process*

Item	Phrasing	Qualitative Response
Item 1	Nature plays an important role in my life.	People working in the field, living in the country, or working in nature will answer differently to those unaware or who do not enjoy the same access. It is important to reach as wide an audience as possible. It would be good to have a definition of the word "nature" before or even better a question before that will provide an understanding of what the participants regard as nature when they talk about their relationship about it. Otherwise, one might think of their garden, and the next of the ocean and another of the planet. At least how "abstract" the level of nature is that participant think of, should be made visible Great way of thinking back to good memories - it would be very insightful to add a qualitative open-end here to ask participants to relate short nature memories so you can see what these positive moments are typically
Item 2	I can recall key moments that have positively shaped my relationship with nature.	
Item 3	I can recall key moments that have negatively shaped my relationship with nature.	Likewise, this is an important way to understand how there are areas where people may perhaps be wary in nature.

Table 7.3 (continued)

Item	Phrasing	Qualitative Response
Item 4	When I'm not in nature, I feel a longing to be in natural spaces or around natural things.	This is a really nice question for me since I've consciously realised my need to be in nature. It denotes how someone recognises their need for nature. For those who haven't thought about it much, however, they might find it a bit too much. It may be easier for some to answer that they haven't been in nature for a while they have a longing to get back to it. So it is more like they need another dose.
Item 5	When I am in places where there is not much nature present or nature is hard to access, I long to be in nature instead.	Perhaps the word instead is too strong - because sometimes we need to be in places with no nature so this is creating a false choice. The words 'as soon as possible' could be used instead of 'instead'. Or you could say that you long to bring nature to those spaces (maybe this is over-complicating things). I feel this question is somewhat similar to the one above - could maybe be combined to one question?
Item 6	I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.	Initially I thought this worked well - but you could say most of us can use sight for nature so could answer yes to this which is quite different from the others (with touch/taste possibly being the least used). I assume you can't create questions within the question to ask which of the senses they tend to use Well... everyone has to say "yes" to how this question is proposed (you cannot connect to anything without the senses) So, maybe a differentiation between the use of single and multiple senses could be fruitful

Table 7.3 (continued)

Item	Phrasing	Qualitative Response
Item 7	My wellbeing is negatively impacted when I see or hear about bad things happening to nature.	The word 'wellbeing' might be a bit strong as we often use it as a polite synonym for our mental health - you could say 'It impacts me negatively'...or 'I feel sad'
Item 8	I feel that nature is linked to my personal identity.	Before I specialised in this field I would not have said it was linked to my identity but through that awareness (and growing relationship) I now would say it does
Item 9	When I see or hear about natural spaces or habitats being harmed, I feel personally impacted.	Like the one above about wellbeing this could be a bit strong to be 'personally impacted'.
Item 10	I believe there is value in having a relationship with nature.	The word 'relationship' here might seem odd to some people (even though that's what you've found) Everyone has "a relationship" with nature - it is just very differently shaped, so maybe the direction or character of the relationship should be stated
Item 11	I believe it's important to respect nature.	Respect can be interpreted many ways - not disrespecting e.g. by littering, or just feeling a sense of respect
Item 12	I care for nature.	This is a really clear and simple way of gauging their values

Table 7.3 (continued)

Item	Phrasing	Qualitative Response
Item 13	I enjoy the risks that I experience in nature	This could be tricky to answer - because of the two aspects of enjoyment and risks - also depends on the type of nature seen as risky and why
Item 14	I find nature to be scary.	This almost needs a qualifier e.g. some types/aspects of nature as it almost implies all nature
Item 15	I feel that I need to give back to nature.	This is a nice simple way of saying e.g. that you also need to give back in a relationship
Item 16	I am most connected to nature when in spaces that are familiar to me.	I struggle with this one as it doesn't have to be familiar to feel connected in my view - it can be about a special moment in time
Item 17	I am uncomfortable in nature.	This could be interpreted as physically uncomfortable or perhaps even mentally uncomfortable
Item 18	Nature exists for humans to use.	I really struggle with this one as there are some forms of nature that humans do use e.g. for wood or when growing our own food - so a person could hold the view that nature is not for human use but also use it so it could be contradictory
Item 19	I do not care when nature is harmed.	This question works better I think than the ones about personal wellbeing etc - as it is just very simple

Table 7.3 (continued)

Item	Phrasing	Qualitative Response
Item 20	I find nature to be boring.	It is good you have this because some people will find it boring - you could also say 'being in nature' - do you have a positive opposite of this one? e.g. I find that nature captures my attention?
Item 21	I find nature to be inherently cruel.	This is somewhat strange to me - but I also think it is somewhat true but it is hard to interpret e.g. you could say taking away the beauty of a flower in blossom seems cruel as it withers back only to be reborn again is somewhat cruel?
Item 22	I do not care about natural spaces or habitats.	do you have a positive version of this one - would work well
Item 23	Being in nature makes me feel exposed.	Hard to say in what way 'exposed'
Item 24	I seek out routes with nature when commuting.	This is a really good question in my opinion as it is really a conscious choice to seek out nature - and something many could relate to
Item 25	Nature has nothing to offer me.	

Table 7.3 (continued)

Item	Phrasing	Qualitative Response
Item 26	I see beauty in nature.	This is a nice simple question but one could also answer the opposite that I see ugliness in nature
Item 27	Nature brings me joy.	A bit like in a relationship - does another thing/person make you happy or do you make yourself happy? in this case do you bring yourself joy when you are in nature?
Item 28	I avoid routes with nature on my commute.	Again, some people may do exactly this - perhaps for safety reasons or others e.g. allergies - again it could be good to have an open-ended follow up
Item 29	I engage with nature through digital technology.	You might need to define digital tech here because it could be widely interpreted

7.3.2 Results from Study 2: Pre-Validation Survey

Following a review of the qualitative responses from Study 1 minor changes were made by the Nature Relationship Working Group. Following a meeting to discuss the responses to the content validation the Nature Relationship Working Group completed one final Pre-Validation survey aimed at prioritising information. Table 7.4 outlines the final agreement rates and suggested changes to items. Based on the responses from Study 1 and Study 2 the following changes were made. Firstly, the item phrased as '*I enjoy the risks that I experience in nature*' was altered slightly to read as '*I enjoy the adventures I experience in nature.*' Similarly, item 23 '*Being in nature makes me feel exposed*' transformed into '*Being in nature makes me feel vulnerable.*' Items regarding longing for nature were combined and transformed into '*When I'm not in nature, I feel a desire to be in natural spaces or around natural things.*' The following items were completely removed from the proposed measure:

- *I can recall key moments that have negatively shaped my relationship with nature.*
- *When I see or hear about natural spaces or habitats being harmed, I feel personally impacted.*
- *I believe there is value in having a relationship with nature.*
- *I do not care about natural spaces or habitats.*
- *I find nature to be boring.*
- *I engage with nature through digital technology.*
- *I avoid routes with nature on my commute.*
- *I find nature to be inherently cruel.*
- *I do not care when nature is harmed.*
- *I am most connected to nature when in spaces that are familiar to me.*

Table 7.4*Working Group Agreement Rates for Final Scale Items*

Item	Agreement %	Comments
Nature plays an important role in my life.	100	
I can recall key moments that have positively shaped my relationship with nature.	88	I can think about times in my life that have build my positive relationship with nature
When I'm not in nature, I feel a longing to be in natural spaces or around natural things	78	could shorted it to: When I'm not in nature, I long to be in natural spaces or around natural things. Desire instead of longing
I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.	67	I wonder if we should say "... of my available physical senses" - ? Could it be useful to also include vestibular and proprioceptive? I could see how some people might connect with nature by using it for bodily feedback (if that makes sense) Because we cant find out from this question whether people are using 'some' or 'all' of their senses I think you could say ' I use my available senses....'
My well-being is negatively impacted when I see or hear about bad things happening to nature.	100	

Table 7.4 (continued)

Item	Agreement %	Comments
I feel that nature is linked to my personal identity.	100	
I believe it's important to respect nature.	100	
I care for nature.	78	Is this emotional caring - as in "I care about nature" or is this an action "I care for nature"? Both are probably good to ask - although - but if I had to choose one I would choose 'i care about nature' given that the question below speaks to the caring "for" nature. Does this mean 'I act in a way that helps take care of nature' or 'I have strong positive feelings for nature'?
I feel that I need to give back to nature. -	89	I feel that I want to give back to nature
I seek out routes with nature when commuting.	67	I seek out routes where nature is available when commuting I seek out routes in nature when commuting. I think this is a tricky one as I can see the value of this but this is a functional activity that many don't have all that much of a choice about. If someone is limited to a specific form of commuting, does that make them less connected? It could be that others disagree, it just seems to me that specifically looking at commuting (an activity which has connotations of going to work rather than moving from one place to another for any reason) may be reductive and likely to be coloured by the person's context rather than the strength of the person's relationship. I could see the value of identifying if someone preferred to have nature in their commute but I wouldn't think someone not seeking out a specific route would necessarily mean that they were less connected (unless we consider including a range of context specific items in the scale, which we may do (I haven't seem them all yet!))

Table 7.4 (continued)

Item	Agreement %	Comments
I see beauty in nature.	89	Could it be important to qualify this - e.g., 'in some natural things'. Just thinking about some of the more negative/destructive elements of nature, and I'm not sure I'd say I see beauty in those, but they are still nature.
Nature brings me joy.	78	Yes - depending on the other emotions listed. e.g. peace, contentment etc. Nature generally brings me joy - to account for people who might experience eco-grief and eco-anxiety as a consequence of a close relationship with nature

Secondly the working group were asked to rate whether they believed a number of items represented negative items that we would need to reverse code, or if the negative connotation added value to the quality of the relationship. Five items were presented to the group, firstly *I enjoy the risks in nature*, with 78% of the group agreeing it represented a positive addition to the relationship. The four other items were all deemed negative items: *Nature exists for humans to use* (78%), *I find nature scary* (67%), *Being in nature makes me feel exposed* (78%) and *Nature has nothing to offer me* (89%). All these items were considered for reverse scoring. The final question referred to the Likert scale option. The group was asked if they agree with the 7-point Likert ranging from 1 = *strongly agree* to 7 = *strongly disagree*. 67% of the group agreed, while those that disagreed pointed out that it should be flipped to 1 – *strongly disagree* to 7 = *strongly agree*. This change was made for final validation.

7.3.3 Exploratory Factor Analysis (Study 3 - Part 1)

An Exploratory Factor Analysis was conducted on the 18 items that remained in the nature relationship scale following the content validation. This was done using principal axis factoring with oblimin rotation and Kaiser normalization in SPSS version 30. The suitability of the data for factor analysis was assessed prior to extraction. The Kaiser–Meyer–Olkin measure of sampling adequacy was .89, and Bartlett’s test of sphericity was significant, $\chi^2(153) = 1952.10, p < .001$, both indicating that the data was suitable for factor analysis. Initial eigenvalues indicated that four factors had eigenvalues > 1.00 (7.13, 1.83, 1.56, and 1.08), together accounting for 64.41% of the total variance. After extraction, these four factors accounted for 54.49% of the variance. Inspection of the scree plot (Figure 7.4) supported a four-factor solution. Items with primary loadings of at least .40 on a single factor and minimal cross-loadings were retained as candidate

indicators of that factor. Items with weak primary loadings ($< .40$) or substantial cross-loadings were considered for removal.

Figure 7.4

Scree Plot of Eigenvalues from the Exploratory Factor Analysis of Nature Relationship Items

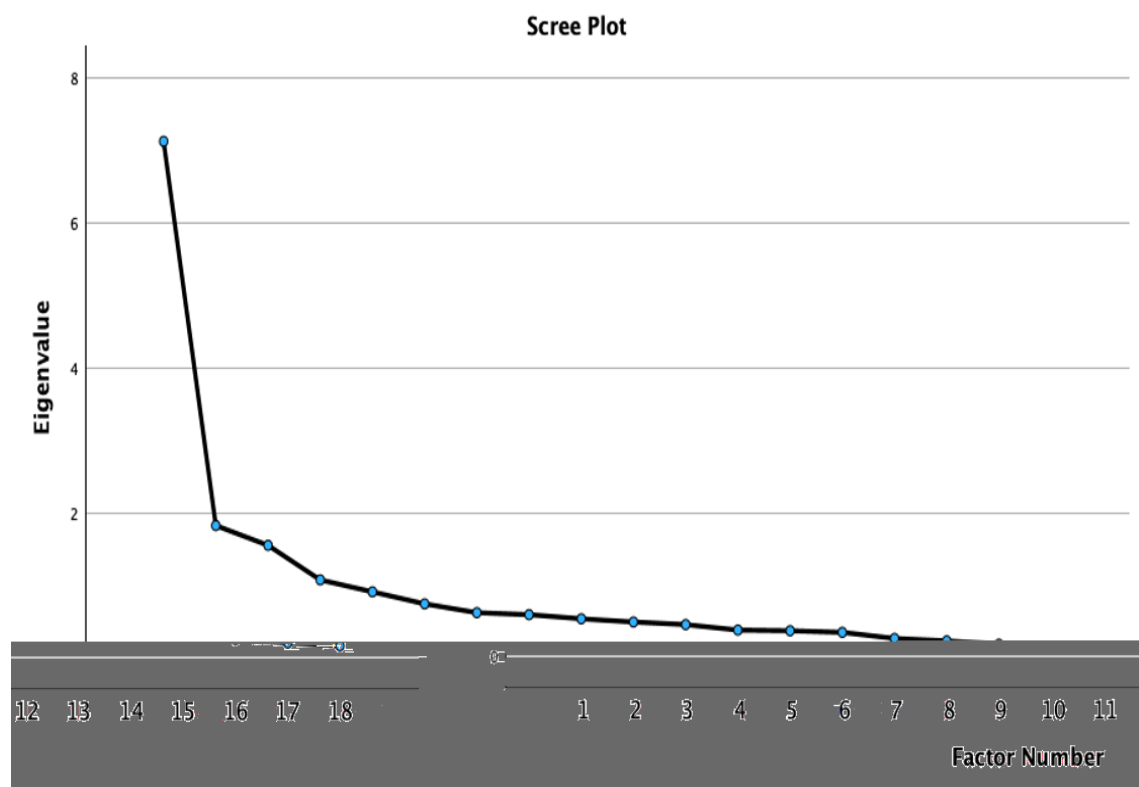


Table 7.5*Pattern Matrix for the Quality of Human–Nature Relationship Scale*

Item	Factor	Factor	Factor
	1	2	3
Nature plays an important role in my life.	.81		
When I'm not in nature, I feel a desire to be in natural spaces or around natural things.	.81		
Nature generally brings me joy.	.80		
I enjoy the adventures I experience in nature.	.79		
Nature has a lot to offer me.	.72		
I feel that nature is linked to my personal identity.	.71		
I can recall key moments that have helped build my positive relationship with nature.	.70		
I use my available senses (sight, taste, smell, touch, hearing) to connect with nature.	.64		
I see beauty in nature.	.55		.34
I feel that I need to give back to nature.	.52		.30
I seek out routes where nature is available when commuting.	.46		
I find nature to be scary.		.78	
Being in nature makes me feel vulnerable.		.60	
Nature has nothing to offer me.	-.23	.37	-.33
I believe it's important to respect nature.			.75
I care about nature.	.40		.56
Nature exists for humans to use.	.13		-.40
My well-being is negatively impacted when I see or hear about bad things happening to nature.	.33	.11	.32

Note. Extraction method: principal axis factoring. Rotation method: oblimin.

Coefficients < .40 are suppressed.

7.3.3.1 Factor 1: Bond with Nature

The first factor showed high loadings from items describing the importance of nature in one's life, positive affective experiences within nature, and a sense of personal connection to nature (e.g., "Nature plays an important role in my life"; "When I'm not in nature, I feel a desire to be in natural spaces or around natural things."; "I feel that nature is linked to my personal identity"). This factor was interpreted as reflecting a general bond with nature, capturing the extent to which nature is valued, enjoyed, and integrated into one's identity and everyday life. This item is reflective of the conceptualisation of the relationship within current literature. However, it extends beyond mere connection and sense of oneness with nature. Core item factor loadings were high for this factor (.70 - .81). Several other items loaded between .45 and .69.

7.3.3.2 Factor 2: Vulnerability in Nature

The second factor was defined by items reflecting fear and vulnerability in natural settings ("I find nature to be scary"; "Being in nature makes me feel vulnerable"; "My well-being is negatively impacted when I see or hear about bad things happening to nature") and was therefore interpreted as a vulnerability in nature factor.

7.3.3.3 Factor 3: Respect and Care for Nature

The third factor captured a more moral dimension to the relationship, with strong positive loadings from items emphasising a need to respect and show concern for nature (e.g., "I believe it's important to respect nature"; "I care about nature"). This was alongside a negative loading (-.40) on the anthropocentrism item "Nature exists for humans to use". This factor was interpreted as Respect and Care for nature, reflecting beliefs about the moral value of nature and the importance of treating nature well, reflective of the findings of phase two of this research.

7.3.3.4 Factor 4: *Miscellaneous*

The final factor was less interpretable. It consisted of lower factor loadings which did not form a coherent conceptual theme. Given the weak and ambiguous loading pattern associated with Factor 4, and the lack of a clear theoretical interpretation for this factor, it was not retained for further conceptual development. Items that loaded primarily on this factor or showed substantial cross-loadings (e.g., “Nature has nothing to offer me”; “My well-being is negatively impacted when I see or hear about bad things happening to nature”) were therefore treated as poorly performing and excluded from subsequent scale refinement and analyses.

7.3.3.5 Factor Correlations

Factor correlations indicated that Factor 1: *Bond with Nature* and Factor 3: *Respect and Care for Nature* were moderately positively related ($r = .33$), whereas Factor 2: *Vulnerability in Nature* was only weakly (and negatively) associated with these positive dimensions (r values between $-.16$ and $-.08$). The fourth factor showed only minimal correlations with the other factors.

Table 7.6*Factor Correlation Matrix*

Factor	1	2	3	4
1	-			
2	-.122	-		
3	.329	-.082	-	
4	-.088	-.158	.056	-

Note. Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization

Table 7.7*Exploratory Factor Analysis Loadings and Item Retention Decisions for Quality of Human-Nature Relationship Scale*

Item Number	Item Wording	Primary factor (EFA)	Primary Loading	Decision
Item 1	Nature plays an important role in my life	Bond with nature (F1)	.81	Retained
Item 3	When I'm not in nature, I feel a desire to be in natural spaces or around natural things	Bond with nature (F1)	.81	Retained
Item 12	Nature generally brings me joy	Bond with nature (F1)	.80	Retained
Item 16	I enjoy the adventures I experience in nature	Bond with nature (F1)	.79	Retained
Item 15	Nature has a lot to offer me	Bond with nature (F1)	.72	Retained
Item 6	I feel that nature is linked to my personal identity	Bond with nature (F1)	.71	Retained
Item 2	I can recall key moments that have helped build my positive relationship with nature	Bond with nature (F1)	.70	Retained
Item 4	I use my available senses to connect with nature	Bond with nature (F1)	.64	Retained
Item 11	I see beauty in nature	Bond with nature (F1)	.55	Retained

Table 7.7 (continued)

Item Number	Item Wording	Primary factor (EFA)	Primary Loading	Decision
Item 19	I feel that I need to give back to nature	Bond with nature (F1)	.52	Retained
Item 10	I seek out routes where nature is available when commuting	Bond with nature (F1)	.46	Retained
Item 13	I find nature to be scary	Vulnerability in nature (F2)	.78	Retained
Item 17	Being in nature makes me feel vulnerable	Vulnerability in nature (F2)	.60	Retained
Item 7	I believe it's important to respect nature	Respect and care for nature (F3)	.75	Retained
Item 8	I care about nature	Respect and care for nature (F3)	.56	Retained
Item 14	Nature exists for humans to use	Respect and care for nature (F3, reverse scored)	-.40	Retained
Item 18	Nature has nothing to offer me	Weak/complex (Factors 2-4)	.37/-.33	Removed
Item 5	My well-being is negatively impacted when I see or hear about bad things happening to nature	Weak/complex (Factors 1,3,4)	.33/.32/-.43	Removed

Note. Items in this measure are labelled 1-19. Item 9 in the study was an instructional manipulation task so was excluded from the analysis.

7.3.4 Confirmatory Factor Analysis (Study 3 -Part 2)

To evaluate the suggested structure presented in the above Exploratory Factor Analysis, a series of five Confirmatory Factor Analyses were conducted in R open-source statistical software (Version 2025.09.2+418) using the lavaan package. Maximum likelihood estimation was used to test for the best fit in the factor loadings. Model fit was evaluation following common guidelines which consider chi-square test (χ^2), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) with 90% confidence intervals and the Standardized Root Mean Square Residual (SRMR). Research suggests that CFI and TLI values should be $\geq .90$, RMSEA $\leq .08$, and SRMR $\leq .08$ to be considered an acceptable model fit. The 5 models can be seen in Table 7.8.

7.3.4.1 Three-Factor Model

A three-factor model was first to be explored given the findings of the Exploratory Factor Analysis. Three latent factors were considered in this model. Factor 1, labelled *Bond* was comprised of 11 items (Item1, Item2, Item3, Item4, Item6, Item10, Item11, Item 12, Item 15, Item16, Item19). The second factor was *Vulnerability* and comprised two items (Item13, Item17). The third and final factor was labelled *Respect and Care* and was analysed with three items (Item7, Item8, Item14[reverse scored]). The three-factor model showed poor fit to the data, $\chi^2(101) = 336.34$, $p < .001$, CFI = .86, TLI = .83, RMSEA = .10 (90% CI [.09, .12]), SRMR = .07.

In refining the item set for the Confirmatory Factor Analysis items, it was decided to remove an item (Item14[reverse scored]) which was not conceptually aligned with the factor and displaying low factor loading (Std.all= .35). However, the model fit remained

unsatisfactory, $\chi^2(87) = 316.12$, $p < .001$, CFI = .86, TLI = .83, RMSEA = .11 (90% CI [.10, .12]), SRMR = .06. Therefore, removing Item 14 did not improve the overall fit of the three-factor model.

Table 7.8

Confirmatory Factor Analysis Model Fit Comparisons

Model	χ^2	df	p	CFI	TLI	RMSEA	SRMR
3 Factor	336.34	101	< .001	.86	.83	.10	.07
3 Factor without Item14	316.12	87	< .001	.86	.83	.11	.06
2 Factor	273.98	64	< .001	.87	.84	.12	.07
2 Factor without Item10	267.13	53	< .001	.86	.83	.14	.07
1 Factor	336.97	65	< .001	.83	.79	.14	.08

7.3.4.2 Two-Factor Model

A two-factor model analysis was conducted in which the second factor, *Vulnerability* (Item13, Item17), was removed. In the three-factor model, the correlation between *Bond* and *Respect and Care* was shown to be a moderate, statistically significant correlation ($r = .65$, $p < .001$), indicating that these two factors captured closely related aspects of a positive relationship with nature. However, the *Vulnerability* factor indicated a small, non-significant, negative correlation with both *Bond* ($r = -.11$, $p = .08$) and *Respect and Care* ($r = -.11$, $p = .08$). This would suggest that *vulnerability* is independent of the other two factors and may not be measuring the same construct. Therefore, a two-factor model was also analysed. The two-factor model yielded a similarly unsatisfactory

fit, $\chi^2(64) = 273.98$, $p < .001$, CFI = .87, TLI = .84, RMSEA = .12 (90% CI [.11, .14]), SRMR = .07.

Similar to the three-factor model above, further refinement of the model resulted in items with low factor loadings being removed. This time Item 10 (Std.all = .41) was removed as it was the weakest loading item with all other loadings being between .64 and .85. The model still had an unsatisfactory fit, $\chi^2(53) = 267.13$, $p < .001$, CFI = .86, TLI = .83, RMSEA = .14 (90% CI [.12, .15]), SRMR = .07.

7.3.4.3 One-Factor Model

Finally a one-factor model in which all thirteen items from both factors, *Bond* (11) and *Respect and Care* (2) items were specified to load on a single Quality of Nature Relationship factor. As factor 3, *Respect and Care* consisted of only two items, a full one factor analysis was conducted to test the overall fit of the items. This model also demonstrated poor fit, $\chi^2(65) = 336.97$, $p < .001$, CFI = .83, TLI = .79, RMSEA = .14 (90% CI [.13, .16]), SRMR = .08. Because these indices fall well outside the acceptable thresholds, this suggests that human-nature relationship quality cannot be accurately measured as a single, unidimensional trait, thereby supporting the multidimensional structure identified in the two-factor model.

