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A mixed-methods examination of nature beliefs as predictors of sustainable behaviour in the UK

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Preface

A study based on *Chapter 4* has been published:

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Summary

Behaviour change is needed to address the ecological crisis. There is a gap in our understanding of the UK public's *nature beliefs* (beliefs about non-human species and the natural environments in which they interact) and how these beliefs influence sustainable behaviour. This thesis is a mixed-method examination of nature beliefs and their relationship with two broad kinds of sustainable behaviour: pro-environmental behaviours (i.e., those that reduce carbon emissions and protect the environment) and pro-nature behaviours (i.e., those relating more specifically to the protection and conservation of non-human species and their habitats).

After an introduction to the context and rationale of the thesis (*Chapter 1*), *Chapter 2* reviews a range of nature beliefs and the evidence for their association with sustainable behaviour, noting conflicting evidence for anthropomorphism (perceiving nature to have humanlike characteristics). *Chapter 3* describes the epistemological and ontological underpinnings of the thesis and briefly summarises the quantitative and qualitative approaches used in each study. *Chapter 4* presents a systematic review, concluding that there is strong evidence that anthropomorphism influences sustainable behaviour via empathy, connectedness to nature, and guilt. *Chapter 5* presents a grounded theory of the facilitators of pro-nature behaviours, noting its similarities with the Value-Belief-Norm (VBN) model (Stern, Dietz, Abel, Guagnano, & Kalof, 1999). *Chapter 6* presents findings from a quantitative survey of an approximately representative UK sample: biospheric values predict consumption pro-environmental behaviours, and only two beliefs (connectedness to nature and empathy toward nature) are found to be predictive of high-cost pro-environmental behaviours. *Chapter 7* brings together all nature beliefs from the preceding chapters and tests the ability of each to uniquely predict pro-environmental behaviours and pro-nature behaviours. The study replicates the finding that biospheric values predict consumption pro-environmental behaviours and that connectedness to nature predicts high-cost pro-environmental behaviours. No other variable is positively predictive high-cost pro-environmental behaviours in this study. Connectedness to nature also predicts high-cost pro-nature behaviours, as does empathy toward nature. Instrumental value beliefs are found to be negatively predictive of both high-cost pro-environmental and pro-nature behaviours. *Chapter 7* additionally explores eco-anger and eco-guilt as potential mediators explaining the link between connectedness to nature/empathy toward nature and high-cost sustainable behaviour and provides empirical support for an extended VBN model as an explanation for high-cost behaviours.

The findings of the studies presented in this thesis are interpreted through the lens of group identities (identifying with humans versus identifying with the natural world) and the implications of

this for interventions and future research are discussed (*Chapter 8*). The findings have implications for matching message content to existing beliefs and dispositions. I argue that tackling the ecological crisis requires the development of cultural norms that reframe humans as part of the natural world and de-emphasise nature's instrumental value to humans.

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Chapter 1 Background

1.1 Introduction

This chapter begins by describing the ecological crisis: its causes, consequences, and how public institutions are attempting to address it. I highlight the role of individual behaviour in mitigating the problem by promoting nature conservation, reducing greenhouse gas emissions, and influencing wider society and policy. I briefly summarise the literature on nature beliefs and their influence on individual behaviour. I also describe how public messaging tends to frame nature in a way that appeals only to one kind of nature belief (instrumental value beliefs), and how this might not result in the desired impact of messaging on behaviour change. This chapter concludes by outlining how the thesis will address its overarching aims: to establish the prevalence of nature beliefs and sustainable behaviours in the UK, to examine how a range of nature beliefs independently predict different kinds of sustainable behaviour in the UK, and to build a theoretical understanding of the psychological mechanisms involved.

1.2 The Ecological Crisis

The Convention on Biological Diversity (CBD; 2006) defines *biodiversity* (or "biological diversity") as variability of individuals within species, variability between species, and the variability of ecosystems. According to the CBD (2006), an ecosystem is the collection of animals, plants, micro-organisms, and the environment in which they reside, interacting dynamically as a functional unit. Human activities are causing global degradation of ecosystems and biodiversity loss, which some have termed an *ecological crisis* (Kolasi, 2021; Panu, 2020). The World Wildlife Fund (WWF, 2020) has reported that, between 1970 and 2016, there was an average 68% decrease in the population size of all monitored vertebrate species worldwide. Over the same period, in the UK 41% species' population sizes have decreased whereas only 26% of species have increased in abundance (WWF, 2020). There is growing consensus that we have entered the Anthropocene: a new geological epoch marked by significant anthropogenic changes to the Earth's natural systems, including mass species extinction (Ceballos, Ehrlich, & Dirzo, 2017; Waters et al., 2016). Biodiversity loss and ecosystem decline are the result of numerous human activities and impacts, including habitat loss, overexploitation of resources, invasive species, and climate change (Nielsen et al., 2021c). These threats interact; for example, rising levels of CO_2 in the atmosphere drive the spread of certain invasive species (Nielsen et al., 2021c).

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019) published a report detailing the various serious ramifications of ecosystem decline

and biodiversity loss for human health. Healthy ecosystems and species variety are required for good air quality, food availability, and access to natural medicines on which approximately four billion people rely. The spread of disease is becoming more likely as humans continue to change natural ecosystems; as temperatures rise from climate change, mosquito migration northward to European countries is likely to increase, leading to the potential spread of viruses like Zika and dengue (Ryan, Carlson, Mordecai, & Johnson, 2019). How we relate to and treat other species also presents a constant threat of new illnesses. For example, there is evidence that the Covid-19 pandemic began in the wet markets of Wuhan where a strain of coronavirus made a zoonotic jump from animals to humans (Maxmen, 2022; Sandhu et al., 2021). Intensive farming is also implicated in an increased emergence of zoonotic diseases (Jones et al., 2013).

Our impact on climate and ecological systems has socioeconomic consequences, such as the social conflict that will likely intensify if food and water security are threatened (IPBES, 2019). For example, The United Nations (UN) Secretary General in 2007 claimed that violence in Darfur was precipitated by a drought caused by decline in rainfall (Ki-Moon, 2007). Hsiang, Meng, and Cane (2011) demonstrated that the occurrence of the El Niño/Southern Oscillation (ENSO) phenomenon was associated with a doubling in the probability of civil conflicts between 1950 and 2004. Anderson and DeLisi (2011) summarised the evidence for three pathways through which rising global temperatures can increase violent behaviour: direct effects of higher temperatures on irritability and aggression; exacerbation of factors that put children on a violence-prone developmental trajectory; effects of rapid climate change on livelihoods and survival, migration, political instability, and intergroup conflict. Changes to climate and ecological systems can be non-linear, in which a tipping point is reached leading to positive feedback loops and sudden systemic changes that are difficult to reverse (Barnard et al., 2021; Watson et al., 2021). While climate change has received much of the media focus, ecological issues such as biodiversity loss have received relatively little (Legagneux et al., 2018).

Initiatives to conserve biodiversity are taking place at national and local levels. At the government level, Wales passed The Well-being of Future Generations (Wales) Act 2015, which requires public bodies to set goals for achieving a range of objectives. These objectives include the efficient use of natural resources to reduce the greenhouse gas emissions that contribute to biodiversity loss, and maintaining biodiverse environments and healthy ecosystems. All UN member states have signed up to its sustainable development goals, which include two goals that relate to protecting biodiversity (on land and in the sea) (UN, n.d.). Nilon et al. (2017) examined city plans that had incorporated biodiversity-related targets, highlighting common features of plans from 40 cities internationally such as habitat conservation and ecological connectivity (e.g., maintaining corridors for wildlife). Most city plans included community engagement, incorporating elements such

as citizen science and education. These engagement efforts can help build a political mandate for environmental policy (Willis, 2018) and overcome political reluctance to implement conservation targets (Berke & Godschalk, 2009; Holmes, Rebelo, Dorse, & Wood, 2012).

1.3 The Need for Individual Behaviour Change

Nielsen et al. (2021c) remarked that the issue of conservation has not received much consideration from behavioural science, even though human behaviour is driving biodiversity loss. According to the Office for National Statistics, household emissions in the UK have shown less of a downward trend than the energy, manufacturing, and transport sectors since 1990, and households are the single highest contributors to the greenhouse gas emissions (*Office of National Statistics*, 2022). The highest-impact behaviours that individuals can take to reduce their carbon emissions include having one fewer child, living car-free, avoiding transatlantic flights, eating a plant-based diet, and reducing food waste, whereas lower-impact behaviours include recycling and upgrading to energy-efficient lightbulbs (Cologna, Berthold, & Siegrist, 2022; Wynes & Nicholas, 2017). Other actions that can help conserve species more directly include planting pollinator-friendly plants and avoiding the use of insecticides (Barbett, Stupple, Sweet, & Richardson, 2019). High-income individuals and countries have far larger carbon footprints, so need to reduce their emissions more than those with lower incomes. The United Nations Environment Programme's Emissions Gap Report highlights the stark disparity in carbon emissions between countries, and between the wealthiest and poorest individuals within countries (UNEP, 2022).

Research has also demonstrated that individual lifestyle changes can contribute to positive social tipping points, leading to systemic changes: when individuals change their behaviour it can increase their credibility, leading to social conformity effects and large-scale adoption of sustainable behaviour (Moore et al., 2022). Consumers can also influence what businesses choose to invest in and produce; for example, Nielsen et al. (2021c) highlighted that ecosystem-harming activities are incentivised by consumers, citing the example of Amazon deforestation being partially driven by the demand for beef (Nepstad, Stickler, & Almeida, 2006). Bajželj et al. (2014) posited that, as demand for meat is on track to increase with increasing global population size, it will be important to look at reducing demand; these authors calculated very large potential reductions in CO_2 emissions that can be achieved by reducing demand for meat, in addition to reducing supply.

Nielsen et al. (2021a) argued that individuals have a variety of roles extending beyond the household: as participants in organisations and workplaces, as consumers, and as citizens who vote in elections, and can have large impacts by influencing policy that will lead to widespread systemic changes. Pro-environmental and pro-nature behaviours thus encompass more than just consumer (*private-sphere*) actions; they also include political, community and organisational (*public-sphere*)

actions (Stern, 2000). It has been noted that the study of sustainable behaviour has tended to focus more on the private-sphere behaviours which would influence an individual's carbon footprint, and less on more public-sphere behaviours that would have an influence on the wider system (Nielsen, Cologna, Lange, Brick, & Stern, 2021b). There has also been a focus on pro-environmental over pro-nature behaviours (Richardson et al., 2020).

1.4 The Role of Nature Beliefs

According to the Theory of Planned Behaviour (TPB) (Ajzen, 1991), a behaviour can be predicted by three types of belief about the behaviour: beliefs about the consequences of the behaviour (leading to a particular attitude about the behaviour); normative beliefs about others' perceptions of the behaviour (leading to a sense of perceived pressure to perform the behaviour, or subjective norm); beliefs about one's ability to perform the behaviour (influencing perceived behavioural control). Subjective norms and attitudes impact behaviour indirectly via their influence on intention to perform the behaviour. Perceived behavioural control has a direct impact on behaviour as well as an indirect impact via intention. These sorts of beliefs have been found to be predictive of sustainable behaviour and behavioural intentions (De Leeuw, Valois, Ajzen, & Schmidt, 2015; Judge, Warren-Myers, & Paladino, 2019; Nigbur, Lyons, & Uzzell, 2010); for example, De Leeuw et al. (2015) reported that pro-environmental behaviours (such as putting rubbish in the proper recycling bin and putting on clothing instead of turning on the heat) were significantly predicted by behavioural beliefs (the likelihood that the behaviour would, e.g., protect the environment), normative beliefs (e.g., to what extent important others expected them to adopt the behaviour), and control beliefs (e.g., the availability of facilities such as recycling bins to aid the behaviour).

Whereas the TPB (Ajzen, 1991) provides an insight into sustainable behaviour by considering beliefs about those behaviours, we should also consider *nature beliefs*. Nature can be defined as the totality of non-human species as well as the natural environments in which they interact (such as ecosystems) (Muradian & Pascual, 2018); as such, nature beliefs are generalised beliefs about species and their natural environments. For instance, anthropomorphism of the natural world is the process in which nonhuman targets are perceived as having "humanlike" characteristics (Epley, Waytz, & Cacioppo, 2007). Although anthropomorphism of nature has been shown to be associated with higher sustainable behaviour (Tam, 2015b), there is some evidence to indicate that it might be counterproductive in some circumstances (e.g., Tam, 2015a). When the focus of anthropomorphism is on mental characteristics (intelligence, consciousness, and having the capacity to experience pain), this is termed *mind attribution to nature* (Tam, 2015b), and much of the research has focused on this kind of anthropomorphism.

Empathy rests on the belief in another's capacity for experience, as it is an emotional response to another's experience (Baron-Cohen & Wheelwright, 2004); *empathy toward nature* in particular has shown positive associations with sustainable behaviour (Tam, 2013). Schultz (2000) found that people who were asked to take the perspective of an animal depicted as being harmed by pollution showed significantly higher environmental concern than those asked to remain "objective". Empathy could be considered a relationship-based experience, which is also true for another concept: connectedness (Tam, 2019). *Connectedness to nature* refers to a perceived overlap between oneself and the natural world; a belief that one is part of the natural world (Mayer & Frantz, 2004). Connectedness to nature is consistently associated with sustainable behaviour (Mackay & Schmitt, 2019) and environmental concern (Nisbet, Zelenski, & Murphy, 2009).

People can also hold beliefs about nature's value. One such belief is that nature and non-human species are valuable in their own right (*intrinsic value beliefs*), regardless of their usefulness to humans (Mathews, 2016). A majority of the United States public (69%) endorsed intrinsic value beliefs (Wickizer, 2016) and intrinsic value beliefs were found to be predictive of support for legislation to conserve endangered species; this appears, however, to be the only study to investigate these associations in a quantitative manner. *Biospheric values*, in which people consider issues from the perspective of benefits or costs to ecosystems and the natural world (Stern & Dietz, 1994), share similarities with intrinsic value beliefs (Dietz, Fitzgerald, & Shwom, 2005). Biospheric values have received a lot of focus in the research and have been consistently shown to be associated with sustainability; for example, Katz-Gerro, Greenspan, Handy, and Lee (2017) demonstrated that biospheric value orientation, compared to other values, was the most consistent determinant of different kinds of environmental behaviour and that its effects on environmental behaviour are similar across countries. Wang, Van der Werff, Bouman, Harder, and Steg (2021) found biospheric values to be predictive of sustainable behaviour in Chinese and Dutch students. Bouman, Steg, and Kiers (2018) reported findings from the European Social Survey of 28 countries, including the UK, showing consistently high biospheric values that were prioritised, along with altruistic values, over egoistic and hedonic values. Biospheric values have repeatedly shown associations with environmental attitudes (Schultz & Zelezny, 1999). Katz-Gerro et al. (2017) found that biospheric values were the most consistent predictors of sustainable behaviour in a multi-national study when compared with an array of values that were not nature-specific (Schwartz's [1992] universalism, benevolence, and conformity values).

Another nature belief is that nature and non-human species are only valuable for their usefulness to humans (*instrumental value beliefs*) (Wickizer, 2016). Wickizer (2016) found that 64% of their United States sample disagreed with perceiving nature in this way. No studies to my knowledge have quantitatively examined associations between instrumental value beliefs and

sustainability. Despite this, governments and policymakers often frame nature in terms of its instrumental value, i.e., the value derived from its usefulness to humans (Kortetmäki et al., 2021; Muradian & Pascual, 2018). The Well-being of Future Generations (Wales) Act 2015 calls on public bodies to maintain and enhance the natural environment, highlighting the role for natural environments in supporting wellbeing and providing the air we breathe, food, drinking water, clothes, medicine, materials, and green spaces. The IPBES (2019) mainly frames climate change in terms of its impacts on human interests, such as health, wellbeing, and livelihood. Rose, Brotherton, Owens, and Pryke (2018) noted that the Lawton review of England's wildlife highlighted the economic storyline of conservation, arguing for restoration of habitats and re-establishing ecosystem services (Lawton et al., 2010). The United Nations Economic Commission (2007) also frames nature in terms of its ecosystem services. The fact that instrumental value beliefs might not be very prevalent among the public, whereas biospheric values and intrinsic value beliefs appear to be prevalent, calls into question the framing of nature purely in terms of its instrumental value.

Beliefs determine how information is processed: Newman, Nisbet, and Nisbet's (2018) national United States survey suggested that individuals choose to consume media that portrays climate change in a way that is congruent with their worldview and interpret the information in line with their beliefs. Beliefs (e.g., political worldviews) appear to bias how participants visually attend to climate-related information (Luo & Zhao, 2021). Information is more persuasive when it resonates with recipients' existing beliefs (Giorgi, 2017), and policymakers, journalists, and experts choose informational frames to persuade others, and to make information more appealing (Nisbet & Huge, 2006). Environmental information can be framed in a way that presents the problem in a particular light, including who is responsible and what should be done, and simplifies the information by focusing on specific aspects (Nisbet, 2009). There has been little research to determine how an array of nature beliefs might be differentially associated with sustainable behaviour, or to theorise how these beliefs might interact and the mechanisms underlying their associations with sustainable behaviour. A clearer understanding of the range of nature beliefs in the UK, their prevalence, and their associations with sustainability, would inform public institutions and organisations on how best to present information about nature and the climate and ecological crises in a way that resonates with the public. It would also indicate which nature beliefs are most appropriate to foster in a range of settings (e.g., education) in order to encourage the adoption of sustainable behaviour among the public (see Table 1.1 for a list of the nature beliefs investigated in this thesis).

Table 1.1: A List of the Nature Beliefs Examined in This Thesis, and Their Definitions.

Term	Definition
Anthropomorphism of nature	Perceiving nature to have humanlike characteristics (Epley, et al., 2007)
Mind attribution to nature	Perceiving nature to have humanlike mental characteristics (Tam, 2015a)
Empathy toward nature	Understanding the emotional experience of the natural world and sharing this experience (Tam, 2013)
Connectedness to nature	Perceiving oneself to be part of the natural world as opposed to apart from it (Mayer & Frantz, 2004)
Intrinsic value beliefs	Believing that nature and non-human species are valuable in their own right, regardless of their usefulness to humans (Mathews, 2016).
Biospheric values	Believing in the value of considering issues from the perspective of benefits or costs to ecosystems and the natural world (Stern & Dietz, 1994)
Instrumental value beliefs	Believing that nature and non-human species are valuable for their usefulness to humans Wickizer, 2016)

1.5 Thesis Overview

In this chapter I have presented the need for the UK public to adopt sustainable behaviour to address the ecological crisis. I highlighted that the most common framing of the ecological and climate crises is in terms of the implications for humans, and that nature is frequently presented solely in terms of its instrumental value to humans. I noted research showing that instrumental value beliefs are not very prevalent in the United States public, that intrinsic value beliefs are prevalent among the United States public, and that biospheric values are prevalent internationally, including in the UK; this calls into question the effectiveness of framing information from a purely instrumental value standpoint in the UK.

As I have summarised, the research on anthropomorphism and its association with sustainability has shown some conflicting findings. Some other beliefs (empathy toward nature; connectedness to nature; biospheric values) have received consistent associations with sustainability, whereas others (intrinsic value beliefs; instrumental value beliefs) have received very

little empirical attention. Furthermore, the empirical research on nature beliefs is quite disjointed and does not consider the relative importance of nature beliefs or their conceptual overlaps (e.g., the fact that connectedness and empathy both entail relationship-based experiences) (Tam, 2019), and there is a lack of theory to understand mechanisms by which nature beliefs such as connectedness to nature might impact on sustainable behaviour, and how different nature beliefs might interact. The research on nature beliefs and sustainable behaviour has mostly taken place outside the UK and measures require validation in UK samples.

The overarching aims of this thesis are to understand the prevalence of nature beliefs in the UK, to understand their contribution to an array of pro-environmental and pro-nature behaviours in the UK, and to develop a theoretical understanding of how nature beliefs might predict sustainable behaviour. It is hoped that this will inform the kinds of beliefs about the natural world that could be nurtured to encourage an ecologically-conscious population. A better understanding of this area could also prove valuable to any initiative aiming to influence sustainable behaviour; as previously discussed, frames that align with the beliefs of intended targets can be especially effective (Giorgi, 2017). Understanding the kinds of nature beliefs held by the UK public, and their prevalence, could inform the way that policies and campaigns present information in ways that can encourage desirable behaviour (Lehner, Mont, & Heiskanen, 2016). In addressing the thesis's aims, the remainder of the thesis is structured as follows:

Chapter 2 is a review of the various kinds of nature beliefs, the different kinds of sustainable behaviour, and introduces theories that might help explain the link between them. Here, I highlight gaps and conflicts in the literature and how the research questions of the thesis aim to address these gaps.

Chapter 3 provides a methodological overview for the thesis: my epistemological approach, the rationale for a mixed-method line of enquiry, and a brief methodological overview for each of the four studies contained in the thesis.

Chapter 4 is a systematic review of correlational and experimental evidence that anthropomorphism (mind attribution to nature in particular) is associated with sustainable behaviour. Strong evidence is provided for this association, as well as for certain mediators (e.g., connectedness to nature and empathy toward nature).

Chapter 5 presents the results of a grounded theory study of pro-nature behaviours. Intrinsic value beliefs about particular species are theorised to be important for affording moral consideration to those species, whereas instrumental value beliefs impede this process. Generalised intrinsic value beliefs stimulate moral concern for nature, whereas external (usually social) triggers give rise to

sporadic pro-nature behaviour. Sustained behaviour is supported by developing an internalised morality around this issue, as well as developing a pro-nature social group.

Chapter 6 is the first of two quantitative surveys and analyses assessing the psychometric properties of measures of nature beliefs and sustainable behaviour in an approximately representative UK sample. The study explores how two kinds of empathy (toward nature and toward humans) dissociate in predicting sustainable behaviour, and tests how an array of nature beliefs predict three kinds of pro-environmental behaviours. High-cost pro-environmental behaviours appear to be solely predicted by connectedness to nature and empathy toward nature.

Chapter 7 presents the results of analyses testing the unique contributions of all nature beliefs identified in the preceding chapters, looking at three kinds of pro-environmental behaviours and four kinds of pro-nature behaviours. Many of the findings from *Chapter 6* are replicated (e.g., connectedness to nature is found to be predictive of high-cost pro-environmental behaviours) and novel findings are presented (e.g., connectedness to nature and empathy toward nature are both predictive of high-cost pro-nature behaviours).

Chapter 8 is a general discussion that synthesises the findings from each study, relating the findings to the broader literature and theory, in particular, Self-Categorisation Theory (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). In this final chapter I discuss the implications of the various findings across the four studies described in the thesis, mainly in terms of matching message content to pre-existing beliefs and dispositions. I also propose that cultural shifts are required in terms of how we understand our place within nature, suggesting ways that this could be achieved and what further research would be required to help us meet this aim.

Chapter 2 Literature Review

2.1 Chapter Overview

The chapter begins with a brief summary of species characteristics that appear to attract more positive or negative attitudes and that might influence sustainable behaviour. This leads on to a consideration of nature beliefs that might explain the importance of these characteristics (anthropomorphism and mind attribution to nature) and I highlight conflicts in the literature on anthropomorphism's role in sustainable outcomes. I then review a range of other nature beliefs that are relevant to the field of sustainability: biospheric values, intrinsic value beliefs, instrumental value beliefs, connectedness to nature, and empathy toward nature. I discuss different kinds of pro-environmental behaviour, different kinds of pro-nature behaviour, and behaviours that differ in costliness and impact. The chapter concludes with a consideration of the gaps in the literature with regard to how different nature beliefs might interact in their influence on sustainability and I summarise how the research questions of the thesis aim to address these gaps. The chapter also introduces a key model of sustainable behaviour that will be returned to throughout the thesis: the Value-Belief-Norm model (Stern, Dietz, Abel, Guagnano, & Kalof, 1999).