7.3.4.4 Summary of Confirmatory Factor Analysis

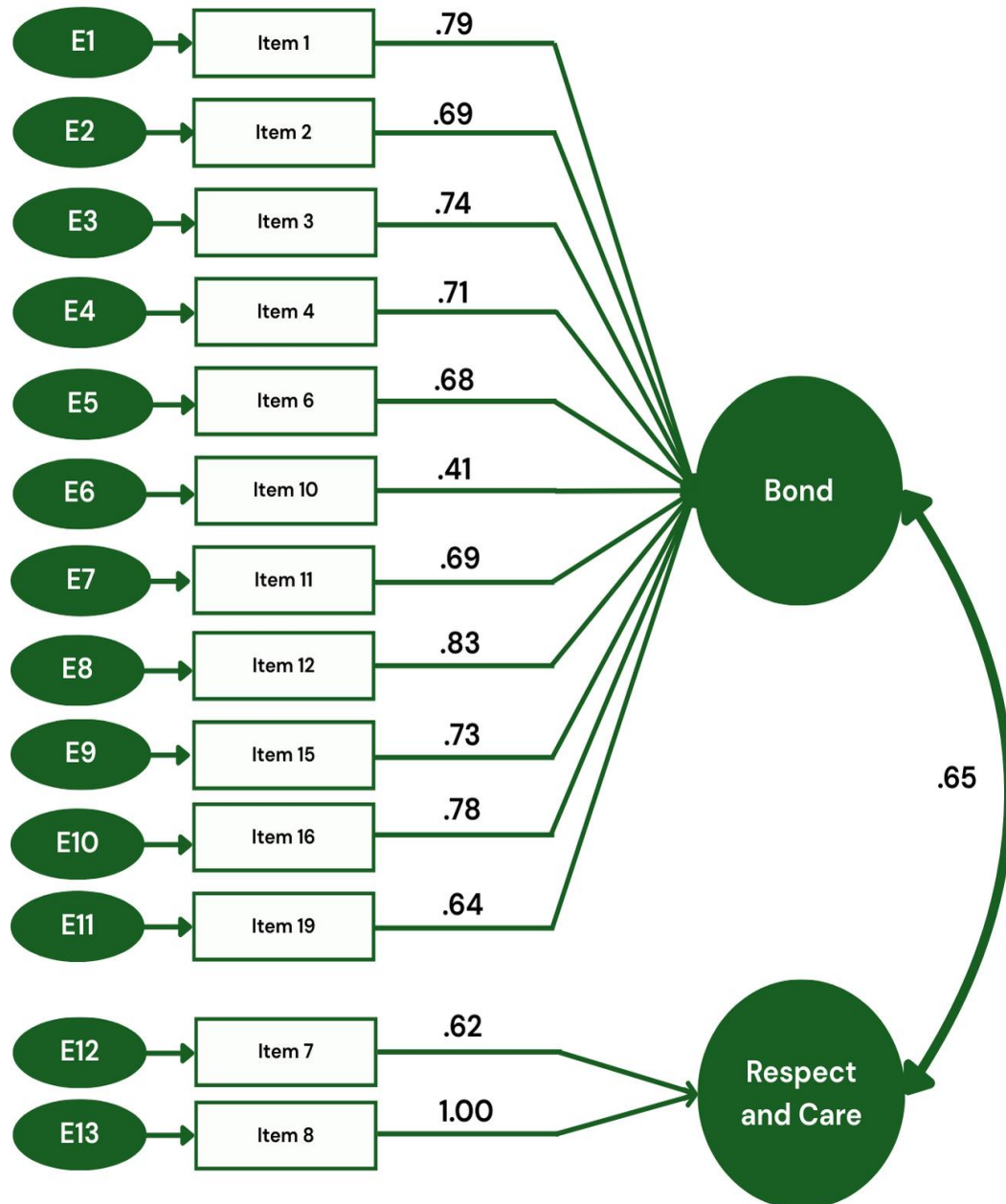
Across the five analyses conducted no one model tested achieved acceptable fit as per guidelines for best practice. Taken as a whole it is clear that the items in the *Bond* (11 item) factor form a clear and coherent cluster which captures the affective and cognitive connection between humans and their environment. This is alongside the complimentary *Respect and Care* (2 item) factor which highlights the importance of

having a sense of respect for the natural world in maintaining your relationship with it.

This model (Figure 7.5) will be used in subsequent reliability and validity analyses.

Figure 7.5

Final Two-Factor Model Fit

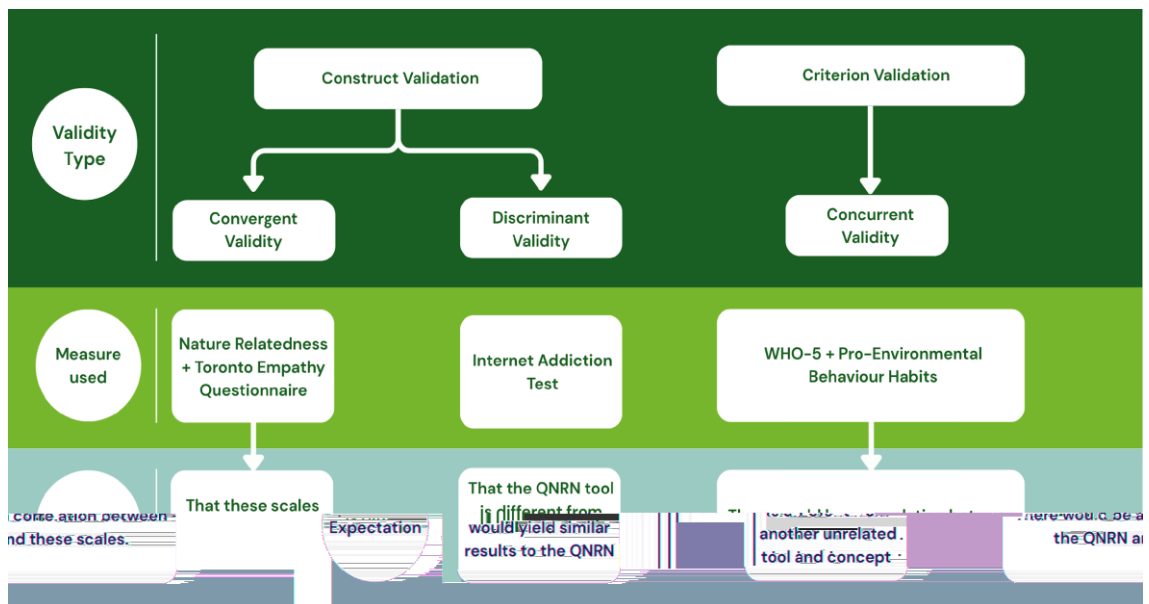


7.3.5 Reliability and Validity Analysis (Study 3 – Part 3)

A number of reliability and validity analyses were run in R statistical software to test the internal consistency, convergent validity, discriminant validity and criterion validity of the new measure. The analysis was conducted on both the eleven-item *Bond* subscale and the full thirteen-item measure (*Bond* and *Respect and Care*). A full correlation matrix can be found in Table 7.9.

Figure 7.6

Scale Validation Process



7.3.5.1 Internal Consistency

The *Bond* subscale (11 items) showed good internal consistency (Cronbach's $\alpha = .90$, 95% CI [.88,.92]). The inter-item correlation was .49 and the item–total correlations were all positive and substantial indicating that each item contributed meaningfully to the overall scale. The Cronbach's α did not meaningfully increase with the removal of any item which supports the inclusion of all eleven items.

The two item factor of *Respect and Care* items were significant and strongly correlated ($r = .62$, 95% CI [.53, .70], $p < .001$) with an acceptable Cronbach's $\alpha = .77$, 95% CI [.69,.83]. This supports the retention of these items. However, given the limited number of items in this subscale, future iterations of the scale should consider expanding this domain to capture a broader range of respectful and caring attitudes towards nature.

When all thirteen items (Bond with Respect and Care) were combined into an overall Quality of Nature Relationship score, internal consistency remained in the excellent category, Cronbach's $\alpha = .90$, 95% CI [.88, .92], with an average inter-item correlation of .46. Item-total correlations were all positive and high. It was shown that removing any single item did not increase or decrease alpha (α s = .89-.91), indicating that all items contributed meaningfully to the overall measure.

7.3.5.2 Convergent Validity

Convergent validity was examined by correlating the new measure with an established measure of nature relatedness (NR-6). The Bond subscale showed a strong positive correlation with NR-6 ($r = .75$, 95% CI [.68, .80], $p < .001$), indicating substantial overlap with an existing measure of a closely related construct. Respect and Care was a moderate positive associated with NR-6 ($r = .39$, 95% CI [.27, .50], $p < .001$), indicating that this brief moral/attitudinal facet aligns with established measures of nature relatedness. The overall 13-item Quality score showed a very similar pattern, correlating strongly with NR-6 ($r = .74$, 95% CI [.68, .80], $p < .001$). These results provide clear evidence of convergent validity for both the Bond subscale and the overall Quality of Nature Relationship score.

However, contrary to expectations, neither Bond nor the overall Quality score showed any meaningful association with general interpersonal empathy as measured by

the TEQ (Bond: $r = .00$, 95% CI $[-.13, .13]$, $p = .993$; Quality: $r = -.01$, 95% CI $[-.14, .13]$, $p = .897$).

7.3.5.3 Discriminant Validity

Discriminant validity was assessed with respect to problematic internet use, a construct that is conceptually distinct from the quality of one's relationship with nature. Bond showed only a small negative association with Internet Addiction Test scores (IAT; $r = -.15$, 95% CI $[-.28, -.02]$, $p = .028$), with a very similar result for the overall Quality score ($r = -.16$, 95% CI $[-.28, -.02]$, $p = .023$). Respect and Care showed a small, non-significant negative correlation with IAT ($r = -.13$, 95% CI $[-.26, .01]$, $p = .065$). These small associations indicate that, while individuals with a higher-quality relationship with nature may report slightly lower problematic internet use, the constructs are clearly not strongly overlapping, supporting the discriminant validity of the new measure.

7.3.5.4 Criterion Validity

Criterion validity was evaluated by examining associations with psychological wellbeing and pro-environmental behaviour. Bond was positively correlated with wellbeing as measured by the WHO-5 ($r = .23$, 95% CI $[.10, .36]$, $p < .001$), indicating that individuals reporting a higher-quality relationship with nature also tended to report better psychological wellbeing. The Quality score showed a similar association with WHO-5 ($r = .22$, 95% CI $[.09, .34]$, $p = .001$). However, in contrast to this, the *Respect and Care* facet alone was not associated with wellbeing ($r = .03$, 95% CI $[-.11, .16]$, $p = .704$), suggesting that the broader sense of bond and connection between human and nature is more important to psychological wellbeing than the act of care.

Bond also showed a positive association with self-reported pro-environmental behaviour (PEB; $r = .28$, 95% CI [.15, .40], $p < .001$). The Quality score again followed the same pattern, with a slightly stronger correlation ($r = .29$, 95% CI [.17, .41], $p < .001$). Respect and Care had the strongest correlation to PEB ($r = .30$, 95% CI [.18, .42], $p < .001$). These findings suggest that a higher-quality relationship with nature is meaningfully related to engaging more frequently in pro-environmental actions and experiencing greater wellbeing, providing support for the criterion-related validity of the new measure.

Table 7.9

Correlations (r) Between Quality of Nature Relationship Scores and External Measures

	Bond	Respect and Care	Full QHNR Scale
NR-6	.75***	.39***	.74***
TEQ	.00	-.08	-.01
IAT	-.15*	-.13	-.16*
WHO-5	.23***	.03	.22**
PEB	.28***	.30***	.29 ***

Note. Values are Pearson correlations. * $p < .05$, ** $p < .01$, *** $p < .001$.

7.4 Discussion

Three in-depth studies were conducted to explore the factor structure, reliability and validity of the new Quality of Human-Nature Relationship Scale measure. There was strong evidence for a 2-factor measure with strong reliability and validity. In the Exploratory Factor Analysis an initial four factors model emerged, but only two factors remained in the final model. Factor 1 (11 items) reflected a broad concept of having a Bond *with Nature*. This reflected current measures which encapsulate the affective

element of the relationship. This includes items which specify enjoying time in nature, engaging with sense, and nature forming an element of your identity. The second accepted factor was Factor 3 (2 items) which captured *Respect and Care for Nature*. This was a much more moral attitude-based subscale, each question respectively asked about the importance of respecting nature and the importance of caring for nature. A third factor, Factor 2 did not form part of the final scale, however reflected a significant line of discourse in the literature around the negative elements of nature (Barrable & Booth, 2022; Soga & Gaston, 2016). The results suggest that with refinement of the items, and potential expansion of this specific dimension, there is potential for a third factor to contribute to the construct. The final model comprised two correlated factors which fit reasonably within the given constraints of the data (Boateng et al., 2018).

The *Bond with Nature* factor parallels existing concepts like nature relatedness and connectedness. Items with high loadings on this factor (e.g. “*Nature plays an important role in my life*” or “*I feel that nature is linked to my personal identity*”) suggest it aligns with an affective–identity bond to nature as seen within current literature (Nisbet et al., 2009; Mayer & Frantz, 2004; Schultz 2002). In particular, these particular items echo Nisbet et al.’s (2009) and Schultz (2002) notion that feeling part of nature is important to our relationship. Similarly the factor *Respect and Care* align with measures worked on by Schultz (2000) on experiencing biospheric value where experience and connection to the natural world, and a sense of identity sharing can involve a level of concern for the environment.

Reliability for both subscales met expectations with the 11-item *Bond* scale showed excellent internal consistency ($\alpha = .90$) while the 2-item *Respect and Care* scale was acceptably consistent ($\alpha = .77$). It is expected with the addition of more items this

score could increase. When combined, the full 13-item scale also displayed high reliability ($\alpha = .90$), indicating that the items map onto a single overall construct.

The tests of validity had some mixed results. The Bond subscale had a very strong correlation ($r = .75$) with the pre-established Nature Relatedness-6 (NR-6) scale, and the overall Quality of Human-Nature Relationship Scale score correlated equally strongly ($r = .74$) (Nisbet & Zelenski, 2013). This demonstrated clear convergent validity. The Respect and Care subscale also correlated positively with NR-6 ($r = .39$), which suggests that a sense of moral attitude and affiliation towards nature is associated with experiences of nature connectedness. A surprising result given the conceptualisation of the new measure, was that neither Bond nor overall Quality of Human-Nature Relationship Scale had a meaningful correlation with empathy (TEQ; Spreng et al., 2009). This acted better for discriminant validity than convergent. It is a noteworthy finding as it suggests these are two distinct constructs, however noteworthy because one might expect compassionate orientation to people to extend to nature; our null finding suggests these domains are separate. However, this is not distinct from findings within environmental psychology that suggest that empathy is more aligned to environmental concern (Schultz, 2002).

For discriminant validity, problematic internet use (IAT) was explored through correlations with the new measure. *Respect and Care* displayed a non-significant result while *Bond* and overall Quality of Human-Nature Relationship Scale displayed a small negative correlation. This supports the discriminant validity.

Finally, when exploring criterion validity, the overall Quality of Human-Nature Relationship Scale measure and the *Bond* factor were associated with psychological wellbeing (WHO-5) and Pro-Environmental Behaviour (PEB). Interestingly, *Respect and Care* did not have a strong correlation with wellbeing, yet unsurprisingly given the

combination of (Hickman, 2024; Lutz et al., 2023) and previous findings in this thesis (Chapter 5) being concerned for nature can cause high levels of eco-anxiety and distress. However, while *Respect and Care* was not associated with wellbeing, it was positively associated with pro-environmental behaviours.

7.4.1 Limitations

There are a few limitations within this set of studies. The first being the limitations on sample size. While the minimum threshold was achieved, a larger more diverse sample would further add to the reliability and validity of this scale. A second limitation in relation to sample size is due to the constraints on participant numbers the Exploratory Factor Analysis and Confirmatory Factor Analysis were conducted on the same sample which is not recommended. In light of this, it is highly recommended that this measure be seen as a preliminary development of the Quality of Human-Nature Relationship Scale measure. Further refinement and exploration is needed by the Nature Relationship Working Group.

Given the need to refine and reexplore the measure, further attention should be given to the purpose of the identified factors. The *Respect and Care* factor comprises two individual items. While it had an acceptable rate of reliability and some expected validity scores there is an argument to be had for expansion of this domain. When undergoing the next round of psychometric testing, more attention to the factor of *vulnerability* should be given, now that more contemporary research has brought this issue to light. Finally, the recruitment of participants needs to be more diverse. The Subject Matter Expert group (Study 1), which again, met minimum requirements could have benefitted from the inclusion of practitioners to ensure that it was applicable to practice. Similarly a more

diverse sample of participants for validation is required to ensure this measure is valid in a cross-cultural sample. Particular attention should be given to non-WEIRD samples.

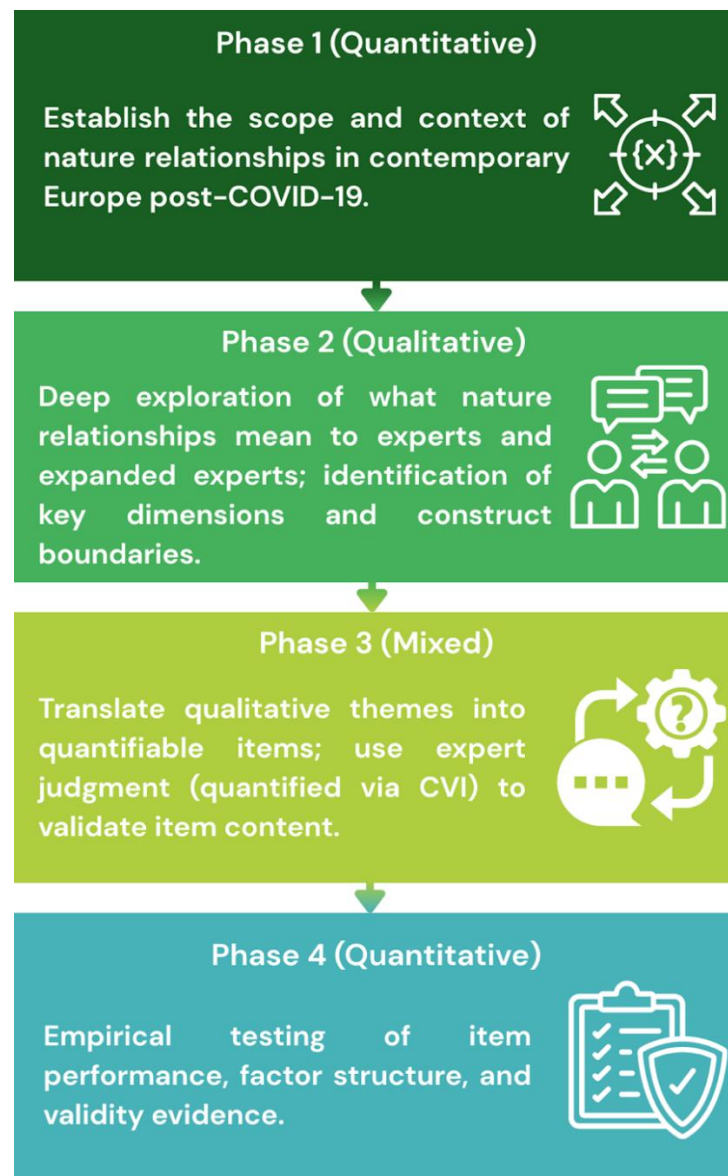
7.5 Conclusions

Overall, this chapter demonstrates that the Quality of Human-Nature Relationship Scale has a coherent structure capturing both a deep affective bond with the natural world, and a respectful and moral obligation to care for nature. The scale is internally consistent and supports validity. However, for the Quality of Human-Nature Relationship Scale to be a useful tool for research and practice there needs to be further refinement and validation. Future research should continue to refine and adapt the current pool of items, retest the psychometric properties, explore cultural validation, and test its applicability to practical settings.

societal challenges had for individuals' exposure, engagement and perceptions of nature. This insight allowed for deeper insights on the potential topics that may arise in the qualitative research in Phase 2 (Chapter 5).

Figure 8.1

Visualisation of the Flow of the Phases of the Doctoral Research



The qualitative phase (Chapter 5) explored the perceptions of 'experts' and 'expanded-experts', in relation to their own human-nature relationships. This resulted in a thematic-model of the different factors which interact with the human-nature

relationship. Phase Two helped generate clarity in relation to the overall concept. The thematic-model was then brought forward to Phase 3 (Chapter 6) in which a working group of experts met on multiple occasions to translate the various themes into an item pool to develop a new measure. This new measure is referred to as the Quality of the Human-Nature Relationships scale (QHNR). Following the rating and refinement of the items a final 29-item pool was sent to external bodies for further testing. This is Phase 4 (Chapter 7) where the new measure went through content validation with subject matter experts, pre-validation with the working group and finally psychometric evaluation with a sample of 214 students and of academic staff members. This resulted in a final 13-item, two factor, reliable and valid measure. The full flow of the phases can be seen in Figure 8.1.

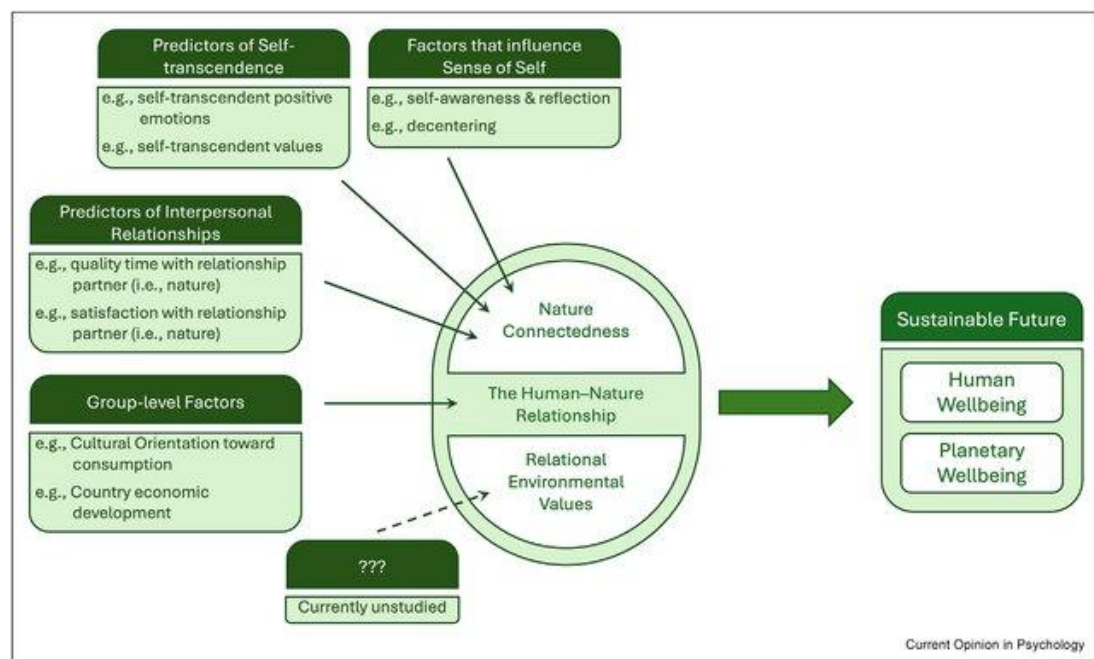
8.3 Main Findings

The main finding is a contradiction to what is currently presented in empirical research in relation to the state versus trait debate of human-nature relationships. This sense of feeling connected to nature is not a stable trait-like attribute (Capaldi et al., 2014; Nisbet et al., 2009; Schultz, 2002), but rather a dynamic changing experience that reflects more relational values including elements of reciprocity, acceptance, trust and care (see Chapter 5). It is a relationship which is shifting with the influence of wider context and life circumstances (Richardson & Thatcher, 2023) much like the relationships we experience in human-human contact. Contemporary reviews (Lengieza et al., 2023; Lengieza & Aviste, 2025) suggest that this “true relationship” between humans and nature exist (Figure 8.2). The construct of nature connectedness is not redundant in these findings, but rather a complementary element for those who experience high quality human-nature relationships. By considering this connection as a stable trait we are risking

the loss of knowledge regarding the elements which contribute to maintaining or disrupting the relationship, making it more difficult to repair the relationship and increase engagement. As we will explore later, this has significant implications for fostering relationships with nature and increased potential societal impact which is critical in what may be termed uncertain times.

Figure 8.2

Paradigmatic and Theoretical Advancements in the Study of the Human–Nature Relationship (from Lengieza & Aviste, 2025, used under CC-BY 4.0)



A second major finding, which builds on the developments summarised in Figure 8.2, is that the present thesis extends human–nature relationship research by shifting attention from whether individuals feel connected to nature towards the perceived quality of that relationship. The measure developed in this thesis operates at the level at which an individual’s ongoing relationship with nature is expressed and evaluated. This level of quality appears to be shaped by ongoing engagement, emotionally meaningful interactions, and an orientation toward respect and care. Importantly, the quality of the

relationship may be evaluated in relation to the individual's own concept of nature, or in relation to a definition provided by the researcher. We therefore postulate that there is value in asking individuals to appraise their own definition of nature as part of a process that encourages reflection on the quality of the human–nature relationship.

Next, converging evidence supported the idea that nature poses an element of risk, vulnerability and other conceptually negative influences in the human relationship with the natural world. Interviews and findings from the revised inventory both suggest that this is vital to our understanding. While much of the literature has focused on the element of re-connecting with nature (Lumber et al., 2017), more attention should be given to the process of acknowledging, accepting and respecting the more negative relational factors involved in this dynamic.

8.3.1 Phase 1 Findings

Phase 1 of the research was conducted to provide contextual grounding for the design of the following phases of research by exploring the influence the COVID-19 pandemic had on nature engagement, favourite natural typologies and access to nature during the strict lockdown restrictions in countries such as Ireland and Malta. This phase was not intended to resolve the conceptual question which this thesis is based on, but rather, it was conducted to provide exploratory insights into individuals' perceptions of the human-nature interactions prior to in-depth engagement into the topic through qualitative interviews. This study was aligned with the early research plan to explore the concept of urban nature connectedness, however due to the early mentioned changes in the GoGreenRoutes consortium the research team had to realign the research goals with the expectations when one of the partners withdrew from the project.

Despite not initially setting out to contribute to the overarching conceptual based question, the insights gained from the study have contributed to the overall findings of this thesis. Firstly, nature spaces for everyday engagement were heterogeneous. Individuals had access to a mixture of private garden homes, communal nature spaces and in some cases even had no access to nearby natural space. This lack of access, although prevalent throughout urban centres in Europe, was brought to the fore during COVID-19 lockdown scenarios and aligns with evidence contributing to the knowledge on nature inequity in cities (Nigg et al., 2023). The concept of ‘Nearby Nature’ was most frequently referred to as urban green spaces or areas for leisure activities, reemphasising the importance of outdoor engagement to counteract the COVID-19 restrictions. An interesting finding was that while this was the nature individuals had access to, they commonly did not rate it as their favourite space. Forests and coastal areas were the most frequently selected favourite natural spaces, two typologies that are not necessarily easily accessible for citizens in cities. This again highlights the issues with nature inequality and the risk of nature experiences contributing to nature exposure rather than meaningful engagement with nature, the latter of which has increasingly been recognised as integral to the many co-benefits of human nature interactions (Bratman et al., 2019; MacIntyre & Donnelly, 2019).

Another notable finding which contributed to the final conceptualisation element of this thesis is the limited scope of current inventories in the field. Findings from Phase 1 suggest that *nature relatedness* (e.g. assessed using the NR-6; Nisbet & Zelenski, 2013) may not fully capture the full relationship dynamic in contemporary contexts. In this study, NR-6 scores were relatively high, however, wellbeing scores (measured using WHO-5) were low with a little to no association, which would not be expected given the engagement level had not changed significantly (Capaldi et al., 2014). This result

supports the basic tenet of this research, that viewing a relationship with nature as a trait-like structure does not account for the richness of the human experience. Individuals relate to nature in the wider context of access and society where challenges to nature access are dynamic. Meaningful engagements cannot readily occur if you are restricted in accessing the spaces you can feel connected to.