2.2 Which Species are Deemed Likeable, and by Whom?

Understanding the nature beliefs relevant to sustainable behaviour can begin with an investigation of factors that lead us to like some species more than others. Schlegel and Rupf (2010) asked a sample of Swiss primary school pupils and students from grammar schools and an agricultural school to rate the likeability of individual pictures of species. The authors found that older participants and those with more knowledge of species tended to like species more. In a sample of Japanese adults, Hosaka, Sugimoto, and Numata (2017) found that age was positively correlated with liking birds and insects but negatively correlated with liking mammals. Women and people with children were more likely to dislike insects and animals that are generally considered unfavourable. No socio-demographic factor was predictive of likeability ratings when all animals were considered together. The biggest predictor of likeability for all animals in combination was childhood experience of nature, and collecting wildflowers/fruits and catching insects were more predictive of likeability ratings than climbing trees and wild water swimming. Hence, demographic factors such as age and gender, and prior experience with nature, appear to be associated with more positive evaluations of species.

Species characteristics are also associated with likeability. Schlegel and Rupf (2010) reported that, on average, their sample of young people preferred most mammals, birds, and butterflies, to

(other) insects, reptiles, and amphibians. The authors also found that species deemed to be pests were particularly likely to attract a negative likeability rating. Species deemed pests also appear to attract less support for conservation; for example, Drymon and Scyphers (2017) reported that the willingness of recreational anglers in Florida to contribute financially to shark conservation efforts was much lower for those who believe that the growing population of coastal sharks threatens recreational fishing opportunities. Gallagher, Cooke, and Hammerschlag (2015) showed that their sample of recreational anglers in Florida was generally more supportive of shark conservation measures that were least restrictive to recreational fishing.

Species appearance has repeatedly been shown to be an important factor in determining likeability. Schlegel and Rupf (2010) reported that species attracted significantly higher likeability ratings when the rating was made on the basis of appearance (or species' rarity/worthiness of protection/benefit to humans). Roque de Pinho et al. (2014) showed in their Kenyan sample that considering an animal to be beautiful was the strongest predictor of support for saving giraffes, gazelles, and elands, whereas the strongest predictor of support for removing hyenas, buffalos, and elephants was the perceived ugliness of these species. Colléony, Clayton, Couvet, Saint Jalme, and Prévot (2017) reported that participants in a Parisian zoo conservation programme were more likely to "adopt" animals (for conservation purposes) that were charismatic, and that charisma was more influential than species' endangered status. Species size can also influence human preferences towards animals (Bitgood, Patterson, & Benefield, 1988).

To explain the role of species appearance, Tisdell, Wilson, and Nantha (2006) proposed a *similarity principle*, in which species similarity to humans, based on physical appearance, is a major basis for likeability and attractiveness (Gunnthorsdottir, 2001; Kellert, 1985; Plous, 1993). Tisdell et al. (2006) also noted the evidence that United States government spending decisions are influenced by factors relevant to similarity such as the physical size of species and whether they are deemed a higher life-form, more than scientific considerations such as their endangered status (Metrick & Weitzman, 1996, 1998). Tisdell et al. (2006) examined phylogenetic distance, which is an objective measure of species' genetic and physical similarity based on evolutionary relationships; they reported that participants were more willing to pay for the adoption of animals that are phylogenetically closer to humans. Batt (2009) showed that a UK sample of university students preferred animals that were deemed more similar to humans (based on objective measures of biobehavioural similarity, including superficial appearance and other factors such as lifespan, reproductive strategy, and social organisation). Tisdell, Wilson, and Nantha (2005) reported that the Australian public generally favoured the survival of mammals (which are phylogenetically closer to humans) over birds and reptiles. The authors noted that their findings are consistent with those of DeKay and McClelland (1996) that mammals are generally preferred to birds, and birds to reptiles

(following the expected order of phylogenetic distance). Species that are phylogenetically closer to humans receive more empathic responses from humans (Kellert, 1985; Plous, 1993; Samples, Dixon, & Gowen, 1986). Waerstad et al. (2002) found that participants choose harsher punishments for offenders who have abused animals deemed more similar to humans, indicating that moral concern might also be higher for species deemed more similar to humans.

2.3 Nature Beliefs

While it might be informative to assess objective species characteristics that encourage sustainable behaviour, this might limit the focus on particular aspects of nature while neglecting less charismatic or viscerally appealing parts of the climate and ecological systems that are nonetheless essential for supporting climate and ecosystems, such as peatland (Humpenöder et al., 2020) and soil bacteria (Lladó, López-Mondéjar, & Baldrian, 2017). Another approach to this topic is to consider beliefs that people hold about nature and non-human species more broadly, and their influence on sustainable behaviour. Beliefs are subjective, can refer to a broad range of targets, and can be malleable to an extent, or activated by targeted messaging. Verplanken and Holland (2002) found that an experimental priming paradigm, in which participants were asked to form an impression of a person with strong environmental values, led to more sustainable consumer choices than those primed to think about non-environmental values. In this thesis, *nature* is defined broadly to encompass non-human species as well as the natural environments in which they interact (such as ecosystems), in line with the approach taken by researchers in this area (Muradian & Pascual, 2018). The following sections provide an overview of nature beliefs to be found in the literature and their association with sustainable behaviour. Concepts that are related to or include nature beliefs (e.g., attitudes) will also be considered, as will their overlap with and distinctiveness from nature beliefs.

2.3.1 Anthropomorphism

In *Section 2.2*, the similarity principle was highlighted as a basis for species likeability and sustainable behaviour. Anthropomorphism of nature could be considered the subjective, belief counterpart to measures of objective species similarity to humans. Epley et al. (2007) defined anthropomorphism as the process in which the behaviour of nonhuman entities is imbued with humanlike characteristics, intentions, motivations, and emotions. There is evidence that women anthropomorphise nature more than men, and that a tendency to anthropomorphise nature might decrease with age (Tam, 2013; Tam, 2014). Understanding the influence of anthropomorphism has received relatively little focus in environmental research, despite being an important frontier in environmental research for a multitude of reasons. We judge species similarity to humans not solely on the basis of perceptible features and behaviours, but also infer imperceptible characteristics such

as consciousness, capacity to feel pain, or an ability to feel emotions. Inferring “humanlike” mental characteristics and capacities such as these is termed mind attribution to nature.

The link between perceiving “humanlike” qualities in nature and sustainable behaviour is suggested by linguistic conventions that personify nature (e.g., “Mother Earth”), and movements such as veganism, which often highlight the sentience of animals (Hooley & Nobis, 2015). Researchers have found anthropomorphism of nature to be positively correlated with pro-environmental attitudes (Apostol, Rebega, & Miclea, 2013) and there is experimental evidence that manipulating anthropomorphism leads to increases in pro-environmental attitudes (Wang, Ming, & Zhang, 2020). Clayton, Fraser, and Burgess (2011) proposed that concern for animals and support for conservation depends on the belief that non-human species can experience humanlike emotions and cognitions, evoking the argument of Crompton and Kasser (2009) that encouraging pro-nature attitudes requires re-categorising animals as part of the in-group of humans. Chan (2012) theorised that anthropomorphism of species should lead to greater desire to save their lives via an increase in empathy.

That said, some of the evidence for anthropomorphism has been conflicting; Tam (2015a) presented experimental evidence that the influence of anthropomorphism on pro-environmental outcomes can be contingent on participants’ pre-existing need for social connection and can be counterproductive for those with a low need for social connection. Chan (2012) cautioned against the indiscriminate use of anthropomorphism, which could, for instance, lead to inadvertent support for the killing of a predator to that species. Root-Bernstein, Douglas, Smith, and Verissimo (2013) provided empirical evidence that anthropomorphism can have adverse consequences for environmental attitudes, citing a study by Knight (2005) in which Japanese zoo visitors who perceive monkeys’ feeding interactions to be akin to human gift-giving behaviour come to be disappointed in behaviour that violates human norms, such as stealing and fighting between the monkeys.

Apart from anthropomorphism, a variety of other nature beliefs are associated with sustainable behaviour. In the following sections we will consider a range of other nature beliefs (and constructs related to beliefs). First, I will consider attitudes, before discussing empathy toward nature and connectedness toward nature. Then I will consider broad values in relation to nature, and finally an additional set of nature beliefs to be found in the Value-Belief-Norm model (Stern et al., 1999), which details how values, awareness of the consequences of environmental decline on valued targets, and beliefs about a personal obligation to act, lead to sustainable behaviour.

2.3.2 Attitudes Toward Nature

Attitudes are multifaceted, comprising behavioural, cognitive, affective, and motivational aspects (Schwarz & Bohner, 2001); for example, Allport (1935) defined an attitude as a psychological and neural state that influences one's responses to all targets and situations relating to the attitude. Attitudes are always *about* something (the attitude object), which in the case of nature conservation might be a particular species, natural environments, behaviours that might impact on nature, or nature itself. Zanna and Rempel (1988) considered attitudes to be based partially on a person's beliefs about the attitude object. Maio, Haddock, and Verplanken (2018) remarked that the various definitions of attitudes involve a judgement of liking/disliking or favouring/disfavouring an attitude object, and defined attitudes as the summary evaluation of the object founded on affective, cognitive, and behavioural information.

Kellert (1985) developed a typology of 10 ways in which people perceive and emotionally respond to animals, based on survey data. According to Kellert (1985), people can primarily be orientated toward the sensory features of animals (aesthetic), the potential for control or mastery over them (dominionistic), the systematic study of them (ecologistic/scientific), affection toward them (humanistic), the right/wrong treatment of them (moralistic), enjoying direct experience with them (naturalistic), representing them in language and thought (symbolic), using or subordinating them for the good of humans (utilitarian), actively avoiding them out of fear or dislike (negativistic), or passively avoiding them out of indifference (neutralistic). Kellert (1985) reported that the most common of these types of orientation toward animals in a representative United States sample were the humanistic, moralistic, utilitarian, and negativistic.

Numerous researchers have generated questions corresponding to these different attitude types and have confirmed their validity. For example, Thompson and Mintzes (2002) developed a questionnaire about attitudes toward sharks and found a principal component solution in which there were four components (utilitarian/negative; naturalistic; scientific; moralistic). Kellert (1985) noted that the moralistic and utilitarian attitude types seem to be conceptually opposed in that the first eschews human exploitation of animals and the latter endorses it, whereas the negativistic and humanistic attitude types are opposed in that the first entails a negative affective response to animals and the latter a positive one. On this basis, Serpell (2004) proposed that attitudes toward animals could be simplified as reflecting two motivational components: utility and affect. Utility refers to an animal's perceived usefulness and is related to instrumental value (to be discussed in *Section 2.3.5*). Affect relates to the emotional response to an animal, such as a feeling of affection for an animal; this is related to the concept of *biophilia*, which is a theorised inborn tendency for humans to seek connections with other life in general (Kellert & Wilson, 1993). Two nature beliefs that entail an emotional response to nature are empathy and connectedness, which will now be considered in turn.

2.3.3 Empathy Toward Nature

Empathy has been defined as the motivation or capacity to ascribe mental states to people or animals and involves an emotional response to the other's presumed mental state (Baron-Cohen & Wheelwright, 2004). While not a belief in and of itself, it relies on the belief that others have mental states. Empathy toward nature has been found in multiple studies to be predictive of conservation behaviour (Tam, 2013). Empathy toward nature, when manipulated, can trigger a sense of concern for and obligation to help nature (Schultz, 2000; Berenguer, 2007). Research has also found empathy toward other humans to be associated with sustainable behaviour (Sharma & Christopoulos, 2021). Women have been shown to have higher empathy toward nature than men (Tam, 2013), mirroring gender differences for empathy toward people (Baron-Cohen & Wheelwright, 2004). The extent to which these represent two distinct kinds of empathy, and whether they are uniquely predictive of sustainable behaviour, has not been extensively researched. In understanding the role of empathy toward nature, it would be important to disentangle any specific effects beyond empathy toward people.