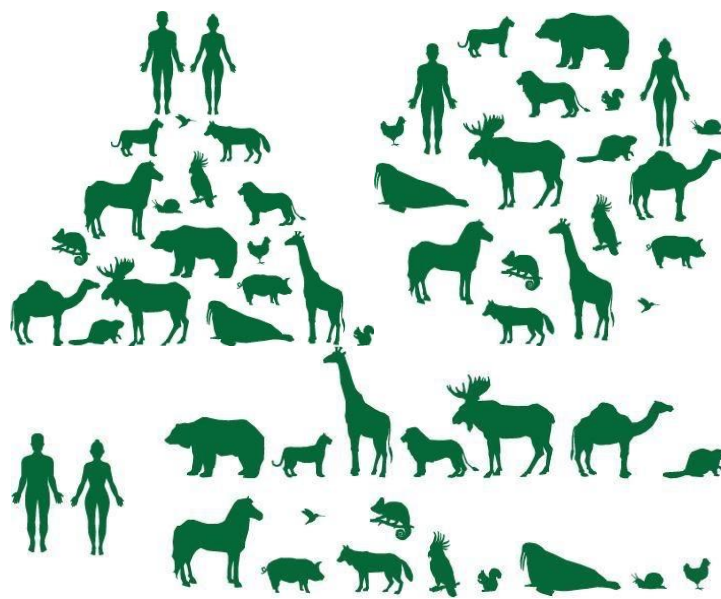
8.3.2 Phase 2 Findings

Phase 2 in Chapter 5 of this thesis, conveyed how both ‘expert’ and ‘expanded-expert’ groups exploration of their lived-experience of human–nature relationships, could clarify the meaning and impact of what constitutes a relationship with the natural world. The primary reflection from the qualitative findings was that many prevailing descriptions of both nature and nature connection are incomplete. Nature is a relational and personal figure, which depending on who you talk to, and the context in which they are in, will possess different qualities. Current measures have not fully taken this perspective into account. To date research treats connection primarily as a stable attribute. Yet, participants in Phase 2 described connection as something that is maintained, disrupted, and in need of repair through different stages of life, different experiences and levels of engagement.

Chapter 5 explicitly highlights the complexity of the human-nature relationship and the need to reconsider our understanding of nature and the dynamics in which nature exists. A large focus is put on helping individuals achieve identity which falls into deep ecology perspectives (Naess, 1973), however the lived experience and perception of this ‘*identity within nature*’ seems to align with an ‘*identity beside nature*’ (Figure 8.3).

Figure 8.3

Conceptual Illustration of Human–Nature Relationships



Note. Adapted from the “Ego–Eco” diagram in Lehmann (2019), where the original diagram is attributed to S. Lehmann (2010). Adaptation used under CC BY 4.0.

The changing relational dynamics, and variability in operational definitions of nature was a topic of discussion in Chapter 5. The lack of consistency in personal definitions raises the question as to, what have we as a discipline been anticipating people are connected to when we measure this? And have the measures been accounting for low nature connectedness or simply a misinterpretation. This phase of the research highlights the diverse definitions that are assigned to nature. Participants' descriptions ranged from feeling connected to the family cat, or the plants in their office as it was nature in which was alive and reactive. It was something they could care for. Others had identity-based definitions of feeling part of the wider world and nature being part of the everyday in the wooden seats they sat on or the sky they could view from the window. How do we measure an individual's connection or relationship without understanding their own perception of what they are connected to?

8.3.3 Phase 3 and 4 Findings

Phase 3 and 4 combined worked towards developing and validating a new measure of quality of human-nature relationships. The analyses show that two distinct factors exist in this concept *Bond* with nature and *Respect and Care* for nature. A third potential factor, which was of interest to the Nature Relationship Working Group shows potential to exist but was negatively correlated with the other two factors. The findings from Phase 3 and 4 support the main findings of the overall thesis.

8.4 Theoretical Implications

The seminal paper in the field of environmental psychology is arguably that by Ulrich (1984) in the journal *Science* when few psychology papers had passed peer review for this most prestigious journal. Almost 50 years ago the early forays of psychology research into human nature interactions has produced overwhelming evidence for the positive impacts of nature exposure. The predominant models of the field of environmental psychology, Attention Restoration Theory and Stress Reduction Theory both are limited in their neural plausibility and testability (MacIntyre et al., 2019). Only in recent years have researchers developed models that enable more precise hypothesis generation and these conceptualisations have greatly advanced the field (e.g. Bratman et al. 2019). Notably, this new generation of research goes beyond the mere exposure hypothesis and attempts to account for the more complex process of engagement. In other words, what are we doing in natural settings, physically, cognitively, emotionally is not clear. The findings of this thesis add to the aforementioned concept of engagement, by conveying how meaning, individual differences and an appreciation of the dynamic nature of our relationship with nature can help us understand our human-nature

interactions more clearly. The coexistence of positive and negative components allows for people to experience nature at times where the relationship is a struggle and at times where it is thriving.

Conceptually, we can move beyond the duality of ‘connected versus ‘disconnected’ to nature and instead view it not as a stable static construct but as a dynamic process, viewed more appropriately as a relationship. This may also call into question, the definition of nature outlined in Chapter 1, which follows the traditional Western dichotomous view of humans and nature. Further research on this aspect is required but the potential for the new inventory to be part of discourse rather than simply a score which is open to interpretation will be posed later.

8.5 Applied Implications

Given the age of uncertainty in 2025, it should be noted that many of the initiatives to support nature and human health continue to be supported. The EU Green Deal, NRL, City Mission, NEB have been bolstered by recent funding announcements and commitments across the EU 27. The need for a more comprehensive understanding of human nature interactions cannot be overstated. As urbanisation continues, the need to optimise human nature interactions in light of other societal challenges is apparent.

Key domains of application are emerging including social prescribing, nature-based interventions and the need to promote social cohesion. Accumulating evidence on the efficacy of social prescribing from the EU RECETAS project conveys the benefits for urban citizens. Indeed, outdoor and nature-based therapy approaches, whether nature is the foreground or the backdrop to the therapy, have gained interest in recent years (Kotera et al., 2022; Gritzka et al., 2020). In the applied setting the new measure could help define individuals’ preferences for nature in addition to baseline. More importantly, it could

provide the start point for conversations about human nature relationships, which is critical if we are to value nature in our lives.

8.6 Strengths and Limitations

8.6.1 Strengths

The thesis outlines a pragmatic methodological approach with diverse perspectives being employed to provide converging evidence. For example, the combination of online survey, modified-Delphi method, and subsequent factor analysis of the new tool was both original and provides a contribution to the literature.

Three aspects are worthy of further consideration. Firstly, the modified-Delphi method was designed to explore a topic which had, despite decades of research, not encompassed the full breadth of challenges that individuals may face in their interactions with nature. As part of the EU funded GoGreenRoutes project, a novel perspective was required to go beyond the state-of-the-art. In the project, the Delphi approach was also employed to understand digital placemaking (Fernandez de Osso Fuentes, 2023). Together they present a plausible argument for applying this methodology to understand the complexities of constructs which may have been overlooked in the literature.

Participatory approaches were also central to the GoGreenRoutes project which included walking interviews, photo-voice, and other co-production methods (Gäcke et al., 2023). In this thesis, a key dimension was to elicit views and generate a shared understanding from citizens who had lived experiences of nature, typically with only informal training, if at all. We termed these participants ‘Expanded-Experts’ and their contributions were augmented by subject matter ‘experts’ to enrich our understanding of human nature interactions. This approach was highly successful and appropriate for this

thesis which attempted to avoid an iterative approach to the genesis of new research and was reliant upon applying a novel perspective.

Similar to other EU funded projects, GoGreenRoutes was committed to ensuring that Open science principles and practices were integral to the research. In this case, a protocol paper was published and the data will be available online as part of published outputs from the project. An innovation that was employed was that both ‘expanded-experts’ and ‘experts’ could waive anonymity in their semi-structured interview. This is both an advance in terms of ethics and facilitates subsequent analyses based on categories not used in the original analysis.

8.6.2 Limitations

One unique aspect of this EU funded study is the change in the work programme that occurred when a partner left the consortium. This resulted in the re-distribution of effort in the respective work package which shifted the course of the PhD to test creation and validation, instead of conceptual development. Obviously, the research occurred during COVID-19 which was viewed as both a barrier and an opportunity for Phase 1. Nevertheless, the survey was a cross-sectional design with a limited sample across partner cities in the project. Moreover, the sample size available for factor analysis was not ideal and the final scale could be cautiously described as preliminary. Several insights from the aforementioned limitations will now be explored in terms of recommendations for future research.

8.7 Future Research Directions

The development and initial validation of the Quality of Human-Nature Relationship (QHNR) scale offers a novel framework for environmental psychology, yet it opens several critical pathways for subsequent empirical investigation. Future research

must focus on three primary areas: demographic and cross-cultural expansion, longitudinal predictive validation, and the re-integration of negative or challenging dimensions of the human-nature dynamic.

The first recommendation for further research is to continue testing the psychometric properties of the Quality of Human-Nature Relationship Scale measure. A larger, more diverse sample should be gathered to run the Confirmatory Factor Analysis on a cross-cultural sample to explore if the two-factor model (*Bond* and *Respect and Care*) remains stable as a larger, separate group to the one collected in this research (Boateng et al. 2018). Future iterations of the scale should be deployed across broader, cross-cultural international cohorts to test for measurement invariance across differing geographic regions, languages, and urban-rural gradients. Crucially, targeted sampling should explicitly seek to enhance participant diversity across unrepresented demographics, specifically incorporating younger adults (18–20 years), older cohorts over 80 years, gender-diverse individuals, and minoritized ethnic groups. Investigating how these diverse lived experiences and varying cultural paradigms interact with the Quality of Human-Nature Relationship item architecture will ensure the instrument's global utility and prevent western, educated, industrialized, rich, and democratic (WEIRD) biases in future human-nature relationship profiling. This invariance should also be explored given the increased knowledge of issues regarding green space equity (Barboza et al., 2021). A longitudinal approach should also be taken to explore test-retest reliability of the measure, while also contributing to the cross-cultural validation of the measure. Re-exploration of item pool is also required to reevaluate weaker factors for further consideration.

Secondly, given the dynamic and context-influenced nature of the human-nature relationship established throughout this thesis, longitudinal research is strongly recommended to establish the scale's predictive validity. Future studies should evaluate

whether baseline scores on the Quality of Human-Nature Relationship Scale can accurately predict tangible, prospective behavioural choices that align directly with the scale's item architecture. For example, the practical environmental navigation item (*I seek out routes where nature is available when commuting*) should be validated using mobile GPS tracking data or daily travel diaries to determine if high scorers actively select longer, green corridors over shorter, highly urbanized pathways during daily transits. Furthermore, the moral-reciprocal item (*I feel that I need to give back to nature*) should be leveraged to predict active pro-environmental behaviours centred on ecological repair—such as habitat restoration, rewilding initiatives, or local conservation volunteering—rather than purely passive or low-effort household conservation habits. Finally, the sensory-engagement item (*I use my available senses... to connect*) offers a clear avenue to predict public health choices, specifically determining if higher scores predict long-term psychological resilience and sustained adherence to outdoor nature-based interventions or green prescriptions over standard indoor clinical therapies. Fostering this line of inquiry will demonstrate that the Quality of Human-Nature Relationship Scale is not just a descriptive index, but a powerful predictive metric for behavioural science interventions.

Finally, a key limitation of the current scale development process was that items pointing toward a negative, overwhelming, or challenging relationship with the natural world did not survive the final psychometric reduction phase and were excluded from the final tool. While this was statistically necessary to maintain clean factor structures and high internal reliability, it leaves a conceptual gap regarding the full spectrum of modern human-nature interactions. Future research should prioritize developing a companion subscale or standalone module specifically designed to capture these challenging elements, such as climate distress, eco-anxiety, and nature-induced discomfort. Investigating how the positive constructs captured by the QHNR scale (such

as a strong emotional Bond) interact with distinct measures of environmental distress (e.g., the Climate Change Anxiety Scale; Hogg et al., 2021) will illuminate whether a deep psychological connection to nature acts as a protective buffer or an emotional accelerant for eco-anxiety. This holistic approach will ensure that future applications can measure not only how humans flourish alongside nature, but also how they navigate the profound emotional challenges of the 21st-century environmental crisis.

8.8 Conclusions

In summary, this thesis provides evidence that human-nature relationships are far more dynamic than it has been conceptualised in the extant literature. In shifting our language and understanding of these dynamic interactions we can account for contemporary societal challenges in digitalised and urbanised environments. The thesis aimed to simultaneously develop a new construct and measurement which represents these modern changes in how humans conceptualise a relationship with nature. In attempts to do so a preliminary measure called the Quality of Human-Nature Relationship Scale was developed, representing the changing values associated with human-nature interactions. Further validation must be completed.

References

- Aiken, L. R. (1985). Evaluating ratings on bidirectional scales. *Educational and Psychological Measurement*, 45(2), 195–202.
<https://doi.org/10.1177/001316448504500201>
- Almaiah, M. A., Hajjej, F., Lutfi, A., Al-Khasawneh, A., Alkhdour, T., Almomani, O., & Shehab, R. (2022). A Conceptual Framework for Determining Quality Requirements for Mobile Learning Applications Using Delphi Method. *Electronics*, 11(5), 788. <https://doi.org/10.3390/electronics11050788>
- Altman, I., & Low, S. M. (Eds.). (1992). *Place attachment*. Springer.
<https://doi.org/10.1007/978-1-4684-8753-4>.
- Anderson, D. J., & Krettenauer, T. (2021). Connectedness to Nature and Pro-Environmental Behaviour from Early Adolescence to Adulthood: A Comparison of Urban and Rural Canada. *Sustainability*, 13(7), 3655.
<https://doi.org/10.3390/su13073655>
- Atchley, R. A., Strayer, D. L., & Atchley, P. (2012). Creativity in the wild: Improving creative reasoning through immersion in natural settings. *PLOS ONE*, 7(12), e51474. <https://doi.org/10.1371/journal.pone.0051474>
- Avella, J. R. (2016). Delphi panels: Research design, procedures, advantages, and challenges. *International Journal of Doctoral Studies*, 11, 305–321.
<https://doi.org/10.28945/3561>
- Badenes-Ribera, L., Silver, N. C., & Pedroli, E. (2020). Editorial: Scale development and score validation. *Frontiers in Psychology*, 11, 799.
<https://doi.org/10.3389/fpsyg.2020.00799>
- Barboza, E. P., Cirach, M., Khomenko, S., Iungman, T., Mueller, N., Barrera-Gómez, J., Rojas-Rueda, D., Kondo, M., & Nieuwenhuijsen, M. (2021). Green space and mortality in European cities: A health impact assessment study. *The Lancet Planetary Health*, 5(10), e718–e730. [https://doi.org/10.1016/S2542-5196\(21\)00229-1](https://doi.org/10.1016/S2542-5196(21)00229-1)
- Barrable, A., & Booth, D. (2022). Disconnected: What Can We Learn from Individuals with Very Low Nature Connection? *International Journal of Environmental Research and Public Health*, 19(13), 8021.
<https://doi.org/10.3390/ijerph19138021>

- Barragan-Jason, G., de Mazancourt, C., Parmesan, C., Singer, M., & Loreau, M. (2021). *Human-nature connectedness as a pathway to sustainability: A global meta-analysis* [Preprint]. In Review. <https://doi.org/10.21203/rs.3.rs-567480/v1>
- Beery, T., Olsson, M. R., & Vitestam, M. (2021). COVID-19 and outdoor recreation management: Increased participation, connection to nature, and a look to climate adaptation. *Journal of Outdoor Recreation and Tourism*, 36, 100457. <https://doi.org/10.1016/j.jort.2021.100457>
- Belton, I., MacDonald, A., Wright, G., & Hamlin, I. (2019). Improving the practical application of the Delphi method in group-based judgment: A six-step prescription for a well-founded and defensible process. *Technological Forecasting and Social Change*, 147, 72–82. <https://doi.org/10.1016/j.techfore.2019.07.002>
- Berger, R. (2015). Now I see it, now I don't: Researcher's position and reflexivity in qualitative research. *Qualitative Research*, 15(2), 219–234. <https://doi.org/10.1177/1468794112468475>
- Berkes, F. (2018). *Sacred ecology* (4th ed.). Routledge.
- Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, 19(12), 1207–1212. <https://doi.org/10.1111/j.1467-9280.2008.02225.x>
- Bishop, F. L. (2015). Using mixed methods research designs in health psychology: An illustrated discussion from a pragmatist perspective. *British Journal of Health Psychology*, 20(1), 5–20. <https://doi.org/10.1111/bjhp.12122>
- Bixler, R. D., & Floyd, M. F. (1997). Nature is scary, disgusting, and uncomfortable. *Environment and Behavior*, 29(4), 443–467. <https://doi.org/10.1177/001391659702900401>
- BlueHealth. (2020). *BlueHealth Community Level Survey (BCLS)*. <https://bluehealth2020.eu/projects/bcls/>
- Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quinonez, 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. <https://doi.org/10.3389/fpubh.2018.00149>
- Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural

- environments. *BMC Public Health*, 10, 456. <https://doi.org/10.1186/1471-2458-10-456>
- 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., Kuo, M., Lawler, J. J., Levin, P. S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., ... Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. *Science Advances*, 5(7), eaax0903. <https://doi.org/10.1126/sciadv.aax0903>
- 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. <https://doi.org/10.1111/j.1749-6632.2011.06400.x>
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), 589–597. <https://doi.org/10.1080/2159676X.2019.1628806>
- Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. SAGE.
- Braun, V., & Clarke, V. (2023). Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a *knowing* researcher. *International Journal of Transgender Health*, 24(1), 1–6. <https://doi.org/10.1080/26895269.2022.2129597>
- Brügger, A., Kaiser, F. G., & Roczen, N. (2011). One for all? Connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. *European Psychologist*, 16(4), 324–333. <https://doi.org/10.1027/1016-9040/a000032>
- Burke, P. J. (1991). Identity processes and social stress. *American Sociological Review*, 56(6), 836–849. <https://doi.org/10.2307/2096259>
- Burke, P. J., & Stets, J. E. (2009). *Identity Theory*. Oxford University Press.
- Business for Nature. (2023, November 8). *Leading organizations release essential new guidance to help businesses develop and publish a nature strategy*. <https://www.businessfornature.org/news/nowfornature>
- Calogiuri, G., Brambilla, E., Flaten, O. E., Fröhlich, F., & Litleskare, S. (2025). Reconnecting people to nature through virtual reality: A mixed-methods field

- study in the context of public engagement events. *Wellbeing, Space and Society*, 8, 100254. <https://doi.org/10.1016/j.wss.2025.100254>
- Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: A meta-analysis. *Frontiers in Psychology*, 5. <https://doi.org/10.3389/fpsyg.2014.00976>
- Cartwright, B. D. S., White, M. P., & Clitherow, T. J. (2018). Nearby Nature ‘Buffers’ the Effect of Low Social Connectedness on Adult Subjective Wellbeing over the Last 7 Days. *International Journal of Environmental Research and Public Health*, 15(6), 1238. <https://doi.org/10.3390/ijerph15061238>
- Chan, K. M. A., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., Gould, R. K., Hannahs, N., Jax, K., Klain, S. C., Luck, G. W., Martín-López, B., Muraca, B., Norton, B., Ott, K., Pascual, U., Satterfield, T., Tadaki, M., Taggart, J., & Turner, N. (2016). Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences of the United States of America*, 113(6), 1462–1465. <https://doi.org/10.1073/pnas.1525002113>
- Chan, K. M. A., Gould, R. K., & Pascual, U. (2018). Editorial overview: Relational values: What are they, and what’s the fuss about? *Current Opinion in Environmental Sustainability*, 35, A1–A7. <https://doi.org/10.1016/j.cosust.2018.11.003>
- Cheng, J. C.-H., & Monroe, M. C. (2012). Connection to nature: Children’s affective attitude toward nature. *Environment and Behavior*, 44(1), 31–49. <https://doi.org/10.1177/0013916510385082>
- Chyung, S. Y., Hutchinson, D., & Shamsy, J. A. (2020). Evidence-Based Survey Design: Ceiling Effects Associated with Response Scales. *Performance Improvement*, 59(6), 6–13. <https://doi.org/10.1002/pfi.21920>
- Clayton, S. (2020). Climate anxiety: Psychological responses to climate change. *Journal of Anxiety Disorders*, 74, 102263. <https://doi.org/10.1016/j.janxdis.2020.102263>
- Clayton, S., Czellar, S., Nartova-Bochaver, S., Skibins, J. C., Salazar, G., Tseng, Y.-C., Irkhin, B., & Monge-Rodriguez, F. S. (2021). Cross-Cultural Validation of A Revised Environmental Identity Scale. *Sustainability*, 13(4), 2387. <https://doi.org/10.3390/su13042387>

- Clayton, S. D., & Opatow, S. (2003). *Identity and the natural environment: The psychological significance of nature*. MIT Press.
- Collins, H. M., & Evans, R. (2002). The Third Wave of Science Studies: Studies of Expertise and Experience. *Social Studies of Science*, 32(2), 235–296.
<https://doi.org/10.1177/0306312702032002003>
- Coscieme, L., Da Silva Hyldmo, H., Fernández-Llamazares, Á., Palomo, I., Mwampamba, T. H., Selomane, O., Sitas, N., Jaureguiberry, P., Takahashi, Y., Lim, M., Barral, M. P., Farinaci, J. S., Diaz-José, J., Ghosh, S., Ojino, J., Alassaf, A., Baatuuwie, B. N., Balint, L., Basher, Z., ... Valle, M. (2020). Multiple conceptualizations of nature are key to inclusivity and legitimacy in global environmental governance. *Environmental Science & Policy*, 104, 36–42.
<https://doi.org/10.1016/j.envsci.2019.10.018>
- Crabtree, B. F., & Miller, W. L. (1999). *Doing qualitative research*. SAGE.
- Creswell, J. W., & Clark, V. L. P. (2017). *Designing and Conducting Mixed Methods Research*. SAGE Publications.
- Dadvand, P., Nieuwenhuijsen, M. J., Esnaola, M., Fornes, 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.
<https://doi.org/10.1073/pnas.1503402112>
- de Groot, J. I. M., & Steg, L. (2008). Value orientations to explain beliefs related to environmentally significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *Environment and Behavior*, 40(3), 330–354.
<https://doi.org/10.1177/0013916506297831>
- de Groot, J. I. M., & Thøgersen, J. (2012). Values and pro-environmental behavior. In L. Steg, A. E. van den Berg, & J. I. M. de Groot (Eds.), *Environmental psychology: An introduction* (pp. 141–152). Wiley-Blackwell.
- de Loë, R. C., Melnychuk, N., Murray, D., & Plummer, R. (2016). Advancing the State of Policy Delphi Practice: A Systematic Review Evaluating Methodological Evolution, Innovation, and Opportunities. *Technological Forecasting and Social Change*, 104, 78–88. <https://doi.org/10.1016/j.techfore.2015.12.009>

- DeCastellarnau, A. (2018). A classification of response scale characteristics that affect data quality: A literature review. *Quality & Quantity*, 52(4), 1523–1559. <https://doi.org/10.1007/s11135-017-0533-4>
- Descola, P. (2012). Beyond Nature and Culture. *HAU: Journal of Ethnographic Theory*, 2, 473. <https://doi.org/10.14318/hau2.1.021>
- DeVellis, R. F. (2016). *Scale Development: Theory and Applications*. SAGE Publications.
- DeVille, N. V., Tomasso, L. P., Stoddard, O. P., Wilt, G. E., Horton, T. H., Wolf, K. L., Brymer, E., Kahn, P. H., & James, P. (2021). Time Spent in Nature Is Associated with Increased Pro-Environmental Attitudes and Behaviors. *International Journal of Environmental Research and Public Health*, 18(14), 7498. <https://doi.org/10.3390/ijerph18147498>
- Diamond, I. R., Grant, R. C., Feldman, B. M., Pencharz, P. B., Ling, S. C., Moore, A. M., & Wales, P. W. (2014). Defining consensus: A systematic review recommends methodologic criteria for reporting of Delphi studies. *Journal of Clinical Epidemiology*, 67(4), 401–409. <https://doi.org/10.1016/j.jclinepi.2013.12.002>
- Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R. T., Molnár, Z., Hill, R., Chan, K. M. A., Baste, I. A., Brauman, K. A., Polasky, S., Church, A., Lonsdale, M., Larigauderie, A., Leadley, P. W., van Oudenhoven, A. P. E., van der Plaat, F., Schröter, M., Lavorel, S., ... Shirayama, Y. (2018). Assessing nature's contributions to people. *Science*, 359(6373), 270–272. <https://doi.org/10.1126/science.aap8826>
- Dima, A. L. (2018). Scale validation in applied health research: Tutorial for a 6-step R-based psychometrics protocol. *Health Psychology and Behavioral Medicine*, 6(1), 136–161. <https://doi.org/10.1080/21642850.2018.1472602>
- Dixon, J., & Lazenby, M. (2023). *Expert Panel Content Validation for Evidence-Based Projects: Adaptation of the Content Validity Index* (SSRN Scholarly Paper 4360675). <https://doi.org/10.2139/ssrn.4360675>
- Donnelly, A. A., & MacIntyre, T. E. (Eds.). (2019). *Physical activity in natural settings: Green and blue exercise*. Routledge. <https://doi.org/10.4324/9781315180144>
- Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New Trends in Measuring Environmental Attitudes: Measuring Endorsement of the New

- Ecological Paradigm: A Revised NEP Scale. *Journal of Social Issues*, 56(3), 425–442. <https://doi.org/10.1111/0022-4537.00176>
- Egffjord, K. F.-H., & Sund, K. J. (2020). Do you see what I see? How differing perceptions of the environment can hinder radical business model innovation. *Technological Forecasting and Social Change*, 150, 119787. <https://doi.org/10.1016/j.techfore.2019.119787>
- Embregts, P. J. C. M., & Frielink, N. (2023). Valuing experiential knowledge to complement professional and scientific knowledge within care and support for people with intellectual disabilities. In *International Review of Research in Developmental Disabilities* (Vol. 65, pp. 43–70). Academic Press. <https://doi.org/10.1016/bs.irrdd.2023.08.003>
- European Commission. (2016). Special Eurobarometer 444: Attitudes of Europeans towards biodiversity. European Union.
- Faber Taylor, A., & Kuo, F. E. (2009). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorders*, 12(5), 402–409. <https://doi.org/10.1177/1087054708323000>
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development. *International Journal of Qualitative Methods*, 5(1), 80–92. <https://doi.org/10.1177/160940690600500107>
- Fernandez de Osso Fuentes, M. J., Keegan, B. J., Jones, M. V., & MacIntyre, T. (2023). Digital placemaking, health & wellbeing and nature-based solutions: A systematic review and practice model. *Urban Forestry & Urban Greening*, 79, 127796. <https://doi.org/10.1016/j.ufug.2022.127796>
- Fink-Hafner, D., Dagen, T., Doušak, M., Novak, M., & Hafner-Fink, M. (2019). Delphi method: Strengths and weaknesses. *Metodološki Zvezki*, 16(2), 1–19. <https://doi.org/10.51936/fcfm6982>
- Fiske, A. P. (1991). Structures of social life: The four elementary forms of human relations: Communal sharing, authority ranking, equality matching, market pricing. Free Press.
- Fiske, A. P. (2004). Four modes of constituting relationships: Consubstantial assimilation; space, magnitude, time, and force; concrete procedures; abstract symbolism. In N. Haslam (Ed.), *Relational models theory: A contemporary overview* (pp. 61–146). Lawrence Erlbaum Associates.

- Flake, J. K., & Fried, E. I. (2020). Measurement Schmeasurement: Questionable Measurement Practices and How to Avoid Them. *Advances in Methods and Practices in Psychological Science*, 3(4), 456–465.
<https://doi.org/10.1177/2515245920952393>
- Frumkin, H., Bratman, G. N., Breslow, S. J., Cochran, B., Kahn, P. H., Jr., Lawler, J. J., Levin, P. S., Tandon, P. S., Varanasi, U., Wolf, K. L., & Wood, S. A. (2017). Nature contact and human health: A research agenda. *Environmental Health Perspectives*, 125(7), 075001. <https://doi.org/10.1289/EHP1663>
- Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of green space increase with biodiversity. *Biology Letters*, 3(4), 390–394. <https://doi.org/10.1098/rsbl.2007.0149>
- Garrard, G. (2014). *Ecocriticism* (2nd ed.). Routledge.
- Gäckle, J., Chebotareva, M., Plüschke-Altof, B., Meul, J., Väänänen, I., Utkarsh, S., Timpe, A., Lohrberg, F., Suutari, T., Lovheim, E., & MacIntyre, T. (2025). Co-Creating Change: Seedbed Interventions as Catalysts for Equitable Urban Planning—The Case of Umeå. *Urban Planning*, 10, Article 9118.
<https://doi.org/10.17645/up.9118>
- Grime, M. M., & Wright, G. (2016). Delphi Method. In *Wiley StatsRef: Statistics Reference Online* (pp. 1–6). John Wiley & Sons, Ltd.
<https://doi.org/10.1002/9781118445112.stat07879>
- Grinyer, A. (2001). Ethical dilemmas in nonclinical health research from a UK perspective. *Nursing Ethics*, 8(2), 123–132.
<https://doi.org/10.1177/096973300100800205>
- Grinyer, A. (2009). The anonymity of research participants: Assumptions, ethics, and practicalities. *Pan-Pacific Management Review*, 12, 49–58.
- Harrison, D. S., Sigman, E. J., Ch'ang, J. H., Sarwal, A., Celotto, A., Malone, A., Nowicki, A., Martin, A., Boling, B., Nobleza, C. O. S., Reeves, C., Greer, D. M., McLaughlin, D., Woods, E. O., Fields, E., Perets, E., Jannotta, G. E., Mears, J., Twomey, K., ... Albin, C. S. W. (2024). A Modified Delphi Consensus Approach to Define Entrustable Professional Activities for Neurocritical Care Advanced Practice Providers. *Critical Care Medicine*, 52(7), 1032.
<https://doi.org/10.1097/CCM.0000000000006260>

- Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health*, 35, 207–228. <https://doi.org/10.1146/annurev-publhealth-032013-182443>
- Hasson, F., Keeney, S., & McKenna, H. (2025). Revisiting the Delphi technique - Research thinking and practice: A discussion paper. *International Journal of Nursing Studies*, 168, 105119. <https://doi.org/10.1016/j.ijnurstu.2025.105119>
- Henderson, L., Tipper, L., Willicombe, S., & Gattis, M. (2024). Shared time in nature increases feelings of social connection amongst university students. *Journal of Environmental Psychology*, 96, 102343. <https://doi.org/10.1016/j.jenvp.2024.102343>
- Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine*, 292, 114523. <https://doi.org/10.1016/j.socscimed.2021.114523>
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, 33(2–3), 61–83. <https://doi.org/10.1017/S0140525X0999152X>
- Hickman, C. (2024). Eco-Anxiety in Children and Young People – A Rational Response, Irreconcilable Despair, or Both? *The Psychoanalytic Study of the Child*, 77(1), 356–368. <https://doi.org/10.1080/00797308.2023.2287381>
- Hinkin, T. R., Tracey, J. B., &ENZ, C. A. (1997). Scale Construction: Developing Reliable and Valid Measurement Instruments. *Journal of Hospitality & Tourism Research*, 21(1), 100–120. <https://doi.org/10.1177/109634809702100108>
- Hogg, T. L., Stanley, S. K., O'Brien, L. V., Wilson, M. S., & Watsford, C. R. (2021). The Hogg Eco-Anxiety Scale: Development and validation of a multidimensional scale. *Global Environmental Change*, 71, 102391. <https://doi.org/10.1016/j.gloenvcha.2021.102391>
- Hong, Q. N., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M.-P., Griffiths, F., Nicolau, B., O'Cathain, A., Rousseau, M.-C., & Vedel, I. (2019). Improving the content validity of the mixed methods appraisal tool: A modified e-Delphi study. *Journal of Clinical Epidemiology*, 111, 49–59.e1. <https://doi.org/10.1016/j.jclinepi.2019.03.008>
- Hsu, C.-C., & Sandford, B. A. (2007). The Delphi technique: Making sense of consensus. *Practical Assessment, Research & Evaluation*, 12(10), 1–8. <https://doi.org/10.7275/pdz9-th90>

- Hyvönen, K., Törnroos, K., Salonen, K., Korpela, K., Feldt, T., & Kinnunen, U. (2018). Profiles of nature exposure and outdoor activities associated with occupational well-being among employees. *Frontiers in Psychology*, 9, 754. <https://doi.org/10.3389/fpsyg.2018.00754>
- Indu, P., Vidhukumar, K., Chacko, D., Menon, V., Grover, S., & Gupta, S. (2025). Criterion validity, construct validity, and factor analysis: An introductory overview. *Indian Journal of Psychiatry*, 67(9), 916–921. https://doi.org/10.4103/indianjpsychiatry_911_25
- Ives, C. D., Giusti, M., Fischer, J., Abson, D. J., Klaniecki, K., Dorninger, C., Laudan, J., Barthel, S., Abernethy, P., Martín-López, B., Raymond, C. M., Kendal, D., & von Wehrden, H. (2017). Human–nature connection: A multidisciplinary review. *Current Opinion in Environmental Sustainability*, 26–27, 106–113. <https://doi.org/10.1016/j.cosust.2017.05.005>
- Jacobs, E. (2023). Transformative experience and informed consent to psychedelic-assisted psychotherapy. *Frontiers in Psychology*, 14. <https://doi.org/10.3389/fpsyg.2023.1108333>
- Jebb, A. T., Parrigon, S., & Woo, S. E. (2017). Exploratory data analysis as a foundation of inductive research. *Human Resource Management Review*, 27(2), 265–276. <https://doi.org/10.1016/j.hrmr.2016.08.003>
- 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). <https://doi.org/10.3390/ijerph16030452>
- 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. <https://doi.org/10.3390/ijerph13020196>
- Jensen, J. K., Persson, A. S., & Soga, M. (2026). Toward a unified understanding of people’s aversion to nature: Biophobia. *Frontiers in Ecology and the Environment*, 24(1), e70019. <https://doi.org/10.1002/fee.70019>
- Joye, Y., & De Block, A. (2011). ‘Nature and I are two’: A critical examination of the biophilia hypothesis. *Environmental Values*, 20(2), 189–215. <https://doi.org/10.3197/096327111X12997574391724>

- Kaiser, K. (2009). Protecting respondent confidentiality in qualitative research. *Qualitative Health Research*, 19(11), 1632–1641.
<https://doi.org/10.1177/1049732309350879>
- Kaplan, R., & Kaplan, S. (1989). *The Experience of Nature: A Psychological Perspective*. Cambridge University Press.
- Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, 15(3), 169–182.
[https://doi.org/10.1016/0272-4944\(95\)90001-2](https://doi.org/10.1016/0272-4944(95)90001-2)
- Keaulana, S., Kahili-Heede, M., Riley, L., Park, M. L. N., Makua, K. L., Vegas, J. K., & Antonio, M. C. K. (2021). A Scoping Review of Nature, Land, and Environmental Connectedness and Relatedness. *International Journal of Environmental Research and Public Health*, 18(11), 5897.
<https://doi.org/10.3390/ijerph18115897>
- Kellert, S. R. (1993). Attitudes, knowledge, and behavior toward wildlife among the industrial superpowers: United States, Japan, and Germany. *Journal of Social Issues*, 49(1), 53–69. <https://doi.org/10.1111/j.1540-4560.1993.tb00908.x>
- Koller, I., Levenson, M. R., & Glück, J. (2017). What Do You Think You Are Measuring? A Mixed-Methods Procedure for Assessing the Content Validity of Test Items and Theory-Based Scaling. *Frontiers in Psychology*, 8.
<https://doi.org/10.3389/fpsyg.2017.00126>
- Korpela, K. M. (1989). Place-identity as a product of environmental self-regulation. *Journal of Environmental Psychology*, 9(3), 241–256.
[https://doi.org/10.1016/S0272-4944\(89\)80038-6](https://doi.org/10.1016/S0272-4944(89)80038-6)
- Kotera, Y., Richardson, M., & Sheffield, D. (2022). Effects of Shinrin-Yoku (Forest Bathing) and Nature Therapy on Mental Health: A Systematic Review and Meta-analysis. *International Journal of Mental Health and Addiction*, 20(1), 337–361. <https://doi.org/10.1007/s11469-020-00363-4>
- Kumar, P., Druckman, A., Gallagher, J., Gatersleben, B., Allison, S., Eisenman, T. S., Hoang, U., Hama, S., Tiwari, A., Sharma, A., Abhijith, K. V., Adlakha, D., McNabola, A., Astell-Burt, T., Feng, X., Skeldon, A. C., de Lusignan, S., & Morawska, L. (2019). The nexus between air pollution, green infrastructure and human health. *Environment International*, 133, 105181.
<https://doi.org/10.1016/j.envint.2019.105181>

- Kvale, S. (2006). Dominance Through Interviews and Dialogues. *Qualitative Inquiry*, 12(3), 480–500. <https://doi.org/10.1177/1077800406286235>
- Kyriazos, T. A. (2018). Applied Psychometrics: Sample Size and Sample Power Considerations in Factor Analysis (EFA, CFA) and SEM in General. *Psychology*, 9(8), 2207–2230. <https://doi.org/10.4236/psych.2018.98126>
- Lange, T., Kopkow, C., Lützner, J., Günther, K.-P., Gravius, S., Scharf, H.-P., Stöve, J., Wagner, R., & Schmitt, J. (2020). Comparison of different rating scales for the use in Delphi studies: Different scales lead to different consensus and show different test-retest reliability. *BMC Medical Research Methodology*, 20(1), 28. <https://doi.org/10.1186/s12874-020-0912-8>
- Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology*, 43, 112–124. <https://doi.org/10.1016/j.jenvp.2015.06.004>
- Lehmann, S. (2019). Reconnecting with nature: Developing urban spaces in the age of climate change. *Emerald Open Research*, 1, 2. <https://doi.org/10.12688/emeraldopenres.12960.1>
- Lengieza, M. L., & Aviste, R. (2025). Relationships between people and nature: Nature connectedness and relational environmental values. *Current Opinion in Psychology*, 62. <https://doi.org/10.1016/j.copsyc.2024.101984>
- Lengieza, M. L., Aviste, R., & Swim, J. K. (2023). Nature as community: An overlooked predictor of pro-environmental intentions. *Journal of Environmental Psychology*, 91, 102127. <https://doi.org/10.1016/j.jenvp.2023.102127>
- Leopold, A. (1949). *A Sand County Almanac*. Oxford University Press.
- Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of Environmental Psychology*, 31(3), 207–230. <https://doi.org/10.1016/j.jenvp.2010.10.001>
- Litleskare, S., MacIntyre, T. E., & Calogiuri, G. (2020). Enable, Reconnect and Augment: A New ERA of Virtual Nature Research and Application. *International Journal of Environmental Research and Public Health*, 17(5), 1738. <https://doi.org/10.3390/ijerph17051738>
- Louv, R. (2005). *Last child in the woods Saving our children from nature-deficit disorder*. Atlantic Books.

- 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. <https://doi.org/10.1371/journal.pone.0177186>
- Lutz, P. K., Passmore, H.-A., Howell, A. J., Zelenski, J. M., Yang, Y., & Richardson, M. (2023). The Continuum of Eco-Anxiety Responses: A Preliminary Investigation of Its Nomological Network. *Collabra: Psychology*, 9(1), 67838. <https://doi.org/10.1525/collabra.67838>
- Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, 35(6), 382–385. <https://doi.org/10.1097/00006199-198611000-00017>
- MacIntyre, T. E., Walkin, A. M., Beckmann, J., Calogiuri, G., Gritzka, S., Oliver, G., Donnelly, A. A., & Warrington, G. (2019). An Exploratory Study of Extreme Sport Athletes' Nature Interactions: From Well-Being to Pro-environmental Behavior. *Frontiers in Psychology*, 10. <https://doi.org/10.3389/fpsyg.2019.01233>
- 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. <https://doi.org/10.1016/j.jenvp.2004.10.001>
- McNeish, D., & Wolf, M. G. (2020). Thinking twice about sum scores. *Behavior Research Methods*, 52(6), 2287–2305. <https://doi.org/10.3758/s13428-020-01398-0>
- Merchant, C. (1980). *The Death of Nature: Women, Ecology, and the Scientific Revolution*. Harper & Row.
- Mikulincer, M., & Shaver, P. R. (2007). *Attachment in adulthood: Structure, dynamics, and change* (p. 578). The Guilford Press.
- Miller, J. R. (2005). Biodiversity conservation and the extinction of experience. *Trends in Ecology & Evolution*, 20(8), 430–434. <https://doi.org/10.1016/j.tree.2005.05.013>
- Miller, M., Davis, A., & Mclean, C. (2021). Development and Pilot Testing of a Trauma-Focused Cognitive-Behavioral Self-Management Mobile App for Post-traumatic Stress Symptoms. *Journal of Technology in Behavioral Science*, 7. <https://doi.org/10.1007/s41347-020-00188-x>
- Morgan, D. L. (2014). *Integrating Qualitative and Quantitative Methods: A Pragmatic Approach*. SAGE Publications, Inc. <https://doi.org/10.4135/9781544304533>

- Murphy, C., MacIntyre, T., & Gallagher, E. (2024). Exploring our relationship with nature: A modified-Delphi study protocol. *Open Research Europe*, 4, 107.
<https://doi.org/10.12688/openreseurope.16295.1>
- Muthukrishna, M., Bell, A. V., Henrich, J., Curtin, C. M., Gedranovich, A., McInerney, J., & Thue, B. (2020). Beyond Western, Educated, Industrial, Rich, and Democratic (WEIRD) Psychology: Measuring and Mapping Scales of Cultural and Psychological Distance. *Psychological Science*, 31(6), 678–701.
<https://doi.org/10.1177/0956797620916782>
- Naeem, N.-K., Hadie, S. N. H., Ismail, I. M., & Yusoff, M. S. B. (2023). Development and validation of Digi-MEE Instrument measuring online learning environments in medical education. *Pakistan Journal of Medical Sciences*, 39(6).
<https://doi.org/10.12669/pjms.39.6.8430>
- Naess, A. (1973). The shallow and the deep, long-range ecology movement. A summary*. *Inquiry*, 16(1–4), 95–100.
<https://doi.org/10.1080/00201747308601682>
- Nash, R. (2014). *Wilderness and the American Mind* (5th ed.). Yale University Press.
- Natural England. (2019). *Monitor of Engagement with the Natural Environment: Technical report to the 2009–2019 surveys*. GOV.UK.
https://assets.publishing.service.gov.uk/media/5e7a3962d3bf7f52f3c78eff/MEN_E_Technical_Report_Years_1_to_10v2.pdf
- Nawagi, F., Munabi, I. G., Vyt, A., Kiguli, S., Rabin, T., Waggie, F., & Mubuke, A. G. (2023). Using the modified Delphi technique to develop a framework for interprofessional education during international electives in health professions training institutions in Sub-Saharan Africa. *Frontiers in Medicine*, 10.
<https://doi.org/10.3389/fmed.2023.1225475>
- Ní Annracháin, M. (2020). Seeing the natural world: Comhbhá an Dúlra (The sympathy of Nature). *Proceedings of the Royal Irish Academy*, 120C, 1–16.
<https://doi.org/10.3318/priac.2020.120.09>
- Nieuwenhuijsen, M. J., Dadvand, P., Márquez, S., Bartoll, X., Barboza, E. P., Cirach, M., Borrell, C., & Zijlema, W. L. (2022). The evaluation of the 3-30-300 green space rule and mental health. *Environmental Research*, 215(Pt 2), 114387.
<https://doi.org/10.1016/j.envres.2022.114387>

- Nigg, C., Petersen, E., & MacIntyre, T. (2023). Natural environments, psychosocial health, and health behaviors in a crisis—A scoping review of the literature in the COVID-19 context. *Journal of Environmental Psychology*, 88, 102009. <https://doi.org/10.1016/j.jenvp.2023.102009>
- 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. <https://doi.org/10.1177/0013916508318748>
- Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2011). Happiness is in our Nature: Exploring Nature Relatedness as a Contributor to Subjective Well-Being. *Journal of Happiness Studies*, 12(2), 303–322. <https://doi.org/10.1007/s10902-010-9197-7>
- Nisbet, E. K., & Zelenski, J. M. (2013). The NR-6: A new brief measure of nature relatedness. *Frontiers in Psychology*, 4, 813. <https://doi.org/10.3389/fpsyg.2013.00813>
- Noble, H., & Heale, R. (2019). Triangulation in research, with examples. *Evidence-Based Nursing*, 22(3), 67–68. <https://doi.org/10.1136/ebnurs-2019-103145>
- Norström, A. V., Cvitanovic, C., Löf, M. F., West, S., Wyborn, C., Balvanera, P., Bednarek, A. T., Bennett, E. M., Biggs, R., de Bremond, A., Campbell, B. M., Canadell, J. G., Carpenter, S. R., Folke, C., Fulton, E. A., Gaffney, O., Gelcich, S., Jouffray, J.-B., Leach, M., ... Österblom, H. (2020). Principles for knowledge co-production in sustainability research. *Nature Sustainability*, 3(3), 182–190. <https://doi.org/10.1038/s41893-019-0448-2>
- Oostvogels, V. J., Dumont, B., Nijland, H. J., De Boer, I. J. M., & Ripoll-Bosch, R. (2024). What about the negatives? An integrated framework for revealing diverse values of nature and its conservation. *People and Nature*, 6(6), 2633–2646. <https://doi.org/10.1002/pan3.10750>
- Perkins, H. E. (2010). Measuring love and care for nature. *Journal of Environmental Psychology*, 30(4), 455–463. <https://doi.org/10.1016/j.jenvp.2010.05.004>
- Petersen, E., Fiske, A. P., & Schubert, T. W. (2019). The Role of Social Relational Emotions for Human-Nature Connectedness. *Frontiers in Psychology*, 10, 2759. <https://doi.org/10.3389/fpsyg.2019.02759>
- Plumwood, V. (2005). *Environmental Culture: The Ecological Crisis of Reason*. Routledge. <https://doi.org/10.4324/9780203996430>

- Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing & Health*, 30(4), 459–467. <https://doi.org/10.1002/nur.20199>
- Pouso, S., Borja, Á., Fleming, L. E., Gómez-Baggethun, E., White, M. P., & Uyarra, M. C. (2021). Contact with blue-green spaces during the COVID-19 pandemic lockdown beneficial for mental health. *Science of The Total Environment*, 756, 143984. <https://doi.org/10.1016/j.scitotenv.2020.143984>
- Pyle, R. M. (1978). The extinction of experience. *Horticulture*, 56, 64–67.
- Raymond, C. M., Brown, G., & Weber, D. (2010). The measurement of place attachment: Personal, community, and environmental connections. *Journal of Environmental Psychology*, 30(4), 422–434. <https://doi.org/10.1016/j.jenvp.2010.08.002>
- Ribeiro, A. I., Triguero-Mas, M., Jardim Santos, C., Gómez-Nieto, A., Cole, H., Anguelovski, I., Silva, F. M., & Baró, F. (2021). Exposure to nature and mental health outcomes during COVID-19 lockdown. A comparison between Portugal and Spain. *Environment International*, 154, 106664. <https://doi.org/10.1016/j.envint.2021.106664>
- Richardson, M., Passmore, H.-A., Lumber, R., Thomas, R., & Hunt, A. (2021). Moments, not minutes: The nature-wellbeing relationship. *International Journal of Wellbeing*, 11(1), 8–33. <https://doi.org/10.5502/ijw.v11i1.1267>
- Richardson, M., & Thatcher, A. (2024). State of science: Refitting the human to nature. *Ergonomics*, 67(4), 582–596. <https://doi.org/10.1080/00140139.2023.2236340>
- Riechers, M., Loos, J., Balázs, Á., García-Llorente, M., Bieling, C., Burgos-Ayala, A., Chakroun, L., Mattijssen, T. J. M., Muhr, M. M., Pérez-Ramírez, I., Raatikainen, K. J., Rana, S., Richardson, M., Rosengren, L., & West, S. (2021). Key advantages of the leverage points perspective to shape human-nature relations. *Ecosystems and People*, 17(1), 205–214. <https://doi.org/10.1080/26395916.2021.1912829>
- Roberts, L. D., & Povee, K. (2014). A brief measure of attitudes toward mixed methods research in psychology. *Frontiers in Psychology*, 5. <https://doi.org/10.3389/fpsyg.2014.01312>
- Rowan, N., & Wulff, D. (2007). Using qualitative methods to inform scale development. *The Qualitative Report*, 12(3), 450–466. <https://doi.org/10.46743/2160-3715/2007.1627>

- Scannell, L., & Gifford, R. (2010). Defining place attachment: A tripartite organizing framework. *Journal of Environmental Psychology*, 30(1), 1–10.
<https://doi.org/10.1016/j.jenvp.2009.09.006>
- Schneider, P., Evaniew, N., Rendon, J. S., McKay, P., Randall, R. L., Turcotte, R., Vélez, R., Bhandari, M., Ghert, M., & PARITY Investigators. (2016). Moving forward through consensus: Protocol for a modified Delphi approach to determine the top research priorities in the field of orthopaedic oncology. *BMJ Open*, 6(5), e011780. <https://doi.org/10.1136/bmjopen-2016-011780>
- Schultz, P. W. (2002). Inclusion with Nature: The Psychology Of Human-Nature Relations. In P. Schmuck & W. P. Schultz (Eds.), *Psychology of Sustainable Development* (pp. 61–78). Springer US. https://doi.org/10.1007/978-1-4615-0995-0_4
- Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology*, 24(1), 31–42.
[https://doi.org/10.1016/S0272-4944\(03\)00022-7](https://doi.org/10.1016/S0272-4944(03)00022-7)
- Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 25, pp. 1–65). Academic Press.
[https://doi.org/10.1016/S0065-2601\(08\)60281-6](https://doi.org/10.1016/S0065-2601(08)60281-6)
- Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online Readings in Psychology and Culture*, 2(1).
<https://doi.org/10.9707/2307-0919.1116>
- Simaika, J. P., & Samways, M. J. (2010). Biophilia as a universal ethic for conserving biodiversity. *Conservation Biology*, 24(3), 903–906.
<https://doi.org/10.1111/j.1523-1739.2010.01485.x>
- Sisti, D. A., & Brendel, D. H. (2015). Pragmatism. In *The Encyclopedia of Clinical Psychology* (pp. 1–6). John Wiley & Sons, Ltd.
<https://doi.org/10.1002/9781118625392.wbecp477>
- Soga, M., & Gaston, K. J. (2016). Extinction of experience: The loss of human–nature interactions. *Frontiers in Ecology and the Environment*, 14(2), 94–101.
<https://doi.org/10.1002/fee.1225>