Empathy toward nature might develop as a result of experiences with nature. Morris, Knight, and Lesley (2012) showed that participants who had owned at least one animal had a significantly higher level of belief that horses, dogs, and rodents have emotions than those who had never owned an animal, suggesting that empathy could at least partially explain the link between familiarity with animals and attitudes toward species. Berenguer (2007) provided experimental evidence that being shown pictures of species can increase biospheric concern (i.e., concern for the welfare of non-human species, including animals, birds, marine life, and plants) in participants who are instructed to take the perspective of the depicted animal (a manipulation intended to evoke empathy). Only those who saw an animal being harmed evidenced increased concern for nature, whereas no effect was observed when an animal was shown in nature, or a person engaging in a recreational activity in nature. Schultz (2000) replicated these findings with a similar study, showing that asking participants to take the perspective of a species that had experienced harm (either a dead bird on the beach covered in oil, or a felled tree) increased self-reported feelings of empathy toward the species, generated a sense of moral obligation to help the depicted species and nature as a whole, and increased participants' allocation of funds to an environmental association. Shelton and Rogers (1981) also found a behavioural outcome, in which inducing participants to take the perspective of whales led to more intention to protect whales than for those who did not take whales' perspectives.

2.3.4 Connectedness to Nature

Connectedness to nature is an extensively researched construct in the field of sustainability and describes a person's perception of being part of nature (Mayer & Frantz, 2004). Schultz (2000)

argued that connectedness to nature influences concern for environmental problems as natural entities will be included in the cognitive representation of oneself. Zylstra, Knight, Esler, and Le Grange (2014) reviewed the different terms that reflect this concept, including nature relatedness and connection to nature; they concluded that the common theme among the definitions is that connectedness to nature is a state of consciousness that entails consistent awareness of the interrelatedness of nature and oneself. It comprises an affective, cognitive, and experiential component. The authors highlight its relevance to identity-based concepts such as environmental identity (Clayton, 2003) or the ecological self (Bragg, 1996). A meta-analysis by Mackay and Schmitt (2019) demonstrated correlational and experimental evidence that greater connectedness to nature is associated with more sustainable behaviour, and that these effects generalise across demographic variables such as age, gender, ethnicity, and nationality. A cross-sectional study by Martin et al. (2020) showed nature connectedness to be associated with higher pro-environmental behaviours. Richardson et al. (2020) showed connectedness to nature to be predictive of variance in pro-nature behaviours, while Hughes, Richardson, and Lumber (2018) reported an association between children's connectedness to nature and the probability of carrying out pro-nature behaviours.

Researchers have differentiated between state and trait nature connectedness, where the former reflects the fluctuating sense of being part of nature and the latter a more dispositional tendency; scores on state and trait measures appear to be correlated (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). There is evidence that exposure to natural settings increase positive affect and ability to reflect on a life problem via increases in state nature connectedness (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). State nature connectedness has also been found to increase following a mindful learning intervention (Wang et al., 2016).

As for demographic correlates, there is no consistent evidence for gender differences in connectedness to nature, but some research has indicated that emotional connectedness in particular is higher in women (Anderson & Krettenauer, 2021; Di Fabio & Rosen, 2019). Research has indicated that connectedness to nature might be higher in adults than adolescents, but that urban and rural dwellers do not differ in levels of connectedness to nature (Anderson & Krettenauer, 2021).

2.3.5 Values

Values are beliefs about what is important and refer to desirable broad goals or states of affairs; for example, ideals such as "social order" rather than the more specific targets, actions, or situations to which attitudes might refer (Schwartz, 2012). Values are context-independent, guide how we evaluate information and how we choose to behave, and have different levels of priorities

(Schwartz & Bilsky, 1990). Schwartz (1992) identified a set of culturally universal values, which are a basic set of abstract guiding principles relevant across a variety of situations. Values differ from goals in that goals might be short-term or situation-specific, whereas values are overarching and tend to be stable over time (Schwartz, 1997). The primary value types identified by Schwartz (1992) can be categorised as reflecting openness to change (self-direction; stimulation), self-transcendence (universalism; benevolence), conservation (traditional; security), and self-enhancement (achievement; power). Value types are in conflict: openness to change values entail welcoming novelty and uncertainty (e.g., being curious and having a varied life), which stands in contrast to conservation values which seek to uphold the *status quo* and are more opposed to change; self-transcendence values consider the welfare of beings other than oneself, in contrast to self-enhancement values that are focused on one's own needs and desires (Schwartz, 1992). Evans et al. (2013) framed information about car-sharing from a position of self-transcendence (the environmental benefits) and found it to lead to more recycling behaviour (*behavioural spillover*) than a control condition in which neutral information about car sharing was provided. When information about car sharing was framed as self-enhancement (the financial gains), there was no difference in recycling behaviour compared with controls. Kaltenborn and Bjerke (2002) reported that negative attitudes toward large carnivores were correlated with the values of "security" and "tradition" and positive attitudes were correlated with values relating to "openness to change" and "nature".

On the basis of Schwartz's (1992) values, Stern (2000) proposed three distinct value types relating to environmentalism: egoistic, altruistic, and biospheric. An egoistic value orientation is a tendency to consider the personal costs and benefits of behaviours and is associated with sustainable behaviour when perceived personal benefits outweigh costs. Someone with an altruistic value orientation will be more likely to perform sustainable behaviour when the benefits to other people outweigh the costs, whereas a person with a biospheric value orientation will decide to act sustainably based on perceived benefits and costs to the environment. De Groot and Steg (2008) noted that prior work had not supported altruistic and biospheric values as distinct constructs (Bardi & Schwartz, 2003) and argued that this was due to studies having relied on Schwartz's original items for measuring values, which only includes a small number of items that would denote a biospheric value orientation. De Groot and Steg (2008) developed a measure and found distinct factors corresponding to egoistic, altruistic, and biospheric values. These researchers also showed that altruistic and biospheric values have different effects on beliefs about the environment and behavioural intentions when biospheric and altruistic goals conflict (e.g., donating to environmental movements versus humanitarian movements). As previously mentioned, biospheric values are commonly expressed across multiple countries and continents (Bouman et al., 2018; Wang et al., 2021) and are a more consistent predictor of sustainable behaviour than other values (Katz-Gerro et al., 2017). Women have stronger biospheric values on average than men, and older people have

stronger biospheric values, although these differences are small (Sargisson, De Groot, & Steg, 2020).

Intrinsic value beliefs, as previously discussed, are a related concept, and have shown connections with sustainable behaviour. Wickizer (2016) assessed the United States public's endorsement of the statement "Wildlife have inherent value, above and beyond their utility to people" (p. 47), finding it to be predictive of support for species-friendly legislation, and that 69% of the United States public believed wildlife to have intrinsic value. Wickizer (2016) reported that older individuals showed lower intrinsic value beliefs than younger individuals, and that gender did not show any association with intrinsic value beliefs. Instrumental value is considered by some to be the conceptual opposite of intrinsic value (O'Neill, 2001). Instrumental value beliefs are a belief that species' value is linked to what they can do for humans; in the United States sample of Wickizer (2016), 63.6% of respondents disagreed with the view that "Wildlife are only valuable if people get to utilize them in some way" (p. 47). There is little research that considers the impact of instrumental value beliefs on sustainable behaviour.

2.3.6 The Value-Belief-Norm Model

The Value-Belief-Norm (VBN) model (Stern et al., 1999) is a framework that could help with understanding the influence of nature beliefs on sustainable behaviour; however, only one of the aforementioned nature beliefs (biospheric values) is includes within it. According to the VBN model, values facilitate the development of an *environmental worldview* in which human actions can adversely impact the environment and other species (typically measured using the *New Ecological Paradigm*; Dunlap, Van Liere, Mertig, & Jones, 2000). This worldview has been framed as a counterpart to the "dominant social paradigm" common in developed nations, characterised by a cultural preoccupation with individualism and economic growth, which are considered to be maladaptive values in an era of unprecedented anthropogenic environmental degradation (Dunlap & Van Liere, 1984). The VBN model purports an environmental worldview to lead to the development of three further beliefs, in sequence: *awareness of the consequences* of human activities for valued targets; *ascription of responsibility* to oneself for contributing to or alleviating those consequences; and a *personal (moral) norm* in which there is a sense of obligation to engage in sustainable behaviour. The personal norm is the precursor to sustainable behaviour (see Figure 2.1). The VBN model has been found to explain variance in actions that are intended to preserve nature and biodiversity (pro-nature behaviours) (Fornara, Pattitoni, Mura, & Strazzera, 2016) as well as more general pro-environmental behaviours such as recycling and using reusable shopping bags (Landon, Woosnam, & Boley, 2018).

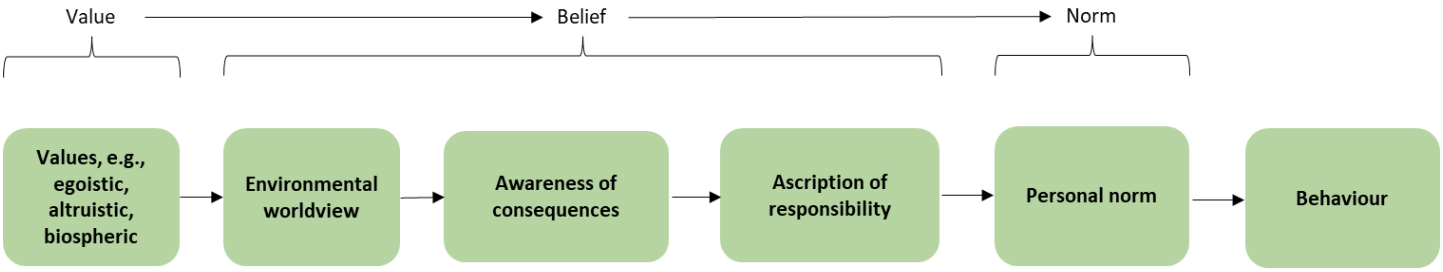


Figure 2.1: The Value-Belief-Norm model (adapted from Stern et al., 1999).

2.3.7 Summary

So far in this chapter I have introduced an array of nature beliefs, how they are conceptually related to each other as well as other concepts, and the state of the evidence about their association with sustainable behaviour. Anthropomorphism of nature often entails inferring mental characteristics, linking it conceptually to empathy (which relies on a belief that another has some experience of the world). Empathy can be experienced toward nature or toward humans, but there has not been research to examine whether these different kinds of empathy make independent contributions to sustainable behaviour. Empathy and connectedness are related in that they are both experienced in relationship contexts. Empathy and connectedness are also similar in both entailing and emotional experience; in this way, they are related to Serpell's (2004) concept of affect-based attitudes toward the natural world. Intrinsic value beliefs and biospheric values are conceptually related and refer to perceiving the value of (protecting) nature and the environment. Instrumental value beliefs are conceptually opposed to intrinsic value beliefs, at least by some definitions; they are related to Serpell's (2004) concept of utility-based attitudes toward the natural world.

Some nature beliefs have quite a well-established relationship with sustainable behaviour (connectedness to nature; empathy toward nature) and for others the evidence is next to non-existent, at least in quantitative research (intrinsic and instrumental value beliefs). Anthropomorphism has received mixed support for its role in sustainable behaviour. The research on nature beliefs is scattered and does not tend to examine these beliefs together to see how they might interact or differentiate in how they are associated with various kinds of sustainable behaviour. This is of note considering the conceptual overlap between many nature beliefs. Much of the research linking nature beliefs to sustainable behaviour has taken place outside the UK, and many of the measures of nature beliefs have not been validated for UK samples.