- Soga, M., Gaston, K. J., & Yamaura, Y. (2017). Gardening is beneficial for health: A meta-analysis. *Preventive Medicine Reports*, 5, 92–99.
<https://doi.org/10.1016/j.pmedr.2016.11.007>
- Spotswood, E. N., Benjamin, M., Stoneburner, L., Wheeler, M. M., Beller, E. E., Balk, D., McPhearson, T., Kuo, M., & McDonald, R. I. (2021). Nature inequity and higher COVID-19 case rates in less-green neighbourhoods in the United States. *Nature Sustainability*, 4(12), 1092–1098. <https://doi.org/10.1038/s41893-021-00781-9>
- Spreng, R. N., McKinnon, M. C., Mar, R. A., & Levine, B. (2009). The Toronto Empathy Questionnaire: Scale development and initial validation of a factor-analytic solution to multiple empathy measures. *Journal of Personality Assessment*, 91(1), 62–71. <https://doi.org/10.1080/00223890802484381>
- Steg, L., & De Groot, J. I. M. (2012). Environmental values. In S. D. Clayton (Ed.), *The Oxford handbook of environmental and conservation psychology* (pp. 81–92). Oxford University Press.
- Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 6(2), 81–97.
- Stets, J. E., & Burke, P. J. (2000). Identity theory and social identity theory. *Social Psychology Quarterly*, 63(3), 224–237. <https://doi.org/10.2307/2695870>
- Stryker, S. (1980). *Symbolic Interactionism: A Social Structural Version*. Benjamin/Cummings.
- Stryker, S., & Serpe, R. T. (1994). Identity salience and psychological centrality: Equivalent, overlapping, or complementary concepts? *Social Psychology Quarterly*, 57(1), 16–35. <https://doi.org/10.2307/2786972>
- Swain, J. (2018). *A Hybrid Approach to Thematic Analysis in Qualitative Research: Using a Practical Example*. SAGE Publications Ltd.
<https://doi.org/10.4135/9781526435477>
- Tam, K.-P. (2013). Concepts and measures related to connection to nature: Similarities and differences. *Journal of Environmental Psychology*, 34, 64–78.
<https://doi.org/10.1016/j.jenvp.2013.01.004>
- Tashakkori, A., Teddlie, C., & Biesta, G. (2010). Pragmatism and the philosophical foundations of mixed methods research. In A. Tashakkori & C. Teddlie (Eds.),

- SAGE handbook of mixed methods in social & behavioral research* (pp. 95–118). SAGE Publications. <https://doi.org/10.4135/9781506335193>
- Taua, C., Neville, C., & Hepworth, J. (2014). Research participation by people with intellectual disability and mental health issues: An examination of the processes of consent. *International Journal of Mental Health Nursing*, 23(6), 513–524. <https://doi.org/10.1111/inm.12079>
- Taylor, E. (2020). We Agree, Don't We? The Delphi Method for Health Environments Research. *HERD: Health Environments Research & Design Journal*, 13(1), 11–23. <https://doi.org/10.1177/1937586719887709>
- Tilley, L., & Woodthorpe, K. (2011). Is it the end for anonymity as we know it? A critical examination of the ethical principle of anonymity in the context of 21st century demands on the qualitative researcher. *Qualitative Research*, 11(2), 197–212. <https://doi.org/10.1177/1468794110394073>
- Topp, C. W., Østergaard, S. D., Søndergaard, S., & Bech, P. (2015). The WHO-5 Well-Being Index: A systematic review of the literature. *Psychotherapy and Psychosomatics*, 84(3), 167–176. <https://doi.org/10.1159/000376585>
- Trevelyan, E. G., & Robinson, N. (2015). Delphi methodology in health research: How to do it? *European Journal of Integrative Medicine*, 7(4), 423–428. <https://doi.org/10.1016/j.eujim.2015.07.002>
- Ugolini, F., Massetti, L., Calaza-Martínez, P., Cariñanos, P., Dobbs, C., Ostoić, S. K., Marin, A. M., Pearlmutter, D., Saaroni, H., Šaulienė, I., Simoneti, M., Verlič, A., Vuletić, D., & Sanesi, G. (2020). Effects of the COVID-19 pandemic on the use and perceptions of urban green space: An international exploratory study. *Urban Forestry & Urban Greening*, 56, 126888. <https://doi.org/10.1016/j.ufug.2020.126888>
- Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224(4647), 420–421. <https://doi.org/10.1126/science.6143402>
- 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. [https://doi.org/10.1016/S0272-4944\(05\)80184-7](https://doi.org/10.1016/S0272-4944(05)80184-7)

- United Nations, Department of Economic and Social Affairs, Population Division.
(2019). *World urbanization prospects: The 2018 revision* (ST/ESA/SER.A/420).
United Nations. <https://population.un.org/wup/assets/WUP2018-Report.pdf>
- Venter, Z. S., Barton, D. N., Gundersen, V., Figari, H., & Nowell, M. S. (2021). Back to nature: Norwegians sustain increased recreational use of urban green space months after the COVID-19 outbreak. *Landscape and Urban Planning*, 214, 104175. <https://doi.org/10.1016/j.landurbplan.2021.104175>
- Verplanken, B., & Orbell, S. (2003). Reflections on past behavior: A self-report index of habit strength. *Journal of Applied Social Psychology*, 33(6), 1313–1330. <https://doi.org/10.1111/j.1559-1816.2003.tb01951.x>
- von der Gracht, H. A. (2012). Consensus measurement in Delphi studies: Review and implications for future quality assurance. *Technological Forecasting and Social Change*, 79(8), 1525–1536. <https://doi.org/10.1016/j.techfore.2012.04.013>
- Weinstein, N., Przybylski, A. K., & Ryan, R. M. (2009). Can nature make us more caring? Effects of immersion in nature on intrinsic aspirations and generosity. *Personality and Social Psychology Bulletin*, 35(10), 1315–1329. <https://doi.org/10.1177/0146167209341649>
- Wells, N. M., & Lekies, K. S. (2006). Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Children, Youth and Environments*, 16(1), 1–24. <https://doi.org/10.1353/cye.2006.0031>
- 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), 7730. <https://doi.org/10.1038/s41598-019-44097-3>
- Whitmarsh, L., & O'Neill, S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *Journal of Environmental Psychology*, 30(3), 305–314. <https://doi.org/10.1016/j.jenvp.2010.01.003>
- Williams, D. R., & Vaske, J. J. (2003). The measurement of place attachment: Validity and generalizability of a psychometric approach. *Forest Science*, 49(6), 830–840. <https://doi.org/10.1093/forestscience/49.6.830>
- Wilson, E. O. (1984). *Biophilia*. Harvard University Press.

- Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. *Landscape and Urban Planning*, 125, 234–244. <https://doi.org/10.1016/j.landurbplan.2014.01.017>
- World Health Organization. (1998). *Wellbeing measures in primary health care/the DepCare Project: Report on a WHO meeting: Stockholm, Sweden, 12–13 February 1998*. World Health Organization. <https://iris.who.int/handle/10665/349766>
- World Health Organization Regional Office for Europe. (2016). *Urban green spaces and health: A review of evidence*. World Health Organization. <https://www.who.int/europe/publications/i/item/WHO-EURO-2016-3352-43111-60341>
- World Health Organization Regional Office for Europe. (2017). *Urban green space interventions and health: A review of impacts and effectiveness*. World Health Organization. <https://iris.who.int/bitstream/handle/10665/366036/WHO-EURO-2017-6358-46124-66715-eng.pdf>
- World Bank. (2024). *Urban population (% of total population) - Ireland*. World Development Indicators. <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=IE>
- Yan, X., & Chuang, P.-L. (2023). How do raters learn to rate? Many-facet Rasch modeling of rater performance over the course of a rater certification program. *Language Testing*, 40(1), 153–179. <https://doi.org/10.1177/02655322221074913>
- Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior*, 1(3), 237–244. <https://doi.org/10.1089/cpb.1998.1.237>
- Zhu, W., Zhang, Y., Lan, Y., & Song, X. (2025). Smartphone dependence and its influence on physical and mental health. *Frontiers in Psychiatry*, 16, 1281841. <https://doi.org/10.3389/fpsy.2025.1281841>
- Zijlema, W., Cerin, E., Cirach, M., Bartoll, X., Borrell, C., Dadvand, P., & Nieuwenhuijsen, M. J. (2024). Cities and mental health: The role of the built environment, and environmental and lifestyle factors in Barcelona.

Environmental Pollution (Barking, Essex: 1987), 346, 123559.
<https://doi.org/10.1016/j.envpol.2024.123559>

Appendices

Appendix A: Ethics Approval for Pan European Study

Thank you for your Research Ethics application which was recently reviewed by the Education and Health Sciences Research Ethics Committee.

The recommendation of the Committee is outlined below:

Project Title: 2019_06_43_EHS GO GREEN ROUTES: Citizens attitudes toward Nature Based Solutions and Environment across European Cities

Principal Investigator: Tadhg MacIntyre

Other Investigators: Giovanna Calogiuri, Cassie Murphy, Mario Balzan, Alan Donnelly, PESS.

Recommendation: This research study has ethical approval until December 2020. EHSREC approve the requested changes as outlined below:

Approved Changes:

Changes to Supporting Documentation

Include additional researchers listed below in online survey documentation.

Other Changes

Additional researchers added to the project:

- Elaine Gallagher Psychology Dept. UL (elaine.gallagher@ul.ie)
- Dr Norma Bargary, Department of Mathematics and Statistics, UL
- Dr. Aoife Donnelly, Environmental Scientist, TU Dublin

Please note that as Principal Investigator of this project you are required to submit a Research Completion

Report Form (attached) on completion of this research study.

To ensure that UL informed consent forms are GDPR-compliant, ULREG has adopted a standardised consent form for all researchers to use. Please update your informed consent form(s) using the attached templates when carrying out this and all future research. Please note that the Research Privacy Notice should also be provided to participants.

Appendix B: Pan European Study



Citizens Attitudes Towards Nature-Based Solutions and Environment Across European Cities: A Feasibility Study



This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 809988.



This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869764.

This research is approved by the University of Limerick EHS ethics research committee (2019_06_43_EHS) with Principal Investigator: Tadhg MacIntyre (Tadhg.macIntyre@ul.ie), Dr Mario Balzan, Dr Judita Tomaskinova (MCAST, Malta), Prof. Giovanna Calogiuri (University of South-Eastern Norway), Prof. Alan Donnelly, Dr Elaine Gallagher and Cassandra Murphy (University of Limerick), and Dr Aoife Donnelly (Technical University Dublin).

Welcome

As part of the ReNature project in collaboration with the University of Limerick, we are conducting research on attitudes towards nature-based solutions and the environment across European cities in relation to COVID-19.

This survey aims to explore the use of public and private green spaces before and during the COVID-19 pandemic, to identify the contributions of these spaces to human well-being and the characteristics of green spaces that are valued by visitors.

We would like to take a few minutes of your time to ask you about your perceptions, views and use of open green spaces *before, during and after* the COVID-19 pandemic lockdown. **This questionnaire is directed to respondents over 18 years old and should take 15–20 minutes to answer. Please do not answer the survey more than once!**

What is the study about?

This survey aims to explore your opinions and attitudes about nature, the environment and sustainability in the context of the global pandemic we faced in 2020.

What will I have to do?

You are invited to contribute to a survey which asks the following: demographic information (age, gender and profession), general well-being and physical activity, attitudes towards nature, the environment and nature-based solutions. The online survey takes about 15 minutes to complete.

What are the benefits?

This feasibility study aims to assess the feasibility of a large-scale survey and also gathers opinions and attitudinal information that may enable optimisation of nature-based solutions in your city. Your answers will contribute towards a better understanding of perceptions about open green spaces and their benefits to human health and well-being.

What are the risks?

There are no foreseen risks in participation.

What if you don't want to take part?

Participation in this study is entirely voluntary and you can choose not to take part or to stop your involvement in this study at any time, without giving a reason and without penalty.

What happens to the information?

The information that is collected will be kept private and stored securely and safely on the researchers' computer. The files are protected with a password. Your name and IP address will not be recorded in the survey. The information gathered in the study will be kept for seven years. After this time, it will be destroyed.

Who else is taking part?

Those who lived in Limerick City, Ireland and in the Malta municipality during the COVID-19 lockdown, and who are over the age of 18. However respondents from other areas of these target countries are welcome to take part.

What if I have more questions?

If you have any questions about the study, you may contact the research team. It is important that you feel that all your questions have been answered.

Thank you for taking the time to read this. We would be grateful if you would consider cooperating with this study.

Contact Information of Project Investigators.**Principal Investigator Co-Investigator**

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Coordinator ReNature Project H2020
Malta College of Art, Science and Technology,
Email: mario.balzan@mcast.edu.mt
Website: renature-project.eu

Other investigators

Prof. Alan Donnelly, Dr Norma Bargary, Dr Elaine Gallagher, Cassandra Murphy MA, GoGreen Routes, University of Limerick. Dr Aoife Donnelly, School of Food Science and Environmental Health TU Dublin

PARTICIPANT CONSENT

“Citizens attitudes toward Nature-Based Solutions and Environment across European Cities: A feasibility survey study”.

Should you agree to participate in this study please read the statements below and, if you agree to them, please click the consent box.

- I have read and understood the participant information sheet.
- I understand what the project is about, and what the results will be used for.
- I understand that what the researchers find out in this study may be shared with others, but that my name will not be given to anyone in any written material developed.
- I am fully aware of what I will have to do and of any risks and benefits of the study.
- I know that I am choosing to take part in the study and that I can stop taking part in the study at any stage without giving any reason to the researchers.

☐
☐
☐

Click here to consent to participate in the survey.

Click here to leave this page and decline to participate.

Click here to find out further information.

Demographic information

Please answer the following demographic information.

Which of these localities are you in?



Valetta, Malta



Limerick, Ireland



Cambridge, UK



Trento, Italy

If you are not from one of the above localities, please specify:

Gender

☐
☐

Male

Female

- ☐ Prefer not to say
- ☐ Other

What is your age?

What is your civil status?

- ☐ Married
- ☐ Widowed
- ☐ Divorced
- ☐ Separated
- ☐ Never married
- ☐ Civil Partnership
- ☐ Other

Occupational status

- ☐ Employed full time
- ☐ Employed part time
- ☐ Unemployed looking for work
- ☐ Unemployed not looking for work
- ☐ Retired
- ☐ Student
- ☐ Self-employed/Freelancer
- ☐ Out of work due to COVID-19
- ☐ Other

Which of the following best describes your area?

- ☐ Urban Core
- ☐ Small Town, Village or Urban Fringe
- ☐ Dispersed Settlements and Rural Areas

Where did you stay during the strictest COVID-19 measures?

- ☐ My current residence
- ☐ Another place

Which of the following best describes this area? (*if selecting another place*)

- ☐ Urban Core
- ☐ Small Town, Village or Urban Fringe
- ☐ Dispersed Settlements and Rural Areas

Do you have access to a private or communal natural area adjacent to your home?

- ☐ Yes, a private garden
- ☐ Yes, a communal green space
- ☐ Agricultural land
- ☐ Both a private garden and communal green space
- ☐ All of the above
- ☐ No

What is your household income per month (total of all members of your household together)? In your own currency.

- ☐ 0-2000
- ☐ 2000-3000
- ☐ 3000-4000
- ☐ 4000-5000
- ☐ 5000-6000
- ☐ 6000-7000
- ☐ 7000-8000
- ☐ 8000+

How many adults (including yourself) are in your household?

0–8

How many children (under 18) are in your household?

0–8

What is your favourite natural space in your locality to visit?



Other (please specify):

WHO - Five

Instructions: Please use the six-point scale provided and kindly answer all items.

Over the last TWO weeks...

	At no time	Some of the time	Less than half of the time	More than half of the time	Most of the time	All of the time
I have felt cheerful and in good spirits.	☐	☐	☐	☐	☐	☐
I have felt calm and relaxed.	☐	☐	☐	☐	☐	☐
I have felt active and vigorous.	☐	☐	☐	☐	☐	☐
I woke up feeling fresh and rested.	☐	☐	☐	☐	☐	☐

My daily life has been filled with things that interest me.	☐	☐	☐	☐	☐	☐
---	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

NR-6

Instructions: For each of the following, please rate the extent to which you agree with each statement.

Please use the five-point scale provided and kindly answer all items.

	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
My ideal vacation spot would be a remote, wilderness area.	☐	☐	☐	☐	☐
I always think about how my actions affect the environment.	☐	☐	☐	☐	☐
My connection to nature and the environment is a part of my spirituality.	☐	☐	☐	☐	☐
I take notice of wildlife wherever I am.	☐	☐	☐	☐	☐
My relationship to nature is an important part of who I am.	☐	☐	☐	☐	☐
I feel very connected to all living things and the earth.	☐	☐	☐	☐	☐

Definitions

For the purpose of this study we have defined some of the topics we will be examining.

Natural Space- Areas of green or blue space.

Green Space- areas of vegetation in a landscape, such as forests and wilderness areas, street trees, parks, gardens.

Blue Space- areas of water or areas adjacent to water (such as the coast, lakes and rivers).

Confinement - The period in which COVID-19 measures were at their strictest (e.g. Ireland: must remain inside a 2km radius, Italy: cannot leave your house).

Deconfinement - The period in which COVID-19 lockdown restrictions were lifted.

Pre-covid

Please answer with reference to the situation as it was **before** the COVID-19 measures.

Did you visit natural spaces on a regular basis?

- ☐ Yes
☐ No

How often did you visit this space?

- ☐ Daily
☐ Several times a week
☐ Once a week
☐ Several times a month
☐ Once a month
☐ Less than once a month
☐ Other (please specify)

Did you feel safe in this natural space?

- ☐ Yes, always
☐ Most of the time
☐ Sometimes
☐ Never

How much time did you typically spend in natural spaces per visit? (in minutes)

How much time would you have ideally liked to spend in a natural space? (in minutes)

With whom do you usually visit this natural space?

- ☐ Myself
☐ With someone else (1 person)
☐ With a group (family/friends)
☐ With a pet
☐ Other (please specify)

What activities did you take part in when in. natural spaces? (Please select all that apply)

- ☐ Walk
- ☐ Jog/Run
- ☐ Cycle
- ☐ Swim
- ☐ Mindfulness/Meditate
- ☐ Read
- ☐ Draw/Paint
- ☐ Hike
- ☐ Farm
- ☐ Other

How do you access the natural space?

- ☐ Car
- ☐ Public Transport
- ☐ Walking
- ☐ Biking
- ☐ Other (please specify)

How long did it take you to travel to this natural space?

Which benefits would you associate with your experience of natural space? Please choose top 3.

- ☐ Enjoying scenery
- ☐ Observing wildlife
- ☐ Experiencing a close contact with nature (through mindfulness, spirituality or other)
- ☐ Feeling a strong sense of place
- ☐ Experiencing an internal connection with the natural environment
- ☐ Learning/sharing knowledge about natural environment
- ☐ Recreational activities linked to staying fit
- ☐ Reducing stress levels
- ☐ Sharing time with family and friends
- ☐ I do not know / don't want to answer
- ☐ Other (please specify)

Which of the following reasons could you give for NOT visiting natural spaces before COVID-19? (select more than one reason)

- ☐ Space is too small
- ☐ Space is normally too crowded
- ☐ Lack of services such as cafés or bars
- ☐ No public toilet facilities
- ☐ Lack of dog-walking facilities
- ☐ Lack of play area for children
- ☐ Lack of space for sports and recreational activities
- ☐ Low tree cover and lack of shaded areas
- ☐ Low naturalness of green area
- ☐ Higher crime/anti-social behaviour risk
- ☐ Untidiness
- ☐ Weather conditions
- ☐ Low accessibility (e.g. no public transport)
- ☐ Too much vehicular transport surrounding area
- ☐ Elevated levels of noise and/or air pollution
- ☐ No appropriate space in the vicinity

What features were predominant in the natural space you visited most frequently?

- ☐ Areas with shade from trees
- ☐ Lawns or formal parks
- ☐ Forest
- ☐ Sandy or pebble beach
- ☐ Cove or estuary
- ☐ Mountains or hills
- ☐ Flower beds
- ☐ Orchard or Vineyards
- ☐ Agricultural land for grazing
- ☐ Agricultural land for tillage/crops
- ☐ Community garden

*Please answer this in relation to your behaviour **before** the COVID-19 crisis.*

Pro-environmental behaviour refers to behaviour that has minimal negative impacts on the environment.

Pro-environmental behaviour is something...

- ☐ I did frequently.
- ☐ I did automatically.
- ☐ I did without having to consciously remember.
- ☐ I had been doing for a long time.
- ☐ I did without thinking.
- ☐ that would have required effort not to do.
- ☐ that belonged to my routine.
- ☐ I started to do before I realised I was doing it.
- ☐ I would have found hard not to do.
- ☐ I had no need to think about doing.

During Confinement

Please answer with reference to the situation as it was during the COVID-19 confinement measures.

I feel my mental health has suffered as a result of the COVID-19 crisis.

- ☐ Agree strongly
- ☐ Agree
- ☐ Neither agree nor disagree
- ☐ Disagree
- ☐ Disagree strongly
- ☐ Prefer not to say

Which of the following statements best describes how your ability to enjoy natural spaces changed during the COVID-19 crisis?

- ☐ I had no access to natural space.
- ☐ I had access to my private natural space.
- ☐ I had no limitations compared to before COVID-19.
- ☐ Other (please specify)

Did you visit natural space during confinement?

- ☐ Yes
- ☐ No

How often did you visit natural space?

- ☐ More often than before confinement
- ☐ The same as before confinement
- ☐ Less than before confinement

Why did you visit natural spaces during confinement?

What barriers prevented you from visiting natural space during confinement?

Post Confinement

Please answer with reference to the situation as it was after the COVID-19 deconfinement.

What words do you associate with 'Nature'?

Instructions: Please choose a minimum of five words from the list below. You may choose as many as you wish of the 25 phrases.

being away
getting away
escape
taking a break
privacy
enjoying peace and quiet
getting outside
fascination
beauty
exploration
interesting things
changing colours
sounds and smells
constant change
natural features
distraction
getting lost
harmony
make sense of the environment
belonging
sense of oneness
time with others
feel safe here
suits me personally
Other

<table border="1"><tr><td>NATURE</td></tr></table>	NATURE
NATURE	

Which benefits would you associate with your experience of natural space?

Please choose top 5.

- Enjoying scenery
- Observing wildlife
- Experiencing a close contact with nature (through mindfulness, spirituality or other)
- Feeling a strong sense of place
- Experiencing an internal connection with the natural environment
- Learning/sharing knowledge about natural environment
- Recreational activities linked to staying fit
- Reducing stress levels
- Sharing time with family and friends
- I do not know / don't want to answer
- Other

Post-Confinement Benefits

Do you have an increased appreciation for the benefits of natural space after confinement?

- ☐ Increased a lot
- ☐ Increased slightly
- ☐ Stayed the same
- ☐ Decreased slightly
- ☐ Decreased a lot

Did anything in particular enhance your appreciation of natural space?

To what extent do you agree that there should be increased funding in your locality for the following areas?

	Strongly agree	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree	Strongly disagree
Access to Green Space	☐	☐	☐	☐	☐	☐	☐
Active travel Opportunities	☐	☐	☐	☐	☐	☐	☐
Increased protection of existing green space	☐	☐	☐	☐	☐	☐	☐
Access to Blue Space	☐	☐	☐	☐	☐	☐	☐

Linear Parks	☐	☐	☐	☐	☐	☐	☐
Areas of high biodiversity	☐	☐	☐	☐	☐	☐	☐
Urban Forests	☐	☐	☐	☐	☐	☐	☐
Urban living rooms in a nature settings	☐	☐	☐	☐	☐	☐	☐

Do you have an increased awareness of nature close to your residence?

- ☐ Increased a lot
- ☐ Increased slightly
- ☐ Stayed the same
- ☐ Decreased slightly
- ☐ Decreased a lot

Do you have an increased environmental awareness?

- ☐ Increased a lot
- ☐ Increased slightly
- ☐ Stayed the same
- ☐ Decreased slightly
- ☐ Decreased a lot

*Please answer this in relation to your behaviour **after** the COVID-19 crisis.*

Pro-environmental behaviour is something...

- ☐ I did frequently.
- ☐ I did automatically.
- ☐ I did without having to consciously remember.
- ☐ I had been doing for a long time.
- ☐ I did without thinking.
- ☐ that would have required effort not to do.
- ☐ that belonged to my routine.
- ☐ I started to do before I realised I was doing it.
- ☐ I would have found hard not to do.
- ☐ I had no need to think about doing.

What emotions are evoked at your favourite natural space?

Evoked emotions (tick all that apply, and/or elaborate):

- anxious
- stressed
- freedom
- down
- lonely
- tired
- happy
- connected
- energetic
- confident
- relaxed
- Other

Evoked Emotions
--

What would you change in your locality to give you greater access to natural spaces?

Any other suggestions or comments?

End of Survey

Thank you for taking time out of your day to take part in our study. If you have any questions, please contact one of the researchers.

Contact Information of Project Investigators.

Principal Investigator Co-Investigator

Dr Tadhg Mac Intyre,
Coordinator GoGreen Routes H2020,
PESS Dept. University of Limerick,
Tel: 087-8393630
Email: tadhg.macintyre@ul.ie

Co-Investigators

Dr Mario V. Balzan and Dr Judita Tomaskinova
Coordinator ReNature Project H2020
Malta College of Art, Science and Technology,
Email: mario.balzan@mcast.edu.mt
Website: renature-project.eu

Other investigators

Prof. Alan Donnelly, Dr Norma Bargary. Dr
Elaine Gallagher, Cassandra Murphy MA,
GoGreen Routes, University of Limerick.
Dr Aoife Donnelly, School of Food Science
and Environmental Health TU Dublin

Appendix C: Ethical Approval for Delphi Study

MAYNOOTH UNIVERSITY RESEARCH ETHICS COMMITTEE

MAYNOOTH UNIVERSITY,

MAYNOOTH, CO. KILDARE, IRELAND



Dr Carol Barrett

Secretary to Maynooth University Research Ethics Committee

Reference Number: SRESC-2021-2441635

23 June 2021

Cassandra Murphy

Department of Psychology

Maynooth University

Re: Application for ethical approval for a Project entitled: GoGreenRoutes Delphi Study

Dear Cassandra,

The above project has been evaluated under Tier 2 process, expedited review and we would like to inform you that ethical approval has been granted.

Any deviations from the project details submitted to the ethics committee will require further evaluation. This ethical approval will expire on 31/05/2023.

Kind Regards,

A handwritten signature in black ink, appearing to read "Carol Barrett".

Dr Carol Barrett

Secretary,

Maynooth University Research Ethics Committee

C.c. Dr. Tadhg MacIntyre, Department of Psychology

Appendix D: Expert Recruitment Email

Dear _____

Firstly I would like to introduce myself. It's a pleasure to meet you in an electronic sense. Just a little background as to who I am. My name is Cassie and I am a PhD researcher at Maynooth University in Ireland, funded by the GoGreenRoutes H2020 project which is led by my supervisor Tadhg MacIntyre (cc'd above). My research involves exploring what nature connectedness means to people in the 21st century, and more specifically - what is urban nature connectedness.