I have summarised the VBN model (Stern et al., 1999), which is one theoretical framework within which nature beliefs might be understood, but it is not known how an array of beliefs (e.g., connectedness to nature) might relate to the concepts within the VBN model. There is a lack of theory regarding mechanisms by which nature beliefs such as connectedness to nature might impact sustainable behaviour, including their interaction with other important psychological constructs such

as a sense of responsibility to act (Munson, Kotcher, Maibach, Rosenthal, & Leiserowitz, 2021). In the following section I will summarise the main types of sustainable behaviour and evidence for what predicts them.

2.4 Sustainable Behaviour

Sustainable behaviour can be categorised in a variety of ways. *Public-sphere behaviours* do not entail a direct environmental impact but influence policy and the behaviour of others; as such, they may lead to relatively high environmental impacts. Public-sphere behaviours can be activist behaviours, which are high-cost public actions (such as participation in protests) (Stern et al., 1999), or non-activist behaviours in the public-sphere, such as contributing to environmental organisations or expressing support for public policies (e.g., being willing to pay higher taxes for an environmental cause) (Stern, 2000). *Private-sphere behaviours* are the behaviours that have a direct environmental impact, although it will be a relatively small impact at the individual level (Stern, 2000). These can be resource conservation-related behaviours taking place in the household (such as reducing energy use and recycling) or consumer-related behaviours (e.g., buying environmentally friendly products/"green" consumerism) (Stern, 2000). Not all behaviours can be neatly categorised in this way; for example, organised clean-up events entail individuals having a direct impact on the environment (private-sphere) but doing so in a public way.

Another way of categorising behaviours is by their costliness. Public-sphere behaviours tend to be considered higher-cost than private-sphere behaviours in general (Whitmarsh, Capstick, & Nash, 2017). For example, publicly visible behaviours can entail organising events that may be considered costly in terms of time and effort (McAdam, 1986). The financial and social consequences of performing behaviours constitute another aspect of their cost (e.g., social disapproval) (McAdam, 1986; Steg & Vlek, 2009). There are some private-sphere behaviours that are nonetheless quite costly; for example, there are cultural and social barriers to overcome in reducing meat consumption (Macdiarmid, Douglas, & Campbell, 2016). Another complicating factor is that situational and personal factors could increase/decrease the costs of behaviour; for example, living car-free may be a lower-effort behaviour for those who live near work or live in an area with good public transport. People's personal circumstances, e.g., having a family, could also make public behaviours more costly (McAdam, 1986).

There is a dearth of literature showing the influence of personal and psychological predictors of high-cost and high-impact behaviours (Nielsen et al., 2021b); this will be considered in more detail in the following section. Researchers have also noted that pro-nature behaviours have been devoted far less attention than other kinds of behaviours (Richardson et al., 2020), and a consideration of these behaviours will then follow.

2.4.1 High-Cost and High-Impact Behaviours

Sustainable behaviour can be more or less costly in terms of the social ramifications of performing them, their financial implications for individuals, or the effort they require (Steg & Vlek, 2009). Whitmarsh et al. (2017) developed a measure of sustainable behaviour, finding that items could be divided into lower-cost and higher-cost components. *Low-cost behaviours* were those deemed to require little effort, such as making small adjustments to everyday behaviours taking place in or around the home (e.g., taking shorter showers, turning off lights when not in use; also known as private-sphere behaviours). *High-cost behaviours* required more effort and tended to occur in the public/political sphere (e.g., getting involved in conservation work to protect natural environments, setting up a recycling scheme at work, doing something together with neighbours, colleagues or friends to address an environmental problem). Martin et al. (2020) reported a high frequency of lower-cost behaviours (such as recycling) and a low frequency of higher-cost behaviours (such as volunteering) in their representative adult English sample.

Costliness of behaviour might explain the value-action-gap, which is the disparity between the things people say they believe in or value and what they do (Blake, 1999). This is a well-known phenomenon in environmental behaviour: a meta-analysis found quite weak correlations between environmental beliefs and sustainable behaviour (Bamberg & Möser, 2007). Blake (1999) argued that the value-action gap may be due to external constraints on individual behaviour such as structural and institutional factors. Hards (2012) summarised evidence for this interpretation, such as the constraints that work and family place on environmental movement participation (Tindall, Davies, & Mauboules, 2003), and that physical settings and social context are better predictors of sustainable behaviour than attitudes, knowledge, and beliefs (Hormuth, 1999; Olli, Grendstad, & Wollebaek, 2001). While there is a public mandate for governments to enact climate-friendly policies in the UK (Whitmarsh et al., 2021) and internationally (Steentjes, Demski, & Poortinga, 2021), support drops sharply when questions highlight the individual financial costs or behaviour change implied by policies (Whitmarsh et al., 2021).

Physical, social, and financial constraints on sustainable behaviour do not appear to be the sole reason for the value-action-gap: Kennedy, Beckley, McFarlane, and Nadeau (2009) found that 72% of Canadians reported a discrepancy between their intended and actual pro-environmental behaviour despite most participants reporting few situational barriers to behaviour. When there are external barriers in place, it is also likely that their influence will depend on psychological factors. Psychological factors are clearly important to consider even when behaviours are costly; social change usually begins with a small number of individuals willing to undertake behaviour that is effortful and goes against what is normal and supported by social structures at the time (Stern et al., 1999). Corraliza and Berenguer (2000) found that sustainable behaviour depended on an interaction

between situational as well as personal variables, such as attitudes. Steg, Bolderdijk, Keizer, and Perlaviciute (2014) postulated a framework in which situational factors provide cues that activate psychological motivators such as values. Martin et al. (2020) found that nature connectedness moderated the impact of watching nature programmes on more costly conservation behaviour (such as volunteering), whereas this interaction was less evident for less costly household behaviour (such as recycling). This paper is quite unique in its finding that psychological factors are associated with high-cost behaviours; when high-cost behaviours are studied, psychological factors tend not to be predictive of them (Lee, Kim, Kim, & Choi, 2014).

Recently it has been argued that a more important focus for psychologists should be the *impact* of a behaviour and that research in environmental psychology has tended to privilege low-impact behaviours (Nielsen et al., 2021b). As previously discussed, the more high-impact behaviours are arguably the public/political-sphere actions that contribute to large systemic changes; these could be considered higher-cost behaviours in terms of the effort or potential social costs they entail (e.g., attending a protest). Some private-sphere behaviours might also be high-impact such as deciding to have fewer children, living car-free, and changing to a plant-based diet; again, these could also be considered quite high-cost in terms of effort and the ramifications of going against social norms. Low-impact behaviours are usually also low-cost (such as recycling) (Cologna et al., 2022; Wynes & Nicholas, 2017), although Van Valkengoed (2021) noted that there are some exceptions, such as voting for green parties, which could change the political system but would not necessarily entail much effort.

2.4.2 Pro-Nature Behaviours

Richardson et al. (2020) noted that most environmental psychology research has focused on behaviours affecting one's carbon footprint and the environment more generally (pro-environmental behaviours) such as recycling and reducing waste (Li, Zhao, Ma, Shao, & Zhang, 2019) as opposed to those specifically focused on the preservation of diverse species (pro-nature behaviours), such as undertaking voluntary species conservation work or installing a bee hotel (Barbett et al., 2019). Barbett, Stupple, Sweet, Schofield, and Richardson (2020) remarked that many researchers have made a distinction between general pro-environmental behaviours and species-preserving pro-nature behaviours. For example, Hughes, Richardson, and Lumber (2018) distinguished between general pro-environmental behaviours concerned with reducing energy expenditure and use of resources (e.g., saving water and recycling) and pro-nature behaviours such as feeding garden birds and joining a nature group. Martin et al. (2020) reported a factor analysis in which items on a pro-environmental behaviours questionnaire loaded onto two behavioural factors, one of which related more directly to nature conservation (e.g., donating money to an environmental/conservation organisation) whereas the other was more concerned with household pro-environmental behaviours

(e.g., recycling). The two factors showed some similar patterns of associations with some variables, i.e., both were associated with watching/listening to nature documentaries and neither was related to living in a greener neighbourhood. For some other variables, there were differential associations; for example, nature visits moderated the association between nature connectedness and nature conservation behaviours, but nature visits did not moderate the association between nature connectedness and household behaviours. Richardson et al. (2020) argued for the importance of understanding the determinants of pro-nature behaviours, in addition to pro-environmental behaviours more generally.

Much of the research on pro-nature behaviours has taken a quantitative and hypothetico-deductive approach, measuring constructs with questionnaires and testing their theorised associations with sustainable behaviour. Qualitative methodologies can be helpful when a more exploratory approach is needed, when the research question is less narrowly specified, and for relatively novel areas of research (Charmaz, 2004). A limited number of studies in this area have adopted a qualitative approach. For example, one qualitative study examined the acceptance of conservation of dry meadows and mire landscapes in Switzerland among individuals who were directly impacted by such measures (such as farmers and landowners) (Schenk, Hunziker, & Kienast, 2007). Measures that were perceived to be beneficial to humans were more likely to be accepted, as were those with a clear economic purpose. A systematic review of qualitative studies on farmers in the United States (Ranjan, Church, Floress, & Prokopy, 2019) identified recurring themes to explain motivation to adopt conservation practices. Farmer characteristics was one theme, where having an identity as a steward or an innovator was associated with stronger nature conservation. The study also identified commonly cited barriers to conservation behaviour, such as perceived social norms and economic factors. However, few qualitative studies have explored the everyday pro-nature behaviours that individuals undertake outside of their professional lives. One such study is that of Caissie and Halpenny (2003), who interviewed volunteers at a Canadian nature conservation programme, identifying both altruistic as well as more egoistic motives for participating, such as pleasure-seeking.

2.5 Research Questions: Addressing Gaps in the Literature

In this chapter I have summarised an array of nature beliefs and some of the evidence regarding their associations with sustainable behaviour. The belief that aspects of nature and non-human species have “humanlike” attributes (anthropomorphism) has received mixed support for its role in sustainable behaviour. For other beliefs, such as intrinsic value beliefs, there is a lack of research altogether, whereas beliefs like nature connectedness have received consistent support for their role in sustainable behaviour. There is little examination of how nature beliefs predict different kinds of behaviour, particularly high-impact, public-spere behaviours and pro-nature

behaviours. The research on nature beliefs is also disjointed and does not consider how beliefs might overlap or interact in predicting behaviour. Indeed, there is conceptual overlap between many nature beliefs, such as the fact that connectedness and empathy are both normally experienced in interpersonal relationships (Tam, 2019). Anthropomorphism also overlaps conceptually with connectedness and empathy toward nature: each belief entails a degree of overlap between one's self-concept and other species. Another potential area of overlap is between empathy for humans and empathy toward nature, and further work is needed to clarify whether these different kinds of empathy make independent contributions to sustainable behaviour. More generally, there is a lack of theory to understand mechanisms by which nature beliefs such as connectedness to nature might impact on sustainable behaviour, including their interaction with other important psychological constructs, such as a sense of responsibility to act (Munson et al., 2021). Finally, much of the research linking nature beliefs to sustainable behaviour has taken place outside the UK, and many of the measures of nature beliefs have not been validated for UK samples.

As mentioned in *Chapter 1*, the aims of this thesis are to understand the prevalence and contribution of nature beliefs to an array of sustainable behaviour in the UK, and to develop a theoretical understanding of how nature beliefs are associated with sustainable behaviour. These aims will be addressed by answering the following six questions:

1. What can we conclude from the highest quality international research about the association between anthropomorphism and sustainable behaviour?
    - *Chapter 4* presents results from a systematic review to address this question.
2. What other nature beliefs, besides anthropomorphism, are associated with sustainable behaviour?
    - *Chapter 4* identifies additional nature beliefs that are empirically associated with sustainable behaviour (mainly pro-environmental behaviours).
    - *Chapter 5* presents a qualitative exploration of nature beliefs that appear to influence pro-nature behaviours.
3. Are measures of nature beliefs and sustainable behaviour valid and reliable in UK samples?
    - *Chapters 6 and 7* examine the factor structure and reliability of nature beliefs and pro-environmental/pro-nature behaviour measures in UK samples.
4. What is the prevalence of nature beliefs and different kinds of sustainable behaviour in the UK public?