To do this I am using a modified-Delphi method whereby I interview individuals who are categorised into two groups, 1. Experts (published in the area of human nature relationships) and 2. Expanded Experts (individuals working with nature -be it eco therapists, activists, poets, political figures with a focus on natural space conservation, city planners etc.). After this I will be coding the transcripts and asking the participants to take part in 2-3 'weighting tasks' where they will be asked to rate the relevance of the coded themes to the construct of urban nature connectedness. Hopefully this will lead us to gather some rich data and shed a light on the role the pandemic, urbanisation and digital advancements have played in this type of connection.

I am contacting you as you are an ideal candidate for the expert group due to your expertise and publishing history in the area of nature connectedness. If you would be willing to take part in my study I would be delighted. I believe your knowledge of the area and your continued research will generate some interesting points. If this is something you would be interested in taking part in I will happily send on more information including the digital information sheet and short demographic survey.

Thank you for taking the time to read this email and I look forward to hearing from you,

Cassie Murphy

*PhD Researcher
Maynooth University*



Appendix E: Expanded Expert Recruitment Post



Is nature part of your daily life?

Do you work with nature?

Maybe you're an artist who creates nature scenes, or an activist who fights to protect nature. Are you involved in a community garden or do you help in the design of city parks?

I want to speak to you about your relationship with nature and explore what this means as part of a Delphi study.

What is involved?

- 1 x 45-60 minute interview
- 2-3 short 10 minute follow up surveys

How to get involved?

Email: Cassandra.Murphy@mu.ie for more information.



Appendix F: Interview Information Sheet

Thank you for your interest in our Delphi study entitled: **Nature Connectedness: A Modified-Delphi Study**.

Below you will find information about the study. Should you have any questions do not hesitate to contact the principal investigator (Cassandra.Murphy@mu.ie).

Purpose of the Study: I am Cassandra Murphy, a doctoral student, in the Department of Psychology, Maynooth University. I am undertaking this research study, Nature Connectedness: A Modified-Delphi Study, as part of my doctoral studies funded by the Horizon2020 project GoGreenRoutes (grant no. 869764). The study will review the construct of nature connectedness and how it has transformed to align with the 21st Century.

About GoGreenRoutes: This project targets urban health across six European cities using a combination of re-naturing cities, digital (Virtual and Digital Nature) and social innovation (e.g. participatory processes of co-creation). The goal is to promote a natural way to foster health and well-being. The project runs from Sept. 2020-August 2024. Our approach is to take a citizen-centred approach to understanding nature, health and the urban environment. For further information see www.gogreenroutes.eu or @gogreenroutes on Twitter.

What will the study involve?

1. Firstly, you will be asked to complete a short pre-interview survey to gather demographic information and to determine your suitability for the study.
2. The study will involve a semi-structured interview (approx. 45-60 mins. in duration) which will be recorded (via video if online or through an audio device if in person).
3. Within four weeks of the interview, you will be asked to review the full interview transcript and approve your quotes, which will be coded to remove any identifying information.
4. Following the analysis of the interviews you will be asked to volunteer to participate in up to three rounds of 10-15 minute online questionnaires in which you rate statements related to nature connectedness using a Likert scale (e.g. 'not important' to 'very important') in order to gain consensus among participants.

Who has approved this study? This study has been reviewed and received ethical approval from Maynooth University Research Ethics Committee (Social Research Ethics Sub-Committee) and the GoGreenRoutes H2020 Ethics Monitoring Process Committee along with the Gender, Inclusion and Diversity Panel of our project. You may have a copy of this approval if you request it and the approval no. from Maynooth University is 2441635.

Why have you been asked to take part? You have been asked to participate because you are considered to fall into the category of expert or expanded expert in the area of nature connectedness. Expert refers to our judgement that you have conducted research central to the idea of nature connectedness. Expanded Expert refers to our judgement that you may have unique experiences to enrich our understanding of nature and human-

nature inspiration and interactions. If you meet the further inclusion criteria (e.g., over the age of 18 years of age) please consider participating.

Do you have to take part? No, you are under no obligation whatsoever to take part in this research. However, we hope that you will agree to take part and give us some of your time to complete a short questionnaire followed by a one-to-one interview with a researcher as outlined in the ethical protocol. It is entirely up to you to decide whether or not you would like to take part. If you decide to do so, you will be asked to sign a digital consent form and you will be forwarded a copy of the information sheet for your own records. If you decide to take part, you are still free to withdraw at any time without giving a reason and/or to withdraw your information up until such time as you return an approved copy of your interview transcription to the researcher. A decision to withdraw at any time, or a decision not to take part, will not affect your relationships with Maynooth University of the GoGreenRoutes project.

What information will be collected? Initially we gather some demographic information from you such as age, gender, place of residence and occupation alongside measuring your level of nature connectedness and attitudes towards pro-environmental behaviour. All information gathered after this will be based on your opinions and experience of the concept of nature connectedness.

Will your participation in the study be kept confidential? Yes, all information that is collected about you during the course of the research will be kept confidential. No names will be identified at any time, unless you give explicit consent to allow this. All hard copy information will be held in a locked cabinet at the researchers' place of work, electronic information will be encrypted and held securely on MU PC or servers and will be accessed only by researchers on the project: Cassandra Murphy, MA, BA; Dr Tadhg MacIntyre and other ethically approved researchers on the GoGreenRoutes project (see below).

No information will be distributed to any other unauthorised individual or third party. If you so wish, the data that you provide can also be made available to you at your own discretion.

'It must be recognised that, in some circumstances, confidentiality of research data and records may be overridden by courts in the event of litigation or in the course of investigation by lawful authority. In such circumstances the University will take all reasonable steps within law to ensure that confidentiality is maintained to the greatest possible extent.'

What will happen to the information which you give? All the information you provide will be coded and kept at Maynooth University in such a way that it will not be possible to identify you (unless you have chosen to waive your anonymity). On completion of the research, the data will be retained on the MU server. After 9 years, all data will be destroyed (by the PI). Manual data will be shredded confidentially, and electronic data will be reformatted or overwritten by the PI in Maynooth University.

What will happen to the results? The research will be written up and presented as a report which will be presented at National and International conferences and may be published in scientific journals. A summary report will be written and used to influence the development of a scale to measure urban nature connectedness to meet the requirements of the H2020 GoGreenRoutes agreement. In line with all H2020 projects

we are required to provide open access to our findings. A copy of the research findings will be made available to you upon request.

What are the possible disadvantages of taking part? I don't envisage any negative consequences for you in taking part in this research.

What if there is a problem? At the end of the interview, I will discuss with you how you found the experience. You may contact my supervisor Dr Tadhg MacIntyre (tadhg.macintyre@mu.ie) if you feel the research has not been carried out as described above or if you have any questions about the process.

Any further queries? If you need any further information, you can contact me:

Principal Investigator

*Cassandra Murphy MA BA,
cassandra.murphy@mu.ie*

*PhD Candidate
Dept. of Psychology
Maynooth University*

Supervisor:

*Dr Tadhg MacIntyre
tadhg.macintyre@mu.ie*

*Asst. Prof. of Environmental Psychology
Dept. of Psychology
Maynooth University*

Additional Investigators:

*Evi Petersen, PhD Candidate,
University of Southern Norway*

*Carina Nigg, PhD Candidate,
Karlsruhe Institute of Technology*

Consent Form

Thank you for taking the time to read through the information sheet.

If you would like to participate in the study then please respond to the following questions confirming your consent to take part.

The purpose and nature of the study has been explained to me in writing. I am aware that I may ask questions before beginning the interview to avoid any confusion.

Yes No

I am participating voluntarily.

Yes No

I give permission for my interview to be recorded.

Yes No

I understand that I can withdraw from the study, without repercussions, at any time, whether that is before it starts or while I am participating.

Yes No

I understand that I can withdraw permission to use the data up until the point at which I return a revised copy of my interview transcript.

Yes No

It has been explained to me how my data will be managed and that I may access it on request.

Yes No

I understand the limits of confidentiality as described in the information sheet.

Yes No

I wish to waive my anonymity.

Yes No

I understand that my data, in an anonymous format, may be used in further research projects and any subsequent publications if I give permission below:

I agree to quotation/publication of extracts from my interview.

Yes

No

I agree for my data to be used for further research projects.

Yes

No

I agree to participate in Cassandra Murphy's research study titled Nature Connectedness: A Modified-Delphi Study.

Yes

No

Sign Here

Participant name:

If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Secretary of the Maynooth University Ethics Committee at research.ethics@mu.ie or +353 (0)1 708 6019. Please be assured that your concerns will be dealt with in a sensitive manner. For your information the Data Controller for this research project is Maynooth University, Maynooth, Co. Kildare. Maynooth University Data Protection officer is Ann McKeon in Humanity house, room 17, who can be contacted at ann.mckeon@mu.ie. Maynooth University Data Privacy policies can be found at <https://www.maynoothuniversity.ie/data-protection>.

Appendix G: Pre-Interview Survey

Thank you for confirming your consent to participate in this study.

You will now be asked to complete the following questions to gather some demographic information. All identifying demographic information will be coded and made anonymous by the principal investigator before proceeding to the next stage.

Demographic Questions

Email Address

Age

Occupation

Country of Residence

What Role does Nature play in your occupation?

Connectedness to Nature

Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Simply state as honestly and candidly as you can what you are presently experiencing.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I often feel a sense of oneness with the natural world around me.					
I think of the natural world as a community to which I belong.					
I recognise and appreciate the intelligence of other living organisms.					
I often feel disconnected from nature.					
When I think of my life, I imagine myself to be part of a larger cyclical process of living.					
I often feel a kinship with animals and plants.					
I feel as though I belong to the Earth as equally as it belongs to me.					
I have a deep understanding of how my actions affect the natural world.					
I often feel part of the web of life.					
I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.					
Like a tree can be part of a forest, I feel embedded within the broader natural world.					
When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.					
I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.					
My personal welfare is independent of the welfare of the natural world.					

Pro-Environmental Behaviour

Please rate these statements in terms of how you feel generally towards pro-environmental behaviour.

Pro-environmental behaviour is defined as “behaviour that harms the environment as little as possible, or even benefits the environment” (Steg & Vlek, 2009).

There are no right or wrong answers. Simply state as honestly and candidly as you can what you are presently experiencing.

Pro-Environmental Behaviour is something:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I do frequently.					
I do automatically.					
I do without having to consciously remember.					
I have been doing for a long time.					
I do without thinking.					
that would require effort not to do it.					
that belongs to my routine.					
I start doing before I realise I’m doing it.					
I would find hard not to do.					
I have no need to think about doing,					

Appendix H: Interview Schedule (Modified-Delphi Round 1)

Be sure to begin interview by building rapport with participant by asking about them and their experience with nature.

*Note: Additional follow-up questions may be asked, as appropriate, with each participant, dependent on their previous response.

AREA OF INQUIRY	INTERVIEW QUESTION	EXPECTED OUTCOME	STUDIES
NATURE	What is your area of work and how does it relate to nature?	Nature involvement of the participant	(Coscieme et al., 2020)
	What do you define as nature?	Definition of the term	
NATURE CONNECTEDNESS	What is your understanding of the phrase ‘nature connectedness’?	Exploration of definition of nature connectedness	(Mayer & Frantz, 2004; Nisbet et al., 2011)
DEVELOPMENT	What is your experience with nature? Participants might refer to recent experiences as well as childhood experiences.	Memories, feelings, attitudes and behaviours towards nature, Sensory Recall,	(Bruni et al., 2020; Soga et al., 2016)
	What is your first memory of nature?		
	Has your relationship with nature changed as you have gotten older? Can you talk a little about that? (has the person moved location, rural to urban, explore how these are different – do they believe NC has stayed with them e.g. trait vs state)	Changes over the lifespan	
ATTACHMENT	What role does attachment play in nature connectedness?	Involvement of attachment in nature connectedness	(Scannell & Gifford, 2010) (Bruni et al., 2020)
AFFINITY	What role does affinity play in nature connectedness?	Involvement of affinity in nature connectedness	(Schultz, 2002)

EMPATHY	Does compassion fit into your relationship with nature?	Experience with compassion and nature	(Schultz, 2000)
KNOWLEDGE	Does having knowledge/education about biodiversity increase your level of nature connectedness?	Knowledge/education and connectedness	(Otto & Pensini, 2017)
TRAIT V STATE	Is nature connectedness something you experience only when immersed in nature? Have you felt connected to nature when you have not been able to access it? – Explain?	immersion vs trait/State	(Capaldi et al., 2014) (Richardson, et al., 2020)
Place	What role does location play in nature connectedness?	Role of location	(Basu et al., 2019)
PRO-ENVIRONMENTAL BEHAVIOUR	What role does pro-environmental behaviour/environmental activism play in nature connectedness (is this age/location specific)?	Pro-environmental behaviour/activism	(Martin et al., 2020)
BARRIERS	What do you think are the barriers for people to connect to nature	Barriers of connecting	(Soga et al., 2018)
DISCONNECT FROM NATURE	Do we know enough about disconnection?	Knowledge about disconnection	(Kesiber & Kesiber, 2017)
EXPERTS	When did you first come across the phrase ‘nature connectedness’? What areas of nature connectedness do you think are currently excluded from the literature?	Identification of fields of interest Identification of gaps in the phenomena	
EXPANDED EXPERTS	How does nature influence your work? What would make connecting to nature easier for you?	Identification of nature implications in a field of work Identification of nature implications in a field of work	
MEMORIES	What is your favourite memory in nature?	Exploration into role of memories in connection	(Sampson, 2015)
FINAL COMMENTS	Do you have any other comments or have anything else to add that you think we did not cover?	Additional comments, exploring other areas not covered with the questions	

Appendix I: Ethics Approval for Scale Development and Validation

MAYNOOTH UNIVERSITY RESEARCH ETHICS
COMMITTEE

MAYNOOTH UNIVERSITY,

MAYNOOTH, CO. KILDARE, IRELAND



Reference Number: SRESC-2023-36583

Dr Carol Barrett
Secretary to Maynooth University Research Ethics Committee
30 June 2023

Cassandra Murphy

Department of Psychology

Maynooth University

Re: Application for ethical approval for a Project entitled: Development and validation of a scale to measure nature relationships.

Dear Cassandra,

The above project has been evaluated under Tier 1 process, rapid review and we would like to inform you that ethical approval has been granted.

Any deviations from the project details submitted to the ethics committee will require further evaluation. This ethical approval will expire on 30/06/2024.

Please note: all projects now require an end of project report which is attached. Please complete and upload the end of project report to your RIS ethics record after the project end date

Kind Regards,

Dr Carol Barrett

Secretary,

Maynooth University Research Ethics Committee

C.c. Dr Tadhg MacIntyre, Department of Psychology

Appendix J: Item Generation Survey (Modified-Delphi Round 2)



Thank you for taking part in our scale development working group. We really appreciate your time and effort on this task.

This is a survey to generate possible scale items to discuss at our next meeting: **April 20th from 4pm-6pm (Irish/UK time)**. For the purpose of this survey please open the following document which will guide you through the segments relevant to each code: <https://bit.ly/GGRcodes>

What must I do? For this task we ask that you rate the relevance of the code from strongly disagree to strongly agree to our measure of nature relationships. Please use the text in the link above to guide your decision. You will also be asked to phrase a question or questions related to that code as you see relevant. This is to help us generate conversation for our next meeting and allow us to start creating the scale items.

Do not feel you must contribute to each section - your expertise in whatever manner that is will be appreciated.

If you have any questions or comments please do not hesitate to contact Cassie (cassandra.murphy@mu.ie).

Do you agree these items should be included in the scale?

	Strongly disagree	Somewhat disagree	Neither agree not disagree	Somewhat agree	Strongly agree
Adulthood	☐	☐	☐	☐	☐
Childhood	☐	☐	☐	☐	☐
Parenthood	☐	☐	☐	☐	☐
Milestones	☐	☐	☐	☐	☐

How would you phrase a question on adulthood?

How would you phrase a question on childhood?

How would you phrase a question on parenthood?

How would you phrase a question on milestones?

Do you agree these items should be included in the scale?

	Strongly disagree	Somewhat disagree	Neither agree not disagree	Somewhat agree	Strongly agree
Digital Support	☐	☐	☐	☐	☐
Longing	☐	☐	☐	☐	☐
Multisensory	☐	☐	☐	☐	☐
Technological	☐	☐	☐	☐	☐

How would you phrase a question on digital support?

How would you phrase a question on Longing?

How would you phrase a question on Multisensory?

How would you phrase a question on Technological?

Do you agree these items should be included in the scale?

	Strongly disagree	Somewhat disagree	Neither agree not disagree	Somewhat agree	Strongly agree
Barriers	☐	☐	☐	☐	☐
Concern	☐	☐	☐	☐	☐
Emotions	☐	☐	☐	☐	☐
Empathy	☐	☐	☐	☐	☐
Familiarity	☐	☐	☐	☐	☐
Identity	☐	☐	☐	☐	☐
Influence	☐	☐	☐	☐	☐
Values	☐	☐	☐	☐	☐
Respect	☐	☐	☐	☐	☐
Risk	☐	☐	☐	☐	☐
Trait v State	☐	☐	☐	☐	☐
Transactional	☐	☐	☐	☐	☐

How would you phrase a question on Barriers?

How would you phrase a question on Concern?

How would you phrase a question on Disconnect?

How would you phrase a question on Emotions?

How would you phrase a question on Empathy?

How would you phrase a question on Familiarity?

How would you phrase a question on Identity?

How would you phrase a question on Influence?

How would you phrase a question on Values?

How would you phrase a question on Respect?

How would you phrase a question on Risk?

How would you phrase a question on Trait v State?

How would you phrase a question on Transactional?

Do you agree these items should be included in the scale?

	Strongly disagree	Somewhat disagree	Neither agree not disagree	Somewhat agree	Strongly agree
Household Nature	☐	☐	☐	☐	☐
Local V Foreign	☐	☐	☐	☐	☐
Nature Definition	☐	☐	☐	☐	☐
Rural	☐	☐	☐	☐	☐
Urban	☐	☐	☐	☐	☐
Wilderness v maintained	☐	☐	☐	☐	☐

How would you phrase a question on Household Nature?

How would you phrase a question on Local v Foreign?

How would you phrase a question on Nature Definition?

How would you phrase a question on Rural?

How would you phrase a question on Urban?

How would you phrase a question on Wilderness v Maintained?

Any other comments?

We thank you for your time spent taking this survey. Your response has been recorded.

Appendix K: Content Validation Survey (Modified-Delphi Round 3)



Thank you for agreeing to participate in the Nature Relationship Scale Development Panel. This scale is designed to take a step back from the construct of Nature Connectedness and look at the stages prior to creating that sense of connection. The Human-Nature Relationship is much like Human-Human Social Relationships in which it goes through it's up and downs.

Purpose of the Study: I am Cassandra Murphy, a doctoral student, in the Department of Psychology, Maynooth University. I am undertaking this research study, development and validation of a scale to measure nature relationships, as part of my doctoral studies funded by the Horizon2020 project GoGreenRoutes (grant no. 869764). This research is focused on developing a scale to measure human-nature relationships.

About GoGreenRoutes: This project targets urban health across six European cities using a combination of re-naturing cities, digital (Virtual and Digital Nature) and social innovation (e.g. participatory processes of co-creation). The goal is to promote a natural way to foster health and well-being. The project runs from Sept. 2020-August 2024. Our approach is to take a citizen-centred approach to understanding nature, health and the urban environment. For further information see www.gogreenroutes.eu or @gogreenroutes on Twitter.

What is involved?

You will be asked to do a number of tasks:

1. Read the various items that make up the Nature Relationship Scale in its current form.
2. Rate how strongly you agree or disagree that the item is relevant to the measure
3. Link the item to the theme you believe it falls under.
4. Add any additional comments you have (how you felt reading it, what you thought of, any edits you suggest to the item).

This will take a total of 10-15 minutes to complete.

Who has approved this study? This study has been reviewed and received ethical approval from Maynooth University Research Ethics Committee (Social Research Ethics Sub-Committee) and the GoGreenRoutes H2020 Ethics Monitoring Process Committee along with the Gender, Inclusion and Diversity Panel of our project. You may have a copy of this approval if you request it and the approval no. from Maynooth University is SRESC-2023-36583.

Do you have to take part? No, you are under no obligation whatsoever to take part in this research. However, we hope that you will agree to take part and give us some of your time to complete the survey. It is entirely up to you to decide whether or not you would like to take part. If you decide to do so, you will be asked to sign a digital consent form and you will be forwarded a copy of the information sheet for your own records. If you decide to take part, you are still free to withdraw at any time without giving a reason.

What information will be collected? All information gathered after this will be based on your opinions and experience of your relationship with nature.

Will your participation in the study be kept confidential? Yes, all information that is collected about you during the course of the research will be kept confidential. All hard copy information will be held in a locked cabinet at the researchers' place of work, electronic information will be encrypted and held securely on MU PC or servers and will be accessed only by researchers on the project: Cassandra Murphy, MA, BA, Dr Elaine Gallagher and Dr Tadhg MacIntyre.

No information will be distributed to any other unauthorised individual or third party, only the research team. Your individual data cannot be made available to you due to the anonymous nature of this study. Should you wish to follow up on the results of this research please see <https://gogreenroutes.eu> for research updates.

'It must be recognised that, in some circumstances, the confidentiality of research data and records may be overridden by courts in the event of litigation or in the course of investigation by lawful authority. In such circumstances, the University will take all reasonable steps within law to ensure that confidentiality is maintained to the greatest possible extent.'

What will happen to the information which you give? On completion of this research project, the data will be retained on the Maynooth University server. After 9 years, all data will be destroyed (by the PI). As all the data collected will be electronic data it will be reformatted or overwritten by the PI in Maynooth University.

What will happen to the results? The research will be written up and presented as a report which will be presented at National and International conferences and may be published in scientific journals. A summary report will be written and used to influence the development of a scale to measure urban nature connectedness to meet the requirements of the H2020 GoGreenRoutes agreement. In line with all H2020 projects we are required to provide open access to our findings. A copy of the research findings will be made available to you upon request.

What are the possible disadvantages of taking part? I don't envisage any negative consequences for you in taking part in this research. However, if you subsequently feel distressed when answering question in the survey, please find supports relevant to your country here: <https://linktr.ee/ggrsupports>

What if there is a problem? If you experience any issues or problems while completing this study, you may contact me (cassandra.murphy.2021@mumail.ie). Similar to above if you find yourself distressed or needing support following completion of this survey please find the relevant supports here: <https://linktr.ee/ggrsupports>

Any further queries? If you need any further information, you can contact me:

Principal Investigator

Cassandra Murphy MA BA,
Cassandra.Murphy@mu.ie
PhD Candidate
Dept. of Psychology
Maynooth University

Additional Investigators

Dr Tadhg MacIntyre
tadhg.macintyre@mu.ie
Asst. Prof. of Environmental
Psychology
Dept. of Psychology
Maynooth University

Your participation is greatly appreciated. If you agree to take part in the study, please complete and sign the consent form on the next page.

I am participating voluntarily.

Yes

No

I understand that I can withdraw from the study, without repercussions, at any time, whether that is before it starts or while I am participating.

Yes

No

I understand that my data, in an anonymous format, may be used in further research projects and any subsequent publications if I give consent below:

Yes

No

I agree to participate in Cassandra Murphy's Nature Relationship Scale Development Panel.

Sign Here

Thank you for agreeing to take part in the content validation of our new measure. We would like to give you some background as to where this idea came from before you begin. The items you see in this study were developed by a working group made up of academic experts from various regions whose work is focused on understanding how we connect with the natural world. You may have even heard one of the working group members speak at an event or seen one of the posters we showcased at different conferences over the last number of weeks and months. We are grateful that you took interest in what we are doing and hope you will find benefit in the work.

The items which will be presented to you today are based on information which was gathered from a number of interviews with individuals who work with nature, in its various forms, every day (e.g. academics, poets, farmers, nature-based therapists, app developers and many more). In the interviews they spoke about their own experiences with nature as they navigated through the different stages of life. With this, a common theme of 'relationship versus connection' evolved. Many stated that they felt their experiences with nature seemed to mimic the relationships they had with other humans. They also felt that the way nature connectedness is framed in the academic literature did not reflect their own experiences, yet they still believed they had a connection of sorts, but they had no way to express this. This is where we hope our new measure will begin to explore this.

Your opinions will help us to ensure the items are accessible and reflect the experiences of a wide range of individuals. If you have any questions or queries please do not hesitate to contact the lead researcher on this - Cassandra.Murphy@mu.ie

The instructions participants see before filling out the measure are as follows-

Instructions: For each of the following, please rate the extent to which you agree with each statement, using a scale from 1 to 5. There are no right or wrong answers to these questions so please respond as you feel rather than how you think 'most people' feel or how you 'should' feel.

The following is an open-text question which allows the participant to reflect on the term nature before filling out the measure. This question is not a question which influences an individuals score, but instead sets the scene for the participant before they begin to read the various items. It will not be evaluated.

What does the term 'nature' mean to you?

Should this be included?

- ☐ Yes
☐ Maybe
☐ No

Any comment?

You are now asked to rate the following question based on their relevance to a measure of the human-nature relationship.