- *Chapters 6 and 7* present prevalence rates from UK surveys.

5. What is the unique contribution of each nature belief to a range of sustainable behaviour in the UK?

   - *Chapter 6* examines some of the nature beliefs in the preceding chapters for their association with resource conservation, consumption, and high-cost pro-environmental behaviours.

   - *Chapter 7* undertakes hypothesis-driven tests of the association of all nature beliefs identified in previous chapters with resource-conservation, consumption, and high-cost pro-environmental behaviours, as well as four pro-nature behaviours: doing-for-wildlife, avoiding-for-wildlife, personal, and high-cost.

6. What theoretical frameworks best account for the impact of nature beliefs on sustainable behaviour in the UK?

   - *Chapter 5* identifies a theory of pro-nature behaviours grounded in qualitative data, noting its similarity to the Value-Belief-Norm (VBN) model (Stern et al., 1999).

   - Following the findings in *Chapter 6* that connectedness to nature and empathy toward nature are the sole predictors of high-cost behaviour, *Chapter 7* tests whether an extended VBN model can explain this association.

   - *Chapter 7* also tests whether eco-guilt and eco-anger explain the association between connectedness to nature/empathy toward nature and high-cost behaviour, as would be predicted by Smith's (1993) extension of Turner et al.'s (1987) Self-Categorisation Theory (see *Section 7.2.2.1*).

   - In the general discussion of *Chapter 8*, the results across all studies are considered through the framework of Turner et al.'s (1987) Self-Categorisation Theory, and its implications for messaging, developing pro-nature dispositions, and future research, are discussed.

Chapter 3 Methodological Overview

3.1 Chapter Overview

This chapter provides a methodological overview for the thesis. Critical realism is described as the ontology and epistemology underpinning the studies and it is argued to be consistent with the mixed-method approach undertaken in the thesis. The thesis is described as a quantitative-dominant approach, and a brief overview is given of the quantitative methodologies in each chapter, and the qualitative methodology (grounded theory) that informs early theoretical development.

3.2 Ontology and Epistemology

Critical realism is a meta-theory of reality (ontology) and how we can acquire knowledge about reality (epistemology) and emerged in response to the dominant philosophies of positivism and social constructionism (Bhaskar, 2014). Critical realism conceives of a reality stratified into three domains: the *real*, the *actual*, and the *empirical* (Bhaskar, 1997). Whereas the empirical is a subset of perceptible (actual) events that we can measure, these events emerge from the underlying mechanisms and structures that comprise the real. Nature beliefs might be considered a psychological mechanism (real domain) leading to particular cognitive, emotional and behavioural responses (actual domain) to specific situations, only some of which we might be able to measure systematically, such as responses to items on questionnaires (empirical domain).

Social phenomena are more complex and ambiguous than natural phenomena and, in critical realism, the outcome of underlying mechanisms is highly dependent on context (Danermark, 2002). Social phenomena are highly related to other characteristics and situational factors of research participants such as gender and age, and the mechanisms are transient and ever-changing. Critical realists subscribe to ontological realism, in which there is a reality that exists independently of human subjectivity, and epistemological relativism, which is the acknowledgement that our understanding will often diverge from reality: the empirical domain is fallible and subject to bias (Bhaskar, 2013). This does not imply judgmental relativism, in which there is equivalent validity to all beliefs and no basis for preferring one over another, but rather judgmental rationality in which it is deemed possible to evaluate one position as being better or worse than another (Bhaskar, 2014). Bhaskar came to consider ontological realism, epistemological relativism, and judgmental rationality to be the “holy trinity” of critical realism (2010, p. 1).

The critical realist paradigm underlies the empirical approach in this thesis. The grounded theory study (*Chapter 5*) follows the approach of Strauss and Corbin (1990), which developed within

the post-positivist tradition (Mills, Bonner, & Francis, 2006). It does not expect the possibility of being free of bias and to arrive at a truth uncoloured by preconceived notions and theories as is the claim of positivism (Olsen, 2007), nor does it equate reality with people's perceptions and constructed meanings of the world, in contrast to social constructionism (Collier, 1994). My grounded theory is founded on the premise that there are real mechanisms that exist independently of social constructs but acknowledges that we can only ever have a narrow window on reality, which we perceive through a filter of interpretation and preconceived notions (Fletcher, 2017). It has been argued that modern grounded theory is well-suited to a critical realist underpinning: Hoddy (2019) explained that, while the grounded theory approach was once seen as theory "emerging" from data in a purely inductive fashion, more modern conceptualisations accept the inevitable influence of theory on interpretation. By using the systematic review as a conceptual starting point, the grounded theory study is in line with the guidance of Strauss and Corbin (1990), which allows for engaging with the literature at all stages of grounded theory. I found it helpful to remember Strauss and Corbin's (1998) quote of Dey (1993): "There is a difference between an open mind and an empty head" (p. 47).

The quantitative approaches in *Chapters 6* and *7* are also underpinned by the critical realist perspective. Concepts are measured with questionnaires, which represent the empirical domain, and are assumed to emerge from true underlying psychosocial phenomena that have causal influences on sustainable behaviour. In the final study, a structural equation modelling approach differentiates latent variables from manifest variables, the latter representing empirical observations and the former reflecting unseen structures and processes that are assumed to explain and give rise to participants' responses on the measures. Structural equation modelling can control for measurement error, and in doing so acknowledges the limitations and fallibility of empiricism to perceive latent constructs directly and without bias. The aim of this method is to maximise the precision of estimates of the real structures and mechanisms underlying observed data.

As critical realism represents a stance that integrates aspects of positivism and social constructionism, it can be a basis for mixed-methods research that uses both qualitative and quantitative approaches to a research question (Olsen, 2007). McEvoy and Richards (2006) argued that critical realism is compatible with a view of quantitative and qualitative methodologies as not ontologically incommensurable but rather different approaches that should be chosen according to the circumstances and research question at hand (Bryman, 2017). Mixed-methods, according to McEvoy and Richards (2006), can be used to triangulate research findings in a variety of ways. This thesis takes a mixed-methods approach in order to arrive at a more complete picture of its subject matter by including different kinds of nature belief and sustainable behaviour and by considering different perspectives on the topic. The next section considers in more detail how mixed-methods were used to address the research questions of the thesis.

3.3 Mixed Methods

As mentioned in *Chapter 2*, the limited research investigating everyday pro-nature behaviours has taken a largely hypothetico-deductive, quantitative approach, despite the relative newness of this area of enquiry. Qualitative methodologies are appropriate when exploration is required in an understudied field (Charmaz, 2004). The newness of a research area calls for an understanding of relevant concepts and theories with an exploratory approach comprising a qualitative component, followed by quantitative methods to test and generalise the theory (Creswell & Clark, 2017). As such, this thesis takes a mixed method approach to take advantage of the strengths of qualitative and quantitative methodologies.

This thesis most closely resembles the exploratory sequential design of Creswell and Clark (2017), comprising four stages: 1. designing and implementing a qualitative strand; 2. using strategies to build on the qualitative findings; 3. designing and implementing the quantitative strand; 4. interpreting the connected results. *Chapters 4* and *5* of the thesis present the first two studies, comprising Stage 1: on the basis of the systematic review (*Chapter 4*), a qualitative study was conducted to build theory about pro-nature behaviours and any nature beliefs that might be associated with them (*Chapter 5*). Stage 2 comprises the study presented in *Chapter 6*, which involved testing important concepts derived from Stage 1 and their validity in an approximately representative UK sample. Stage 3 corresponds to *Chapter 7*, generalising the findings of *Chapter 6* by using a statistical approach in another UK sample. *Chapter 8* is a general discussion that synthesises findings and theory development across all four studies (Stage 4).

This thesis follows what Johnson, Onwuegbuzie, and Turner (2007) described as a "quantitative dominant" mixed methodology, as I feel most at home in the quantitative paradigm but consider qualitative approaches to be essential, particularly for exploratory purposes and theory-building. The first two studies in my thesis explore sustainable behaviour with a systematic review (*Chapter 4*) and a qualitative grounded theory study (*Chapter 5*), with the aim of identifying a broad range of psychological constructs associated with sustainable behaviour. The grounded theory study is an attempt to develop theory to explain pro-nature behaviour. The first quantitative study (*Chapter 6*) undertakes exploratory analyses of an array of nature beliefs identified in the prior chapters and how they are associated with pro-environmental behaviours. The second quantitative study (*Chapter 7*) undertakes confirmatory, hypothesis-driven analyses of all nature beliefs identified in the previous studies and their association with both pro-environmental and pro-nature behaviours. *Chapter 7* tests whether an extended Value-Belief-Norm model (Stern et al., 1999) can explain why connectedness to nature and empathy toward nature explain high-cost sustainable behaviour, and also tests whether eco-emotions can explain this link (as implied by Smith's [2009] adaptation of Turner &

Reynolds's [1987] Self-Categorisation Theory). The quantitative studies (*Chapters 6* and *7*) narrow in on a UK sample, whereas the first two studies are broader and include international samples.

3.4 Timeline of Studies

Chapters 4 – 7 describe the studies that were undertaken as part of this thesis. The first data to be collected was the quantitative dataset for the study described in *Chapter 6* (07.12.2019); these data were not analysed until after the completion of the grounded theory study (*Chapter 5*) and the systematic review (*Chapter 4*). The grounded theory study began as face-to-face interviews (the first interview took place on 13.02.2020), which moved to online interviews when covid-19 restrictions came into effect in the UK (the final interview took place on 10.12.2020). Searches for the systematic review were undertaken on 28.10.2020, during the latter stage of interviewing for the grounded theory study, and the two studies were written up alongside one another. Findings from the grounded theory and systematic review informed analyses of the first quantitative dataset (*Chapter 6*). Data collection for the second quantitative study (*Chapter 7*) took place between 01.10.2021 and 09.12.2021 and was informed by the findings and the gaps identified in the first quantitative study. Figure 3.1 shows a timeline of the studies.

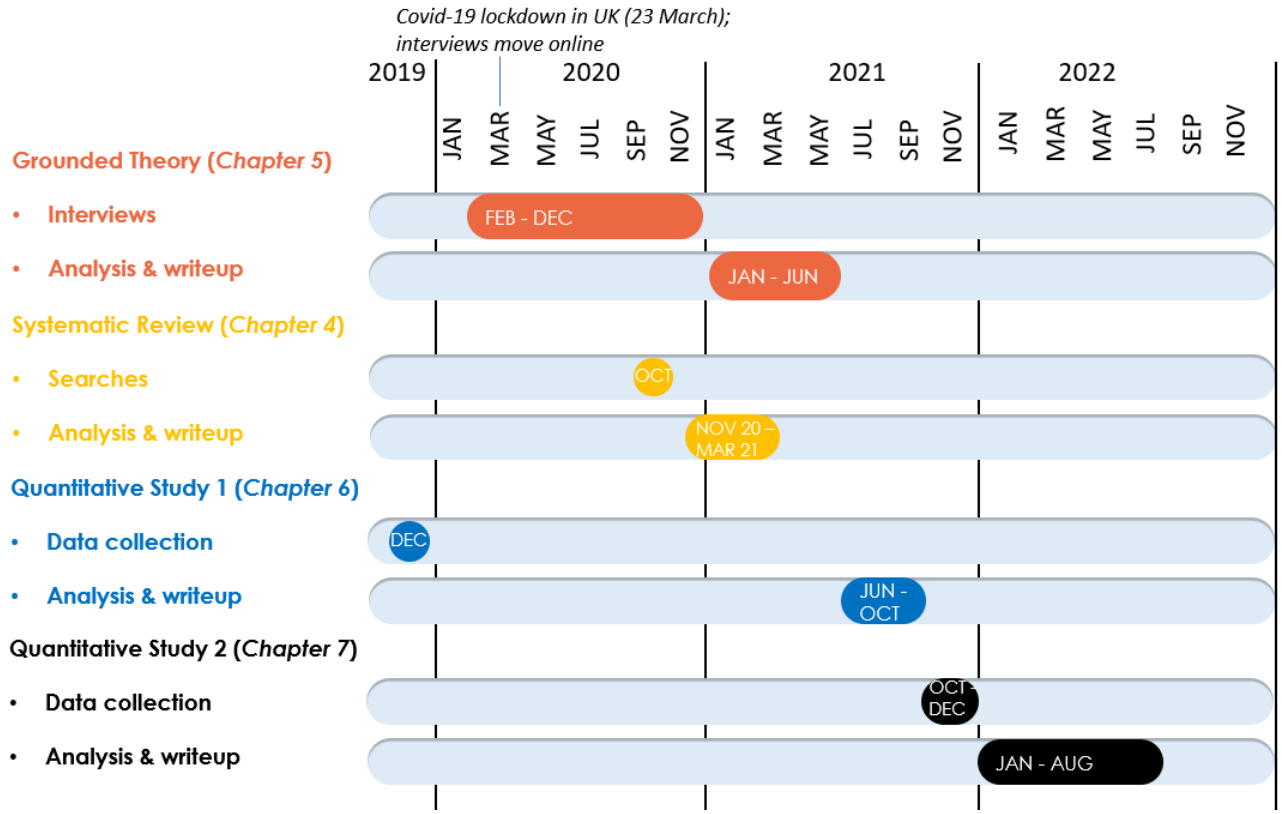


Figure 3.1: A timeline of the studies undertaken as part of the thesis.