	Not relevant	Somewhat relevant	Relevant	Extremely relevant	Unsure
Nature plays an important part in my life.	☐	☐	☐	☐	☐
I can recall key moments that have positively shaped my relationship with nature.	☐	☐	☐	☐	☐
I can recall key moments that have negatively shaped my relationship with nature.	☐	☐	☐	☐	☐
When I'm not in nature, I feel a longing to be in natural	☐	☐	☐	☐	☐

spaces or around natural things.					
When I am in places where there is not much nature present or nature is hard to access, I long to be in nature instead.	☐	☐	☐	☐	☐
I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.	☐	☐	☐	☐	☐
My wellbeing is negatively impacted when I see or hear about bad things happening to nature.	☐	☐	☐	☐	☐
I feel that nature is linked to my personal identity.	☐	☐	☐	☐	☐
When I see or hear about natural spaces or habitats being harmed, I feel personally impacted.	☐	☐	☐	☐	☐
I believe there is value in having a relationship with nature.	☐	☐	☐	☐	☐

I believe it's important to respect nature.	☐	☐	☐	☐	☐
I care for nature.	☐	☐	☐	☐	☐
I enjoy the risks that I experience in nature.	☐	☐	☐	☐	☐
I find nature to be scary.	☐	☐	☐	☐	☐
I feel that I need to give back to nature.	☐	☐	☐	☐	☐
I am most connected to nature when in spaces that are familiar to me.	☐	☐	☐	☐	☐
I am uncomfortable in nature.	☐	☐	☐	☐	☐
Nature exists for humans to use.	☐	☐	☐	☐	☐
I do not care when nature is harmed.	☐	☐	☐	☐	☐
I find nature to be boring.	☐	☐	☐	☐	☐
I find nature to be inherently cruel.	☐	☐	☐	☐	☐
I do not care about natural spaces or habitats.	☐	☐	☐	☐	☐
Being in nature makes me feel exposed.	☐	☐	☐	☐	☐

I seek out routes with nature when commuting.	☐	☐	☐	☐	☐
Nature has nothing to offer me.	☐	☐	☐	☐	☐
I see beauty in nature.	☐	☐	☐	☐	☐
Nature brings me joy.	☐	☐	☐	☐	☐
I avoid routes with nature on my commute.	☐	☐	☐	☐	☐
I engage with nature through digital technology.	☐	☐	☐	☐	☐

You are now asked to read the items again and link them to the appropriate sub scale.

Positive = Positively affects your relationship score.

Negative = Negatively affects your relationship score.

Profile = Helps to get a better understand how you build your relationship with nature.

	Positive	Negative	Profile
Nature plays an important part in my life.	☐	☐	☐
I can recall key moments that have positively shaped my relationship with nature.	☐	☐	☐
I can recall key moments that have negatively shaped my relationship with nature.	☐	☐	☐
When I'm not in nature, I feel a	☐	☐	☐

longing to be in natural spaces or around natural things.			
When I am in places where there is not much nature present or nature is hard to access, I long to be in nature instead.	☐	☐	☐
I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.	☐	☐	☐
My wellbeing is negatively impacted when I see or hear about bad things happening to nature.	☐	☐	☐
I feel that nature is linked to my personal identity.	☐	☐	☐
When I see or hear about natural spaces or habitats being harmed, I feel personally impacted.	☐	☐	☐
I believe there is value in having a relationship with nature.	☐	☐	☐
I believe it's important to respect nature.	☐	☐	☐
I care for nature.	☐	☐	☐
I enjoy the risks that I experience in nature.	☐	☐	☐
I find nature to be scary.	☐	☐	☐
I feel that I need to give back to nature.	☐	☐	☐

I am most connected to nature when in spaces that are familiar to me.	☐	☐	☐
I am uncomfortable in nature.	☐	☐	☐
Nature exists for humans to use.	☐	☐	☐
I do not care when nature is harmed.	☐	☐	☐
I find nature to be boring.	☐	☐	☐
I find nature to be inherently cruel.	☐	☐	☐
I do not care about natural spaces or habitats.	☐	☐	☐
Being in nature makes me feel exposed.	☐	☐	☐
I seek out routes with nature when commuting.	☐	☐	☐
Nature has nothing to offer me.	☐	☐	☐
I see beauty in nature.	☐	☐	☐
Nature brings me joy.	☐	☐	☐
I avoid routes with nature on my commute.	☐	☐	☐
I engage with nature through digital technology.	☐	☐	☐

You will now see each of the items individually with a comment box underneath. Where relevant, please add any comments you have about any potential wording issues, anything that you did not understand or anything you think would be beneficial for the team to explore (e.g. feelings/thoughts when reading items).

All comments will be appreciated and reviewed by the team.

Nature plays an important role in my life

I can recall key moments that have positively shaped my relationship with nature.

I can recall key moments that have negatively shaped my relationship with nature.

When I'm not in nature, I feel a longing to be in natural spaces or around natural things.

When I am in places where there is not much nature present or nature is hard to access, I long to be in nature instead.

I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.

My wellbeing is negatively impacted when I see or hear about bad things happening to nature.

I feel that nature is linked to my personal identity.

When I see or hear about natural spaces or habitats being harmed, I feel personally impacted.

I believe there is value in having a relationship with nature.

I believe it's important to respect nature.

I care for nature.

I enjoy the risks that I experience in nature.

I find nature to be scary.

I feel that I need to give back to nature.

I am most connected to nature when in spaces that are familiar to me.

I am uncomfortable in nature.

Nature exists for humans to use.

I do not care when nature is harmed.

I find nature to be boring.

I find nature to be inherently cruel.

I do not care about natural spaces or habitats.

Being in nature makes me feel exposed.

I seek out routes with nature when commuting.

Nature has nothing to offer me.

I see beauty in nature.

Nature brings me joy.

I avoid routes with nature on my commute.

I engage with nature through digital technology.

Any other comments?

Would you like to be involved in the distribution of this measure for further validation (i.e. share among student samples at your organisation)?

Yes ☐

No ☐

There will be a follow up to this scale in which we will develop a nature-relationship profiling tool which will help us to define how individuals build their relationship with nature, and how they can in-turn strengthen it. This tool is already under development.

Would you like to be involved in the panel to review this tool?

Yes ☐

No ☐

Thank you for taking time out of your day to complete this survey. The team appreciates your time.

If you have indicated that you would like to be contacted for follow-up, a research team member will be in contact. If you have any questions or concerns please get in touch with the lead researcher Cassandra at Cassandra.Murphy@mu.ie

You can keep updated on this research through the GoGreenRoutes project <https://gogreenroutes.eu>

Appendix L: Working group pre-survey (Modified-Delphi Round 4)

Please see remaining the remaining scale items that survived content validation. Please make any final comments regarding wording or otherwise before we send this for final validation. Each item was required to receive a 70% consensus from the panel. This necessitated a rating of 'Relevant' or 'Extremely Relevant'

Nature plays an important role in my life

☐ I am happy with this.
☐ Suggest change to:

I can recall key moments that have positively shaped my relationship with nature.

☐ I am happy with this.
☐ Suggest change to:

When I'm not in nature, I feel a longing to be in natural spaces or around natural things.

☐ I am happy with this.
☐ Suggest change to:

I use some or all of my available senses (sight, taste, smell, touch, hearing) to connect with nature.

☐ I am happy with this.
☐ Suggest change to:

My wellbeing is negatively impacted when I see or hear about bad things happening to nature.

☐ I am happy with this.
☐ Suggest change to:

I feel that nature is linked to my personal identity.

☐ I am happy with this.
☐ Suggest change to:

I believe it's important to respect nature.

☐ I am happy with this.
☐ Suggest change to:

I care for nature.

☐
☐

I am happy with this.

Suggest change to:

I feel that I need to give back to nature.

☐
☐

I am happy with this.

Suggest change to:

I seek out routes with nature when commuting.

☐
☐

I am happy with this.

Suggest change to:

I see beauty in nature.

☐
☐

I am happy with this.

Suggest change to:

Nature brings me joy.

☐
☐

I am happy with this.

Suggest change to:

The following items were shown to be items that the panel were unsure of the relevance to the construct of a Human-Nature Relationship. These items received a 50% consensus on ratings of 'Unsure' or 'Somewhat Relevant' so will be included in future validation analysis. As you will notice these were all negative items - the new element that emerged from the interviews which would account for the panels resistance as it is new.

If you have suggestions on how to further improve please include them below.

I enjoy the risks that I experience in nature.

I find nature to be scary.

Nature exists for humans to use.

Being in nature makes me feel exposed.

Nature has nothing to offer me.

I am now looking to see how you feel these questions should be rated.

Please chose positive item or negative item and brief explanation as to why.

I enjoy the risks that I experience in nature.

☐ Positive.

☐ Negative

Why?

Nature exists for humans to use.

☐ Positive.

☐ Negative

Why?

I find nature to be scary.

☐ Positive.

☐ Negative

Why?

Being in nature makes me feel exposed.

☐ Positive.

☐ Negative

Why?

Nature has nothing to offer me.

☐ Positive.

☐ Negative

Why?

Scoring is suggested to be on a seven-point Likert scale with 1 being 'Strongly Agree' and 7 being 'Strongly disagree'

☐	Agree
☐	Disagree

Suggest alternative and reasoning:

If you are happy to help distribute the validation survey to a student sample please insert your email below so I can send you the link. We will need a large sample for both EFA and CFA.

Any final thoughts or questions?

Thank you for filling this out. I am so grateful for all of your time! Thank you for being patient with me. I really could not do this without you all.

I am looking forward to your comments and feedback. Hopefully we can get this survey out by the end of March/start of April.



CALL FOR PARTICIPANTS



Are you a student or staff member in an academic setting?

We are looking for participants (age 18+) to complete an online survey as part of a research project exploring the complexities of the human-nature relationships

- The survey takes approximately **12–18 minutes** to complete
- All responses are **anonymous** and confidential

Access the study via the QR code:



Maynooth University
National University of Ireland Maynooth

Ethical Approval: SRESC-2023-36583

Appendix N: Scale Validation Informed Consent



Purpose of the Study: I am Cassandra Murphy, a doctoral student, in the Department of Psychology, Maynooth University. I am undertaking this research study, Development and validation of a scale to measure nature relationships, as part of my doctoral studies funded by the Horizon2020 project *GoGreenRoutes* (grant no. 869764). This research is focused on developing a scale to measure human-nature relationships.

About GoGreenRoutes: This project targets urban health across six European cities using a combination of re-naturing cities, digital (Virtual and Digital Nature) and social innovation (e.g. participatory processes of co-creation). The goal is to promote a natural way to foster health and well-being. Our approach is to take a citizen-centred approach to understanding nature, health and the urban environment. For further information see www.gogreenroutes.eu.

What will the study involve? The study will involve the completion of a survey. This may take up to 20 minutes. There will be no follow up to this research.

Who has approved this study? This study has been reviewed and received ethical approval from Maynooth University Research Ethics Committee (Social Research Ethics Sub-Committee) and the GoGreenRoutes H2020 Ethics Monitoring Process Committee along with the Gender, Inclusion and Diversity Panel of our project. You may have a copy of this approval if you request it and the approval no. from Maynooth University is SRESC-2025-36583.

Do you have to take part?

No, you are under no obligation whatsoever to take part in this research. However, we hope that you will agree to take part and give us some of your time to complete the survey. It is entirely up to you to decide whether or not you would like to take part. If you decide to do so, you will be asked to give your consent. If you decide to take part, you are still free to withdraw at any time without giving a reason by exiting the survey. Once you press submit you cannot withdraw.

What information will be collected? Initially we gather some demographic information from you such as age, gender and place of residence. All information gathered after this will be based on your opinions and experience of your relationship with nature.

Will your participation in the study be kept confidential? Yes, all information that is collected about you during the course of the research will be kept confidential. All hard copy information will be held in a locked cabinet at the researchers' place of work, electronic information will be encrypted and held securely on MU PC or servers and will be accessed only by researchers on the project: Cassandra Murphy, MA, BA, Dr Elaine Gallagher and Dr Tadhg MacIntrye.

No information will be distributed to any other unauthorised individual or third party, only the research team. Your individual data cannot be made available to you due to the anonymous nature of this study. Should you wish to follow up on the results of this research please see <https://gogreenroutes.eu> for research updates.

'It must be recognised that, in some circumstances, confidentiality of research data and records may be overridden by courts in the event of litigation or in the course of investigation by lawful authority. In such circumstances the University will take all reasonable steps within law to ensure that confidentiality is maintained to the greatest possible extent.'

What will happen to the information which you give?

On completion of this research project, the data will be retained on the Maynooth University server. After 9 years, all data will be destroyed (by the PI). As all the data collected will be electronic data will be reformatted or overwritten by the PI in Maynooth University.

What will happen to the results? The research will be written up and presented as a report which will be presented at National and International conferences and may be published in scientific journals. A summary report will be written and used to influence the development of a scale to measure urban nature connectedness to meet the requirements of the H2020 GoGreenRoutes agreement. In line with all H2020 projects we are required to provide open access to our findings. A copy of the research findings will be made available to you upon request.

What are the possible disadvantages of taking part? I don't envisage any negative consequences for you in taking part in this research. However you subsequently feel distressed when answering question in the survey, please find supports relevant to your country here: <https://linktr.ee/ggrsupports>

What if there is a problem? If you experience any issues or problems while completing this study, you may contact me (cassandra.murphy.2021@mumail.ie). Similar to above if you find yourself distressed or needing support following completion of this survey please find the relevant supports here: <https://linktr.ee/ggrsupports>

Any further queries? If you need any further information, you can contact me or my supervisor at the following:

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The purpose and nature of the study has been explained to me in writing. I am aware that I may ask questions via email before beginning the questionnaire to avoid any confusion.

Yes ☐ No ☐

I am participating voluntarily.

Yes ☐ No ☐

I understand that I can withdraw from the study, without repercussions, at any time, whether that is before it starts or while I am participating.

Yes ☐ No ☐

The information sheet has made me aware of how my data will be managed.

Yes ☐ No ☐

I am aware that I cannot access my individual results due to anonymity.

Yes ☐ No ☐

I agree for my data to be used for further research projects.

Yes ☐ No ☐

I consent to taking part in this study.

Yes ☐ No ☐

Please answer all the following demographic questions.

Age

Gender

- ☐ Male
- ☐ Female
- ☐ Non-binary/third gender
- ☐ Prefer not to say
- ☐ Self Identify as:

I am a:

- ☐ Student
- ☐ Full Time Employee
- ☐ Part Time Employee
- ☐ Both a Student and an Employee

What country are you from?

Is English your first language?

Yes ☐ No ☐

(if no) What is your first language?

How would you describe your immediate environment?

- ☐ Urban
- ☐ Suburban
- ☐ Rural

How many minutes do you spend in nature on an average week?

- ☐ Less than 30
- ☐ 30-60
- ☐ 60-90
- ☐ 90-120
- ☐ More than 120

Do you have access to 0.5 hectares green space (e.g. half a football pitch in size) within 300m (e.g. 5 min. walk of your residence)?

Yes ☐ No ☐

What distance is it from your residence to green space of this scale?

- ☐ 500m
- ☐ 1KM
- ☐ 2KM
- ☐ More than 2KM

You will now be presented with a collection of measures to help with the validation of a new measure on human-nature relationships. There are no right or wrong answers to any of these. Please answer as honest as possible.

This may take up to 15 minutes to complete. You are free to take breaks and exit the survey. After one week all incomplete responses will be deleted, however, should you return within a one week period you can pick up where you left off.

WHO-5

Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks.

	At no time	Some of the time	Less than half of the time	More than half of the time	Most of the time	All of the time
I have felt cheerful and in good spirits.	☐	☐	☐	☐	☐	☐
I have felt calm and relaxed.	☐	☐	☐	☐	☐	☐
I have felt active and vigorous.	☐	☐	☐	☐	☐	☐
I woke up feeling fresh and rested.	☐	☐	☐	☐	☐	☐
My daily life has been filled with things that interest me.	☐	☐	☐	☐	☐	☐

In your own words please describe what the term 'nature' means to you:

Quality of Human-Nature Relationship

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.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree not disagree	Somewhat agree	Agree	Strongly agree
Nature plays an important role in my life.	☐	☐	☐	☐	☐	☐	☐
I can recall key moments that have helped build my positive relationship with nature.	☐	☐	☐	☐	☐	☐	☐
When I'm not in nature, I feel a desire to be in natural spaces or around natural things.	☐	☐	☐	☐	☐	☐	☐
I use my available senses (sight, taste, smell, touch, hearing) to connect with nature.	☐	☐	☐	☐	☐	☐	☐

My well-being is negatively impacted when I see or hear about bad things happening to nature.	☐	☐	☐	☐	☐	☐	☐
I feel that nature is linked to my personal identity.	☐	☐	☐	☐	☐	☐	☐
I believe it's important to respect nature.	☐	☐	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Somewhat disagree	Neither agree not disagree	Somewhat agree	Agree	Strongly agree
I care about nature.	☐	☐	☐	☐	☐	☐	☐
Please answer disagree to this question.	☐	☐	☐	☐	☐	☐	☐
I seek out routes where nature is available when commuting.	☐	☐	☐	☐	☐	☐	☐
I see beauty in nature.	☐	☐	☐	☐	☐	☐	☐
Nature	☐	☐	☐	☐	☐	☐	☐

generally brings me joy.							
I find nature to be scary.	☐	☐	☐	☐	☐	☐	☐
Nature exists for humans to use.	☐	☐	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Somewhat disagree	Neither agree not disagree	Somewhat agree	Agree	Strongly agree
Nature has a lot to offer me.	☐	☐	☐	☐	☐	☐	☐
I enjoy the adventures I experience in nature.	☐	☐	☐	☐	☐	☐	☐
Being in nature makes me feel vulnerable.	☐	☐	☐	☐	☐	☐	☐
Nature has nothing to offer me.	☐	☐	☐	☐	☐	☐	☐
I feel that I need to give back to nature.	☐	☐	☐	☐	☐	☐	☐

Nature Relatedness

Instructions: Please indicate how much you agree or disagree with each of the following statements, using the scale below:

	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
I always think about how my actions affect the environment.	☐	☐	☐	☐	☐
My connection to nature and the environment is a part of my spirituality.	☐	☐	☐	☐	☐
I take notice of wildlife wherever I am.	☐	☐	☐	☐	☐
My ideal vacation spot would be a remote, wilderness area.	☐	☐	☐	☐	☐

	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
I feel very connected to all living things and the earth.	☐	☐	☐	☐	☐
Even in the middle of the city, I notice nature around me.	☐	☐	☐	☐	☐
My relationship to nature is an important part of who I am.	☐	☐	☐	☐	☐
I am not separate from nature, but a part of it.	☐	☐	☐	☐	☐

	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
The thought of being deep in the woods, away from civilization, is frightening.	☐	☐	☐	☐	☐
I am very aware of environmental issues.	☐	☐	☐	☐	☐
I enjoy being outdoors, even in unpleasant weather.	☐	☐	☐	☐	☐
Humans have the right to use natural resources any way we want.	☐	☐	☐	☐	☐

Internet Addiction

Instructions: After reading each statement carefully please select the response which best describes you. If two choices seem to apply equally well, select the choice that best represents how you are most of the time during the past month. Be sure to read all the statements carefully before making your choice. The statements refer to offline (non-internet) situations or actions unless otherwise specified.

	Not Applicable	Rarely	Occasionally	Frequently	Often	Always
How often do you find that you stay online longer than you intended?	☐	☐	☐	☐	☐	☐
How often do you neglect household chores to spend more time online?	☐	☐	☐	☐	☐	☐
How often do you prefer the excitement of the Internet to intimacy with your partner?	☐	☐	☐	☐	☐	☐
How often do you form new relationships with fellow users online?	☐	☐	☐	☐	☐	☐
How often do others in your life complain	☐	☐	☐	☐	☐	☐

to you about the amount of time you spend online?						
How often do your grades or school work/work responsibilities suffer because of the amount of time you spend online?	☐	☐	☐	☐	☐	☐
How often do you check your email before something else that you need to do?	☐	☐	☐	☐	☐	☐

	Not Applicable	Rarely	Occasionally	Frequently	Often	Always
How often does your job performance or productivity suffer because of the Internet?	☐	☐	☐	☐	☐	☐
How often do you become defensive or secretive when anyone asks you what you do online?	☐	☐	☐	☐	☐	☐

How often do you block out disturbing thoughts about your life with soothing thoughts of the Internet?	☐	☐	☐	☐	☐	☐
How often do you find yourself anticipating when you will go online again?	☐	☐	☐	☐	☐	☐
How often do you fear that life without the Internet would be boring, empty, and joyless?	☐	☐	☐	☐	☐	☐
How often do you snap, yell, or act annoyed if someone bothers while you are online?	☐	☐	☐	☐	☐	☐
How often do you lose sleep due to being online?	☐	☐	☐	☐	☐	☐

	Not Applicable	Rarely	Occasionally	Frequently	Often	Always
How often do you feel preoccupied with the Internet when off-line, or fantasise about being online?	☐	☐	☐	☐	☐	☐

How often do you find yourself saying “just a few more minutes” when online?	☐	☐	☐	☐	☐	☐
How often do you try to cut down the amount of time you spend online and fail?	☐	☐	☐	☐	☐	☐
How often do you try to hide how long you’ve been online?	☐	☐	☐	☐	☐	☐
How often do you choose to spend more time online over going out with others?	☐	☐	☐	☐	☐	☐
How often do you feel depressed, moody, or nervous when you are off-line, which goes away when you are back online?	☐	☐	☐	☐	☐	☐
How often do you lose sleep due to being online?	☐	☐	☐	☐	☐	☐

Instructions: Below is a list of statements. Please read each statement carefully and rate how frequently you feel or act in the manner described. Select your answer on the response form. There are no right or wrong answers or trick questions. Please answer each question as honestly as you can.

	Never	Rarely	Sometimes	Often	Always
When someone else is feeling excited, I tend to	☐	☐	☐	☐	☐

get excited too.					
Other people's misfortunes do not disturb me a great deal.	☐	☐	☐	☐	☐
It upsets me to see someone being treated disrespectfully.	☐	☐	☐	☐	☐
I remain unaffected when someone close to me is happy.	☐	☐	☐	☐	☐
I enjoy making other people feel better.	☐	☐	☐	☐	☐
I have tender, concerned feelings for people less fortunate than me.	☐	☐	☐	☐	☐

	Never	Rarely	Sometimes	Often	Always
When a friend starts to talk about his/her problems, I try to steer the conversation towards something else.	☐	☐	☐	☐	☐
I can tell when others are sad even when they do not say anything.	☐	☐	☐	☐	☐
I find that I am "in tune" with other people's moods.	☐	☐	☐	☐	☐
I do not feel sympathy for people who cause their own serious illnesses.	☐	☐	☐	☐	☐
I become irritated when someone cries.	☐	☐	☐	☐	☐
I am not really interested in how other people feel.	☐	☐	☐	☐	☐

Never

Rarely

Sometimes

Often

Changed to a 'green' energy tariff for your home.	☐	☐	☐	☐	☐
Bought a low-emission vehicle (e.g., hybrid, electric biofuel, less than 1.4L engine).	☐	☐	☐	☐	☐
Bought a product to save water (e.g., water but, water 'hippo', low-flush toilet)	☐	☐	☐	☐	☐

Please indicate how often you take each action

	Never	Occasionally	Often	Always
Turn off lights you're not using.	☐	☐	☐	☐
Drive economically (e.g., braking or accelerating gently).	☐	☐	☐	☐
Walk, cycle or take public transport for short journeys (i.e., trips of less than 3 miles).	☐	☐	☐	☐
Use an alternative to travelling (e.g., shopping online).	☐	☐	☐	☐
Share a car journey with someone else.	☐	☐	☐	☐
Cut down on the amount you fly.	☐	☐	☐	☐

	Never	Occasionally	Often	Always
Buy environmentally-friendly products..	☐	☐	☐	☐
Eat food which is organic, locally-grown or in season.	☐	☐	☐	☐

Avoid eating meat.	☐	☐	☐	☐
Buy products with less packaging.	☐	☐	☐	☐
Recycle.	☐	☐	☐	☐
Reuse or repair items instead of throwing them away.	☐	☐	☐	☐

	Never	Occasionally	Often	Always
Compost your kitchen waste.	☐	☐	☐	☐
Save water by taking shorter showers.	☐	☐	☐	☐
Turn off the tap while you brush your teeth.	☐	☐	☐	☐
Write to your MP about an environmental issue.	☐	☐	☐	☐
Take part in a protest about an environmental issue.	☐	☐	☐	☐

Thank you for taking time out of your day to complete this survey. The research team values your cooperation in helping with the development and validation of a new nature relationship measure.

If you have any questions or concerns please get in touch with the lead researcher Cassandra at Cassandra.Murphy@mu.ie or the supervisor at Tadhg.MacIntyre@mu.ie

If you have felt distressed while completing the survey, please find supports relevant to your country here: <https://linktr.ee/ggrsupports>

If you are a surveycircle user you can redeem your survey code with one click: <https://www.surveycircle.com/BS3N-N985-MLTQ-QFS3/>

The following code gives you Karma that can be used to get free research participants at SurveySwap.io.

Go to: surveyswap.io/sr/IWXO-YT9V-UQD6

Or alternatively, enter the code manually: IWXO-YT9V-UQD6

You can keep updated on this research through the GoGreenRoutes project <https://gogreenroutes.eu>

Appendix O: A Modified-Delphi Study Protocol (Murphy et al., 2024)

Open Research Europe

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Check for updates

STUDY PROTOCOL

Exploring our relationship with nature: A modified-Delphi study protocol

[version 1; peer review: 2 approved]

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V1

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Abstract

Background

A vital element to understanding the the health and wellbeing of both humans and the environment is human-nature interactions. The biophilia hypothesis is referred to when discussing these interactions. This hypothesis suggests that due to evolution, humans have an innate urge to seek out nature. The concept of nature connectedness was developed from this hypothesis and is rooted in the belief that human identity and nature can be intertwined. This research aims to explore the intricate details of how an individual builds this connection in a meaningful way.

Methods

This is done using a modified Delphi method. A Delphi study in its typical form aims to gather the consensus of a group of experts in a specific area of interest. This modified Delphi aims to break down the barrier between the public and the experts by creating a second category of participants referred to as our 'expanded experts.' Expand experts are described as individuals with lived experience of being connected to nature in the everyday. This category comprises of artists, city planners, activists and many more. This allows for a much more inclusive and real-world exploration of experiences. The participants will first take part in a semi-structured interview process to investigate their experiences of connecting with nature. Following a hybrid thematic analysis with both deductive and inductive coding will

Open Peer Review

Approval Status

	1	2
version 1		
30 May 2024	view	view

1. Alexia Barrable^{id}, Queen Margaret University, Musselburgh, UK

2. Stephanie Wilkie, University of Sunderland, Sunderland, UK

Any reports and responses or comments on the article can be found at the end of the article.

be applied to the interviews. These themes will be shared with participants for them to weigh the importance of the theme to the construct to allow a deeper understanding of our interactions with nature.

Results

The results of this project will contribute to and shape the development of a state-of-the-art nature-connectedness scale. Furthermore, understanding how nature connectedness fits into our modern world will allow for more appropriate nature-based interventions for urban residents and beyond.

Plain language summary

This interview-based study looks at the interaction's individuals have with the nature around them and how those interactions help them to feel connected to the natural world. Interviews are taking place with fellow researchers, as well as individuals who work with nature in their everyday. Some examples are nature-based therapists and practitioners, poets, artists, farmers and city planners to name a few. By undertaking this research, it is hoped that we will better understand what nature resources urban residents require in their areas to improve their overall health and wellbeing as well as how individuals interact with the resources they already have access to. The end goal is to produce a method to measure these interactions for future research and practical use.

Keywords

Nature Connectedness, Nature Relationship, Biophilia, Expertise, Interviews, Qualitative, Delphi, Scale Development

H2020

This article is included in the Horizon 2020 gateway.



This article is included in the Earth and Environmental Sciences gateway.

Corresponding author: Cassandra Murphy (cassandra.murphy@mu.ie)

Author roles: **Murphy C:** Conceptualization, Writing – Original Draft Preparation; **MacIntyre T:** Funding Acquisition, Project Administration, Supervision, Writing – Review & Editing; **Gallagher E:** Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

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Introduction

The term nature connectedness (NC), which can also be referred to as connectedness to nature and nature relatedness, is typically used to describe the human-nature relationship, and the positive emotional, physical and cognitive connection between humans and their environment (Barrable & Booth, 2022). Baxter and Pelletier (2019) have expanded on this construct to consider nature connectedness to be a psychological need, supporting Wilson's (1984) biophilia hypothesis which proposed that our urge to engage with nature was innate. This finding strengthens the argument that high levels of nature connectedness are linked to the overall wellbeing of humanity (Keenan *et al.*, 2021; Nisbet *et al.*, 2011) and the environment (Gosling & Williams, 2010; Jensen & Olsen, 2019), which highlights the importance of understanding this connection. Recent conceptualisations have postulated that there are five pathways to connect with nature: contact, emotion, compassion, meaning and beauty (Lumber *et al.*, 2017). Support for this pathways model has emerged from the 'three good things' intervention which reported in general that noticing things in nature can increase nature connectedness scores (Keenan *et al.*, 2021). However, this kind of intervention may have limited impact in an urban setting, where high-quality natural areas are typically unavailable. Differences in scores on nature connectedness have also been reported when it comes to both age and gender. In children it has been found that girls are more connected than males, despite boys reporting having more contact with nature (Mustapa *et al.*, 2021). Among adult student samples no gender differences were found, however some personality factors, which may have developed over time and into adulthood, may be responsible for this change (Di Fabio & Rosen, 2019). This raises the question as to how broad our current understanding of nature connectedness is, as it only focuses on positive experiences, and ignores negative experiences labelling those who score low on the existing measures as disconnected, rather than exploring other factors such as preference, experience or mode of nature exposure (Barrable & Booth, 2022; Salazar *et al.*, 2021).

Gaps in literature

A recent review (MacIntyre *et al.*, 2019, p.21) has described nature connectedness as "a blurred construct with a range of competing concepts developed in order to describe the human-nature relationship, including connectedness to nature (Mayer & Frantz, 2004), and environmental identity (Clayton, 2003)." This variety in understanding the overall construct has led to disparity among measures with Salazar and colleagues (2021) highlighting the inconsistency and lack of efficacy and usability of these measures for practitioners on the ground. Similarly, there is a need for conceptual clarity in how nature connectedness is conceptualised.

Aims and objectives

The aim of this study is to examine the meaning of nature connectedness in the 21st century context (e.g. with increased urbanisation, digitalisation, coronavirus) and to address some

of the aforementioned limitations of the current definitions around the construct of nature connectedness. This study will explore the following questions:-

1. Determine whether there is a distinctive developmental dimension to the construct?
2. Is nature connectedness trait-like or does it have state-like components?
3. What are the steps individuals take to reach a sense of nature connectedness?
4. Does urban nature require a distinct component within the overall construct?
5. Does digital nature require a distinct component within the overall construct?
6. To what extent can advances in the construct be clearly articulated within an overall framework.

The findings will be used to advise on the development of a novel scale to assess the relationships formed between humans and the natural world, as part of another study in the GoGreenRoutes H2020 project.

Protocol

Study design

A modified-Delphi approach will be applied as this method has been previously employed to successfully elicit knowledge on complex constructs and ultimately achieve consensus among experts (Fink-Hafner *et al.*, 2019; Taylor, 2020; Trevelyan & Robinson, 2015). The Delphi method is often used when there is limited or conflicting information on a topic (Taylor, 2020). Data collection for a Delphi technique is in the form of questionnaires which are answered by a panel deemed as experts, usually in the form of academics or medical professionals (Hsu & Sandford, 2007). The modification of the Delphi method in this study is two-fold: 1) A semi-structured interview process will be utilised to elicit comprehensive knowledge about the construct and the lived-experiences of participants, and 2) the sample includes two panels, the experts and the expanded experts, will be used to gain consensus. The same panel will be used for both the interview and weighting process of the Delphi method. The steps taken in the modified-Delphi method are outlined in Table 1. The interviews in this research are phenomenological in nature as it prioritises the lived experience of the participant in the questioning (Groenewald, 2004).

Methods

As outlined in Table 1 and above, the study will use a semi-structured interview method to augment the traditional Delphi rounds. Recent research has shown that saturation in qualitative research can occur between 7 and 9 interviews (Hennink & Kaiser, 2022). This research aims to have a minimum of 9 participants from each panel (expert and expanded experts) and a maximum of 30 participants overall, as a means to avoid saturation. Research has shown that the average number of respondents in a Delphi study

Table 1. Systematic steps of the modified-Delphi study design.

Step 1	Elaborate selection criteria created for experts and expanded experts
Step 2	Make expert panel and recruitment strategy for expanded experts
Step 3	Contact both experts and expanded experts and confirm participation
Step 4	Conduct Semi-Structured Interviews
Step 5	Transcribe interviews and return transcripts for approval and redaction by participant
Step 6	Conduct deductive analysis.
Step 7	Conduct inductive analysis.
Step 8	Administer weighting questionnaire Round 1.
Step 9	Analyse Data.
Step 10	Administer weighting questionnaire Round 2.
Step 11	Analyse Data
Step 12	Synthesise results and publication.

range from 15–20 (Hsu & Sandford, 2007) which allows room for participants who will drop-out between rounds.

A semi-structured interview schedule (MacIntyre *et al.*, 2019) will be designed based off of previous literature on the topic of nature connectedness, and will be refined based upon the results of two pilot interviews, one from each target panel. This will allow for flexibility in each interview and allow for deeper discussions around specific concepts the participant may be an expert in.

After providing informed consent online via Qualtrics (an online survey platform), preceded by an information sheet with the opportunity for participants to submit questions to the researcher about the process of the study, the participants will be asked to complete a short pre-interview survey. This short survey is used to gather demographic information to determine their suitability for the study, alongside information on their current level of nature connectedness (NR-6; Nisbet & Zelenski, 2013) and their pro-environmental behaviour (Self-Report Index of Habit Strength; Verplanken & Orbell, 2003). They will then be asked to take part in a semi-structured interview with a researcher which will be recorded (via video if online or through audio if in person). Interviews will be conducted in English. The details of the study will be explained verbally to the participants before they begin the interview, allowing them to ask questions or withdraw their consent if they should wish to. The interviews will be initially transcribed using Otter.ai but will be manually reviewed and checked for errors before analysis. In the weeks following the interview, the participants will be asked to review the transcript of their

interview and to approve the quotes, which will be coded to remove any identifying information.

A hybrid thematic analysis approach will be taken in relation to the analysis of this data (Fereday & Muir-Cochrane, 2006; Swain, 2018). As part of the initial analysis a round of deductive coding will be conducted to allow for the item generation for the scale development study (separate study) to begin. The researchers will meet and discuss the possible codes for this analysis. These codes will be based off the questions asked in the interviews. These questions were developed based off the current literature on the topics of nature connectedness and urban nature. This will then be followed by a deeper inductive coding to uncover some of the new and complex ideas in the data which will uncover the construct.

Following the thematic analysis of the interviews, participants will be asked to take part up to three rounds of questionnaires referred to as Delphi rounds. In these separate rounds the participants will be asked to 'weight the importance' of various items. The items will resemble the themes which will be developed as a result of the thematic analysis. These different Delphi rounds will take the form of three separate 10–15-minute online surveys in which participants rate (often referred to as weighting the importance of statements related to nature connectedness on a five-point Likert scale from 'very limited importance' to 'very important'. There will be a 4–6-week time period between each round to give participants time to complete the task. Reminder emails will be sent every two weeks in the 6-week period to promote full participation. The different rounds are used to:

1. Build consensus
2. Resolve differences
3. Prioritise information.

The information gathered from the weighting rounds will be used to develop the construct of nature relationships.

Selection criteria for experts and expanded experts

The participants will comprise two samples:

1. Experts: Researchers, predominantly in environmental psychology and environmental science and allied areas, who have studied the concept of nature connectedness. This will include researchers in psychometrics who developed inventories, those who have employed measures in empirical research and those who have conceptualised on this topic and related areas (e.g., human-nature interactions).
2. Expanded Expert Group: This additional group will comprise individuals for whom a connection with nature is central to their work in literature and the creative arts, in architecture and urban planning, or in addressing one of a variety of aspects relating to natural systems.

Recruitment

The expert panel will be recruited through a systematic search for papers using the keywords 'nature connectedness', 'nature relatedness', and 'human nature relationship'. Using software such as Scopus and researchrabb.it, a list of authors who have published in these areas will be collated and contacted. For the expanded-expert panel a social media recruitment campaign will be used to find interested parties. This will require potential interested participants to complete a Microsoft Forms document with basic identifying information giving the researchers permission to follow up with them. Snowball sampling will also be used, whereby a participant can forward on information to relevant colleagues who may be interested in participating in the research.

Anonymity – In certain cases it is difficult to keep participants completely anonymous in studies, especially when working with individuals who are considered experts in their field, such as the participants in this study. As this is a conversational style interview there may be segments of individuals' discussion which can link them to their work, or whose thoughts and ideas may be considered intellectual property. To protect the participant the study offers an option to waive anonymity, allowing them to have their sentiments associated with their identity. Participants will also be offered the opportunity to review their transcripts and given the option to remove sections which they believe to be too identifying or change their decision to waive their anonymity based on having seen the results of the interview.

Right to withdraw consent – It was decided that due to the nature of a Delphi study participants cannot withdraw consent once the first round of the weighting activity has begun. This is because the information they provide in the interview is used to develop the weighting rounds. Participants can withdraw consent "until a point" – this point being when they approve their transcription. They are free to withdraw from participation, however their data will still be used. This will be acknowledged when participants sign a consent form and will be repeating for clarity upon receiving their transcription to review at which point, they are free to withdraw.

Materials

Interviews will be recorded using Voice Memo software (in-person interviews) or MS Teams Classic Version 1.5.00.22362 (online interviews). Audio files will be saved in a m4a format with Otter.ai used for automated transcription. Following the automated transcription, the transcripts will be manually checked and edited for accuracy. MAXQDA, a qualitative coding software will be employed, or the alternative Taguette may be used. Subsequent weighting activities will employ Qualtrics Survey Platform (RRID:SCR_016728) or Google Forms (RRID:SCR_023174) with IBM SPSS Statistics Software (RRID:SCR_016479) used for analysis

or the open access alternative R Project for Statistical Computing (RRID:SCR_001905). Access to licenses for the proprietary software is granted through Maynooth University.

Data collection

The research will be conducted either online or in person depending upon participant location and availability.

Data analysis

The analysis takes place in three steps which includes the thematic analysis, completed using both deductive and inductive coding (Fereday & Muir-Cochrane, 2006; Swain, 2018), and the quantitative analysis.

1. The deductive coding will be based off the work of Crabtree & Miller (1999).
2. The inductive coding following the recent guidelines set out for reflexive thematic analysis, see Braun & Clarke (2022) for steps.
3. For the quantitative elements of the research the main statistical analyses that will be conducted are descriptive statistics such as central tendency (percentage of agreement, mean, median and mode), and level of dispersion (e.g., interquartile range, range, standard deviation, coefficient of variance).

Discussion

The research findings will be invaluable to overcome the definitional dilemma with the array of terms used to operationalise nature connectedness. This potential impact will be important for applied researchers and practitioners in understanding human nature interactions more clearly. This research will allow us to gain more insight into the stages of building a connection with the natural world, including elements of technology and the urban environment.

Ethics and dissemination

Local research ethics committee approval was granted for this study (SSREC approval no. 2441635). The findings of this study will be further disseminated through peer reviewed publication and digestible content for the GoGreenRoutes website and accompanying social media. The results of this study will also inform the development of a new measure based on the forthcoming construct. The results of both studies will be presented at the end of project event in Belgium, June 2024.

Data availability

Underlying data

No data are associated with this article.

Acknowledgements

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References

- Barrable A, Booth D: **Disconnected: what can we learn from individuals with very low nature connection?** *Int J Environ Res Public Health*. 2022; **19**(13): 8021. PubMed Abstract | Publisher Full Text | Free Full Text
- Baxter DE, Pelletier LG: **Is nature relatedness a basic human psychological need? a critical examination of the extant literature.** *Can Psychol*. 2019; **60**(1): 21–34. Publisher Full Text
- Braun V, Clarke V: **Thematic analysis: a practical guide.** SAGE, 2022. Reference Source
- Clayton S: **Environmental identity: a conceptual and an operational definition.** In: S. Clayton & S. Opatow (Eds.), *Identity and the Natural Environment: The Psychological Significance of Nature*. MIT Press, 2003; 45–65. Publisher Full Text
- Crabtree BF, Miller WL: **Doing qualitative research.** SAGE, 1999. Reference Source
- Di Fabio A, Rosen M: **Accounting for individual differences in connectedness to nature: personality and gender differences.** *Sustainability*. 2019; **11**(6): 1693. Publisher Full Text
- Fereday J, Muir-Cochrane E: **Demonstrating rigor using thematic analysis: a hybrid approach of inductive and deductive coding and theme development.** *Int J Qual Methods*. 2006; **5**(1): 80–92. Publisher Full Text
- Fink-Hafner D, Dagen T, Doušak M, et al.: **Delphi method: strengths and weaknesses.** *Advances in Methodology and Statistics*. 2019; **16**(2): 1–19. Reference Source
- Gosling E, Williams KJH: **Connectedness to nature, place attachment and conservation behaviour: testing connectedness theory among farmers.** *J Environ Psychol*. 2010; **30**(3): 298–304. Publisher Full Text
- Groenewald T: **A phenomenological research design illustrated.** *Int J Qual Methods*. 2004; **3**(1): 42–55. Publisher Full Text
- Hennink M, Kaiser BN: **Sample sizes for saturation in qualitative research: a systematic review of empirical tests.** *Soc Sci Med*. 2022; **292**: 114523. PubMed Abstract | Publisher Full Text
- Hsu CC, Sandford BA: **The delphi technique: making sense of consensus.** 2007. Publisher Full Text
- Jensen AK, Olsen SB: **Childhood nature experiences and adulthood environmental preferences.** *Ecol Econ*. 2019; **156**: 48–56. Publisher Full Text
- Keenan R, Lumber R, Richardson M, et al.: **Three good things in nature: a nature-based positive psychological intervention to improve mood and well-being for depression and anxiety.** *J Public Ment Health*. 2021; **20**(4): 243–250. Publisher Full Text
- Lumber R, Richardson M, Sheffield D: **Beyond knowing nature: contact, emotion, compassion, meaning, and beauty are pathways to nature connection.** *PLoS One*. 2017; **12**(5): e0177186. PubMed Abstract | Publisher Full Text | Free Full Text
- MacIntyre TE, Calogiuri G, Donnelly AA, et al.: **Societal challenges, methodological issues and transdisciplinary approaches.** In: Donnelly AA, MacIntyre TE: *Physical activity in natural settings: green and blue exercise*. (A. A. Donnelly & T. E. MacIntyre, Eds.; 1st ed.). Routledge, 2019; 15–35. Publisher Full Text
- Mayer FS, Frantz CM: **The connectedness to nature scale: a measure of individuals' feeling in community with nature.** *J Environ Psychol*. 2004; **24**(4): 503–515. Publisher Full Text
- Mustapa ND, Hassan K, Che Mohd Nasir SN, et al.: **Age and gender differences in experience with and connectedness to nature among children.** *Environment-Behaviour Proceedings Journal*. 2021; **6**(16): 3–9. Publisher Full Text
- Nisbet EK, Zelenski JM, Murphy SA: **Happiness is in our nature: exploring nature relatedness as a contributor to subjective well-being.** *J Happiness Stud*. 2011; **12**(2): 303–322. Publisher Full Text
- Nisbet E, Zelenski J: **The NR-6: a new brief measure of nature relatedness.** *Front Psychol*. 2013; **4**: 813. PubMed Abstract | Publisher Full Text | Free Full Text
- Salazar G, Monroe MC, Jordan C, et al.: **Improving assessments of connection to nature: a participatory approach.** *Front Ecol Evol*. 2021; **8**: 609104. Publisher Full Text
- Swain J: **A hybrid approach to thematic analysis in qualitative research: using a practical example.** SAGE Publications Ltd, 2018. Publisher Full Text
- Taylor E: **We agree, don't we? the delphi method for health environments research.** *HERD*. 2020; **13**(1): 11–23. PubMed Abstract | Publisher Full Text
- Trevelyan EG, Robinson PN: **Delphi methodology in health research: how to do it?** *Eur J Integr Med*. 2015; **7**(4): 423–428. Publisher Full Text
- Verplanken B, Orbell S: **Reflections on past behavior: a self-report index of habit strength.** *J Appl Soc Psychol*. 2003; **33**(6): 1313–1330. Publisher Full Text
- Wilson EO: **Biophilia.** Harvard University Press, 1984. Reference Source

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✓ **Stephanie Wilkie**
School of Psychology, University of Sunderland, Sunderland, England, UK

This is a well-written and reasoned protocol for the proposed Delphi study.

My only concern/suggestion is the authors are conducting a Delphi study with an expanded expert group that only includes people likely to have a strong connection to nature. To represent the construct as a whole, I would suggest the authors consider whether there are additional groups to recruit from for whom nature is not central to their work. Psychometric methods typically require items that clearly differentiate people; and I have some concerns that any measure produced with be limited in that regard.

The rationale also plays into a narrative that everyone must be connected to nature (if not, it's a bad thing). I agree with the authors the construct is blurred, as are many others in person-environment research; so I do commend the aim of the proposed study (and its ultimate aim to create a measure). In future, it will be important to consider the convergent and divergent validity of that measure with other related constructs like place identity, place attachment, environmental identity etc. The authors do allude to this but I thought I would mention it more explicitly as well.

Is the rationale for, and objectives of, the study clearly described?
Yes

Is the study design appropriate for the research question?
Partly

Are sufficient details of the methods provided to allow replication by others?
Yes

Are the datasets clearly presented in a useable and accessible format?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Environmental psychology; place identity; built and natural environments and wellbeing

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 14 June 2024

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Alexia Barrable 

Division of Psychology, Sociology and Education, Queen Margaret University, Musselburgh, Scotland, UK

This is a study protocol aiming to come to a much-needed consensus on nature connectedness, a term that describes a positive human-nature relationship.

The protocol is clear and well presented, covering all the methodological and ethical aspects of the study to be undertaken well.

One thing I would love to see a little more on is the proposed qualitative analysis justification: more specifically, why the authors are suggesting deductive analysis is followed by inductive, and not the other way round.

Overall, however, this is a scientifically sound and ruinously designed protocol that should produce a solid study with useful results.

Is the rationale for, and objectives of, the study clearly described?

Yes

Is the study design appropriate for the research question?

Yes

Are sufficient details of the methods provided to allow replication by others?

Yes

Are the datasets clearly presented in a useable and accessible format?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: nature connectedness, early childhood

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Appendix P: Poster displayed at People and Planet Conference 2022

Maynooth University
National University of Ireland Maynooth

@cassmup16
@GoGreenRoutes

@naturerelationship

www.gogreenroutes.eu

UNDERSTANDING NATURE-CONNECTEDNESS : A MODIFIED-DELPHI APPROACH

BY CASSANDRA MURPHY

SUPERVISORS: TADHG MACINTYRE, DR ELAINE GALLAGHER, AND DR AOIFE DONNELLY.

GO GREEN ROUTES

Horizon 2020
European Union Funding
for Research & Innovation

Grant No. 869764

1. INTRODUCTION TO GOGREEN ROUTES

GoGreenRoutes is a multidisciplinary research project funded by the European Union's Horizon2020 initiative. The project focuses on increasing nature-connectedness through nature-based solutions in six European cultivating cities, including Lahti (see figure 1). The project consortium is made up of researchers from backgrounds such as physical activity, psychology, technology, horticulture etc. working on the areas outlines in figure 2 below.

Cultivating Cities
Burgas (Bulgaria)
Lahti (Finland)
Limerick (Ireland)
Tallinn (Estonia)
Umea (Sweden)
Versailles (France)

Seed Cities
Malta Conurbation
Munich (Germany)
Region of Murcia (Spain)

Cross-Pollination
Tbilisi (Georgia)
Beijing City Network
Mexico

Restoring Degraded Ecosystems
Enhancing Sustainable Urbanisation

NATURE BASED-ENTERPRISES:
a.) Gamification
b.) Behavioural Games
c.) Sustainable Commerce
d.) Smartphone Application

SUSTAINABLE PHYSICAL ACTIVITY
a.) Active Travel
b.) Green Exercise
c.) Restorative Spaces

Improving Risk Management & Resilience
Developing Climate Change Adaptation & Mitigation

DIGITAL INNOVATION:
a.) Soundscape
b.) Digital Placemaking
c.) Emotional Mapping
d.) VR Experiential Showcase

ONLINE LEARNING PLATFORM:
a.) Psychological Resilience
b.) Nature Connectedness
c.) Engaged Citizen Science

360 - HEALTH

Figure 1: Cities involved in the GoGreenRoutes Project.

Figure 2: The structure of GoGreenRoutes.

2. NATURE CONNECTEDNESS

Understanding the relationship we form with nature is important for both our wellbeing and the wellbeing of the environment around us (Donnelly & Macintyre, 2019). The concept of nature-connectedness stems from Wilson's 1984 biophilia hypothesis, which states that all humans have an innate urge to spend time in nature due to our evolution in natural environments. Nature-Connectedness looks beyond our relationship with nature and describes the role nature plays in ones identity (Nisbet, Zelenski and Murphy, 2009). Inventories to assess nature connectedness have limited reliability and validity (Nisbet and Zelenski 2013). Having been developed from the 1984 hypothesis it is safe to say that the construct does not account fully for changes from societal development in nature connectedness, urban nature, and digital or technological nature. This study seeks to address these limitations of the construct in a meaningful way using a pragmatic methodological approach by applying a modified mixed-methods Delphi approach with experts and expanded expert groups.

3. THE DELPHI METHOD

The Delphi method refers to a mixed methods approach which aims to gather information from a group of respondents who are considered experts in their relevant area of knowledge. The method usually focuses on a complex subject in which the researcher aims to achieve consensus within a group of diverse, knowledgeable advisors. It is useful for answering questions that are not amenable to experimental methods, or when there is not enough information about the topic, such as the development of a construct (Bakker-van Gijssel et al., 2018, Lloyd and Stirling, 2015). In this research study we plan to use a second group called expanded experts. These are people in the local communities who have a passion for nature and/or wellbeing. Creating this second group allows for richer results and a broader perspective.

The study will begin with interviews in which interviewer and interviewee will discuss nature-connectedness experiences and opinions from childhood to present day. Following a thematic review the participants will be asked to take part in weighting activities to narrow down the important themes in nature connectedness and contribute to the development of a modern construct.

A Modified-Delphi Method

1. Recruitment of experts and expanded experts
2. Gather demographic information from short online survey (includes information sheet and consent)
3. Conduct interviews
4. Send back interview to confirm contents
5. Send short survey for feedback on interview process
6. Thematic analysis of interview content
7. Send back summary of analysis
8. Use analysis to create round 1 - Build Consensus
9. Analyse round 1
10. Send back round 1 summary
11. Use round 1 analysis to form round 2
12. Analyse round 2 - Resolve Differences
13. Send back round 2 summary
14. Use round 2 analysis to form round 3
15. Analyse round 3 - Prioritise
16. Use results to form definition of construct

Figure 3: A breakdown of the steps in the modified Delphi method.

4. WHAT DO WE NEED FROM YOU?

We are looking for people from our cultivating cities, who fall into our expanded expert group. These are people who have made a career out of their passion for nature and/or wellbeing. These could be activists in climate change or wellbeing, artists who create nature scenes, city planners, poets and authors, podcasters, politicians or even local mayors. If you believe you fall into this category, or know of someone who does, reach out to get involved in this research. We want to hear from you, the locals, with a passion and lived experience of nature-connectedness. If you would like to get involved please email Cassandra at Cassandra.Murphy@mu.ie to discuss further. We look forward to hearing from you.

Figure 4: Examples of expanded experts.

References

1. Wilson, E. O. 1984. Biophilia. Cambridge, Massachusetts: Harvard University Press.
2. Donnelly, A., & Macintyre, T. (2019). Physical activity in natural settings (1st ed.). Oxford: Routledge.
3. Nisbet, E. K., J. M. Zelenski & S. A. Murphy (2009) The Nature Relatedness Scale: Linking Individuals' Connection With Nature to Environmental Concern and Behavior. Environment and Behavior, 41, 715-740.
4. Nisbet, E. K. & J. M. Zelenski (2013) The NR-6: a new brief measure of nature relatedness. Frontiers in psychology, 4, 813-813.
5. Bakker-van Gijssel, E. J., P. L. B. J. Lucassen, T. C. olde Hartman, W. J. J. Assendelft & H. M. J. van Schrojenstein Lantman-de Valk (2018) Development of a health assessment instrument for people with intellectual disabilities: a Delphi study. Family Practice, 35, 599-606.
6. Lloyd, B. & C. Stirling (2015) A tool to support meaningful person-centred activity for clients with dementia – a Delphi study. BMC Nursing, 14, 10.