Chapter 4 Systematic Review: Anthropomorphism and Sustainable Behaviour

[This chapter is linked to a published paper: Williams, M. O., Whitmarsh, L., & Chríost, D. M. G. (2021). The association between anthropomorphism of nature and pro-environmental variables: A systematic review. Biological Conservation, 255, 109022.]

4.1 Chapter Overview

This chapter is a systematic review of the evidence that anthropomorphism is associated with sustainable behaviour. I first summarise the background literature on anthropomorphism and sustainability and argue that this area needs close examination in order to justify the use of anthropomorphism in public messaging. I note that study weaknesses and empirical inconsistencies preclude firm conclusions about anthropomorphism's positive association with sustainability and argue that there is need for a review in this area. After identifying eligible studies following PRISMA guidelines and removing those of poor quality, I synthesise the correlational and experimental evidence that anthropomorphism is positively associated with an array of sustainable outcomes, including the role of mediators (connectedness to nature, empathy toward nature, and guilt).

4.2 Introduction

Campaigns commonly present nature in a way that highlights or fabricates its similarity to humans, with the aim of influencing pro-environmental attitudes and behaviours. An emotive advert for the supermarket chain Iceland in the UK portrayed a talking cartoon Orangutan to warn against the environmental impact of palm oil cultivation and was banned for being too political (Butler & Sweney, 2018). In 2006, Al Gore addressed the United States public on "Good Morning America", describing climate change in terms of the Earth having a fever (ABC News, 2006). Such messages are conveyed without firm empirical grounding for their effectiveness, as research on portraying nature as similar to humans, and whether it can lead to sustainable behaviour, is still in its infancy.

Anthropomorphism is attributing humanlike characteristics to non-human agents (Epley et al., 2007). Anthropomorphism is an under-studied area in environmental research in two respects. First, there is little understanding of whether a dispositional tendency to anthropomorphise is associated with sustainable behaviour and related psychological variables. Second, little is known about whether anthropomorphism can be experimentally manipulated to determine its effects on sustainable behaviour. Some research has found that a tendency to anthropomorphise nature is correlated with more positive attitudes toward animals (Apostol et al., 2013) and that inducing an

anthropomorphic perception of nature increases pro-environmental attitudes (Wang, Ming, & Zhang, 2020). On the other hand, Tam (2015a) found that inducing anthropomorphism positively impacted pro-environmental outcomes only for those with a high need for social connection, and had the opposite effect for those with low need.

There are theoretical reasons why anthropomorphism may, in different contexts, help or hinder sustainability. While Chan (2012) theorises that anthropomorphism of species should lead to greater desire to save their lives via an increase in empathy, this author also cautions against the indiscriminate use of anthropomorphism, which could, for instance, lead to inadvertent support for the killing of a predator to that species. Root-Bernstein et al. (2013) provided empirical evidence that anthropomorphism can have adverse consequences for environmental attitudes, citing a study by Knight (2005) in which Japanese zoo visitors who perceive monkeys' feeding interactions to be akin to human gift-giving behaviour come to be disappointed in behaviour that violates human norms, such as stealing and fighting between the monkeys.

It could be that different sorts of perceived similarity are particularly important when considering sustainable behaviour. Root-Bernstein et al. (2013) summarised different kinds of similarity that humans might perceive with other species, including physical similarity (e.g., forward-facing eyes have been found to determine people's preferences for which species to conserve in an international sample) (Macdonald et al., 2015) and cultural similarity (e.g., depicting animals as wearing clothes) (Allen et al., 1994). Species can be perceived as behaving similarly to humans (e.g., animals seeming to behave deceptively toward other animals) (Hamm & Mitchell, 1997). Mind attribution, which entails ascribing psychological and mental capacities such as emotions, thoughts, and consciousness to non-human entities, has been given special focus in the literature (Higgs, Bipin, & Cassaday, 2020). Mind attribution might be considered in contrast to perceiving only superficial similarities between humans and nature/species, such as physical attributes or observable behaviours, although it has been argued that such observable characteristics might be used by humans to infer psychological characteristics that other species might share with humans (Hamm & Mitchell, 1997). Finally, anthropomorphism has been conceptualised as existing on a continuum from the weaker form of seeing metaphorical similarities between humans and non-human agents and the stronger form of believing that non-human agents have some human characteristics (Epley et al., 2007).

Settling the question of anthropomorphism and the contexts in which it might be a useful tool for pro-environmental campaigns is impeded by study quality. Correlational studies that measure the associations between anthropomorphism and other variables often do not control for the influence of related variables that might explain the association, such as age and gender, despite their

association with both dispositional anthropomorphism and sustainable outcomes (Knight, Cherryman, & Nunkoosing, 2004). There are few studies that have manipulated anthropomorphism to investigate its influence on sustainable outcomes, and that have tested the success of the manipulation. At this juncture it would be sensible to summarise the findings from the highest quality studies on this topic, which could allow for a more scientifically-informed use of anthropomorphism in sustainability campaigns.

The present study is a narrative systematic review which aims to summarise the highest-quality evidence with regard to anthropomorphism and its association with sustainable behaviour and related variables. The review addresses two principal questions: (i) is there reliable evidence for a positive association between anthropomorphism of nature and sustainable behaviour/related psychological variables, and (ii) is there reliable causal evidence from experiments that anthropomorphism of nature leads to sustainable behaviour and related outcomes? Results from studies will be synthesised to address three subsidiary questions: (i) have researchers specified subtypes of anthropomorphism when investigating associations with sustainability-related variables?; (ii) What mediates the association between anthropomorphism and these variables?; (iii) What factors moderate the association between anthropomorphism and these variables? Conclusions drawn from included studies will be weighted by study quality.

4.3 Method

4.3.1 Searches

Searches were conducted on 28.10.2020 through Web of Science, PubMed, Scopus, PsycINFO, and ERIC (see Table 4.1 for the search terms). Scoping searches provided a survey of the field and different kinds of anthropomorphism that were studied in the literature (and the different terminology), which led to the inclusion of “mind attribution” and “animal mind” as terms to reflect particular forms of anthropomorphism.

The theory of planned behaviour (Ajzen, 1991) is a helpful framework for selecting sustainability-related variables of interest, as it has been shown to be valid in explaining the occurrence of pro-nature and pro-environmental behaviours (De Leeuw et al., 2015). Therefore, in addition to searching for behaviours, search terms included outcome variables of interest drawn from the theory of planned behaviour: beliefs (behavioural, normative, control), attitudes (toward the behaviour, species, and the environment), subjective norms, actual and perceived behavioural control (and the related concept of self-efficacy; Bandura, 1977), and intention to perform the behaviour.

Table 4.1: Search Terms.

Anthropomorphism search terms		Nature and species-related search terms		Outcome variables of interest search terms
anthropomorph* OR "mind attribution" OR "animal mind"	AND	species OR wildlife OR animal* OR nature	AND	belief* OR attitud* OR norm* OR control OR intention* OR efficacy OR behav*

Note. Asterisks represent searches for any word that includes the root of the word; for example, belief* would return records including the word "belief" and "beliefs".

4.3.2 Inclusion Criteria and Study Selection

Studies were included if:

1. They reported quantitative analysis of the association between a measure of anthropomorphism/mind attribution to nature and an outcome relating to sustainable behaviour (belief, attitude, norm, intention, efficacy, behaviour) or attitudes toward species/nature.

   OR

2. They reported quantitative analysis of the effect of experimental manipulation of anthropomorphism/mind attribution to nature on one of these outcomes.

   AND

3. They were written in English.

Unpublished ("grey") literature was not an exclusion criterion.

I followed the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009) guidelines for study inclusion. After removing duplicates from the records obtained from all databases, I screened the titles and abstracts of all records for eligibility. Many records were excluded at this point due to their irrelevance to the subject area (such as papers concerning anthropomorphism of inanimate objects or in the field of robotics, or papers in the humanities exploring the concept of anthropomorphism). The remaining records were screened by reading the full text for eligibility (see *Appendix A* for records removed at this stage). Study quality was then assessed, which is described in the following section.

4.3.3 Quality Appraisal Method

Quality appraisal was conducted for each paper to determine internal validity (i.e., the results were a true representation of the relationship between variables under study) and sources of bias that might misrepresent the population under study. For correlational designs, quality could only be assessed with regard to their ability to answer a non-causal hypothesis, i.e., that there is statistical

evidence of an association between the variables. For experimental designs, quality could be assessed in relation to whether the study results could be relied upon to draw causal conclusions.

There are few quality assessment tools designed specifically for environmental psychology, and in particular correlational designs. A tool from the National Heart, Lung, and Blood Institute (NHLBI, 2013) for assessing cross-sectional designs was adapted for the purposes of quality appraising papers with correlational designs in the present review. Table 4.2 shows the items included to assess the correlational papers and the reasons for their inclusion (see *Appendix B* for excluded items).

Table 4.2: Quality Criteria for Appraisal of Correlational Studies.

Items for correlational papers	Reasons for inclusion
1. Was the research question or objective in this paper clearly stated?	This implies an *a priori* hypothesis and increases the likelihood that presented analyses were hypothesis-driven.
2. Was the study population clearly specified and defined?	This allows for generalisability to be assessed.
3. Was there a sample size justification based on a power analysis, or was an effect size reported for the analyses of interest?	This allows the authors to determine how meaningful the results are, beyond statistical significance.
4. Were the measures of interest clearly defined, valid, reliable, and implemented consistently across all study participants?[a]	Unestablished psychometric properties and inconsistent use of measures would detract from the study's internal validity.
5. Did relevant correlations control for any other variable(s)? (Item that I added to the measure.)	This item was added as it was deemed an important aspect of testing the validity of a correlation.

[a]Item 4 was derived by collapsing two items and modifying their wording: "Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?"; "Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?"

Experimental studies were quality-checked against the same first four items as the correlational studies, whereas the fifth item (relating to whether correlations controlled for any other variable[s]) was not deemed as relevant to experimental studies, as they can control for extraneous variables through randomisation and testing for equivalence of baseline group characteristics. Four additional quality appraisal items were applied to experimental studies, three of which were derived from a tool for the quality assessment of controlled intervention studies (NHLBI, 2013) (see *Appendix C* for excluded items). I generated the fourth item, which related to manipulation checks. Table 4.3 shows the four additional items for rating study quality, and the reasons for their inclusion.

Table 4.3: Quality Criteria for Appraisal of Experimental Studies.

Items for experimental papers	Reasons for inclusion
1. Were participants randomised to groups? (Original wording: “Was the study described as randomized, a randomized trial, a randomized clinical trial, or an RCT?”)	Randomisation limits the risk of group differences post-manipulation being attributable to important differences in non-manipulated variables that existed at baseline.
2. Was the method of randomisation adequate (i.e., use of randomly generated assignment)?	It is important to use an appropriate method of randomisation (e.g., random number generation).
3. Were the groups similar at baseline on important characteristics that could affect outcomes (e.g., demographics, risk factors, co-morbid conditions)?	Similarity of baseline characteristics allows for more confidence that any observed effect can be attributed to the experimental manipulation.
4. Did a manipulation check show that the manipulation had the intended effect? (Item that I added to the measure.)	This quality criterion was added as manipulation checks help determine whether any effects were due to the manipulation affecting the variable of interest.

I assessed each of the included studies against the above criteria, with three possible response options to indicate whether the criterion was fulfilled: yes, could not determine, or no. A response option of “partial” was added for item 4 only (good quality measures and consistent implementation) as it was found that studies frequently included a mixture of validated and non-validated measures and including a “partial” response allowed for more nuance in the reporting of study quality on this criterion.

For calculation of inter-rater reliability of scores, responses were transformed into three categories (yes = 1; partial = 0.5; no/could not determine = 0). A member of the supervisory team (LW) independently assessed the quality of all studies. A Kappa value of .78 was calculated, which is in the “substantial” agreement range (i.e., between .61 and 0.80) (Landis & Koch, 1977). Reviewers reached agreement through negotiation with regard to items where their ratings conflicted. I generated an overall rating of study quality by summing the scores on each criterion for each study. For correlational studies, the score boundaries of categories was: poor = below 3; fair = between 3 and 4.49; good = 4.5 and above. For experimental studies, the score boundaries of categories was: poor = below 5; fair = between 5 and 5.99; good = 6 and above.

Quality category score boundaries for correlational and experimental studies were chosen first by deciding on the quality cut-off where studies’ results were deemed unreliable (“Poor”), and then the score boundaries for the “Fair” and “Good” categories were chosen to provide maximal diversity in quality categories whilst maintaining sufficient quality standards.

4.3.4 Study Quality Assessment and Study Exclusion

Tables 4.4 and 4.5 show the results of the quality appraisal for correlational and experimental studies, respectively. It should be noted that this is not an overall judgement of study quality, but an estimation of the strength of the study's results as evidence relating to the present review's questions.

Table 4.4: Quality Appraisal for Correlational Studies.

Authors	1. Question clearly stated	2. Population clearly specified	3. Power analysis/ effect size	4. Good quality measures and consistent implementation	5. Correlations controlled for other variable(s)	Overall quality rating
Apostol et al. (2013)	Yes	Yes	Yes	Partial	Yes	Good
Díaz (2016)	No	Yes	Yes	Yes	Yes	Fair
Hawkins et al. (2020)	Yes	Yes	Yes	Partial	No	Fair
Higgs et al. (2020)	No	No	Yes	Yes	Yes	Fair
Knight et al. (2004)	Yes	Yes	Yes	Partial	No	Fair
Maguire et al. (2020)	Yes	Yes	Yes	Partial	Yes	Good
Manfredo et al. (2020)	Yes	Yes	Yes	Yes	Yes	Good
Riepe and Arlinghaus (2014)	Yes	Yes	Yes	Partial	Yes	Good
Tam (2013, Study 5)	Yes	Yes	Yes	Yes	Yes	Good
Tam et al. (2013, Study 1)	Yes	Yes	Yes	Partial	No	Fair
Tam (2014)						
Study 1	Yes	Yes	Yes	Partial	Yes	Good
Study 2	Yes	Yes	Yes	Partial	Yes	Good
Tam (2015b)						
Study 1	Yes	Yes	Yes	Partial	Yes	Good
Study 2	Yes	Yes	Yes	Partial	Yes	Good
Study 3	Yes	Yes	Yes	Partial	Yes	Good
Tam (2019)						
Study 1	Yes	Yes	Yes	Partial	Yes	Good
Study 2	Yes	Yes	Yes	Yes	Yes	Good
Study 3	Yes	Yes	Yes	Partial	Yes	Good

Table 4.5: Quality Appraisal for Experimental Studies.

Authors	1. Question clearly stated	2. Population clearly specified	3. Power analysis/effect size	4. Good quality measures and consistent implementation	5. Randomisation	6. Adequate randomisation	7. Baseline equivalence of confounding variables	8. Checks confirming effectiveness of manipulation	Overall quality rating
Brown and McLean (2015, Study 2)	Yes	No	Yes	Partial	Yes	CND	No	No	Poor
Butterfield et al. (2012)									
Study 1	Yes	No	Yes	Partial	Yes	CND	No	No	Poor
Study 2	Yes	No	Yes	Partial	Yes	CND	No	No	Poor
Laksmidewi and Soelasih (2019, Study 2)	Yes	No	No	Partial	Yes	CND	No	Yes	Poor
Tam et al. (2013, Study 3)	Yes	Yes	Yes	Yes	Yes	CND	No	Yes	Good
Tam (2014, Study 3)	Yes	Yes	No	Partial	Yes	CND	No	No	Poor
Tam (2015a)									
Study 1	Yes	Yes	Yes	Partial	Yes	CND	No	No	Fair
Study 2	Yes	Yes	Yes	Partial	Yes	CND	No	No	Fair
Wang and Basso (2019)									
Study 2	Yes	Yes	Yes	Partial	Yes	CND	No	Yes	Fair
Study 3a	Yes	Yes	Yes	Partial	Yes	CND	No	Yes	Fair
Study 3b	Yes	Yes	Yes	Partial	Yes	CND	No	Yes	Fair
Study 3c	Yes	Yes	Yes	Partial	Yes	CND	No	Yes	Fair
Wang et al. (2020)									
Study 1	Yes	No	No	Partial	No	CND	No	No	Poor
Study 2	Yes	No	No	Partial	No	CND	No	No	Poor
Study 3	Yes	No	No	Partial	Yes	CND	No	Yes	Poor

Note. CND = could not determine.

Due to the above ratings, eight experimental studies (rated “Poor”) were excluded from further consideration in this review: Brown and McLean (2015, Study 2), Butterfield et al. (2012, Studies 1 & 2), Laksmidewi and Soelasih (2019, Study 2), Tam (2014, Study 3), and Wang et al. (2020, Studies 1 - 3).

4.3.5 PRISMA Flowchart

Figure 4.1 shows the PRISMA flowchart (Moher et al., 2009) of the total papers obtained from searches and their exclusion at each stage (including their exclusion after quality appraisal). The total number of studies retained was 25 (18 correlational studies; 7 experimental studies).

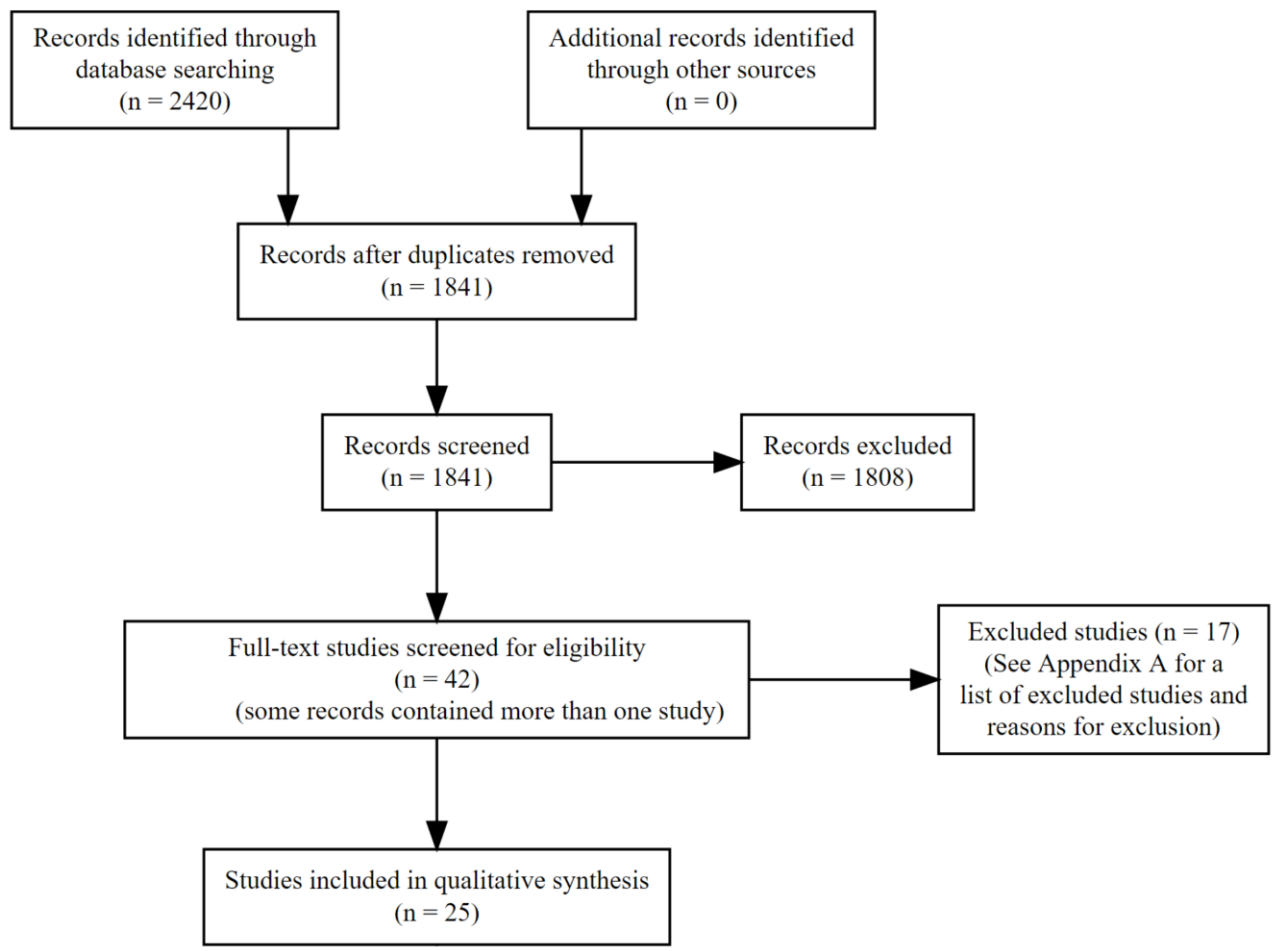


Figure 4.1: PRISMA flowchart

4.4 Results

The following sections summarise the quality of included studies, report key findings from included studies, and then summarise and synthesise findings across studies in narrative format. As researchers reported a heterogeneous set of anthropomorphism measures and studies differed greatly in reported outcomes and methods for manipulating anthropomorphism, a meta-analysis was not deemed a suitable method for synthesising the evidence.

4.4.1 Quality Ratings of Included Studies

The quality ratings for the 25 included studies were “Good” (12 correlational; one experimental) and “Fair” (six correlational; six experimental). All of the correlational studies provided some measure of effect size, all but one specified their population clearly, and all but two were deemed to have stated a clear question. Thirteen correlational studies were deemed to have partially fulfilled the criterion of using good quality measures for relevant variables (in all cases this was due to at least one measure not having its psychometric properties [reliability/validity] described). Five studies were deemed to have exclusively reported good quality measures. Fifteen studies were deemed to have controlled for variables other than anthropomorphism in their analyses (through correlational/regression/mediation analysis).

Of the experimental studies, all were deemed to have stated a clear hypothesis, specified their population clearly, provided a power analysis/reported effect sizes, and reported randomisation of participants into the experimental/control groups. No studies reported how participants were randomised, and therefore it was not known whether randomisation was adequate. No studies reported on the baseline characteristics of the experimental/control groups, and therefore it was not known whether randomisation had achieved the desired effect. Six studies were deemed only to have partially reported good quality measures, and one was deemed to have exclusively reported good quality measures. Five studies conducted a check on whether the manipulation was likely to have influenced anthropomorphism.

4.4.2 Findings of Included Studies

Tables 4.6 and 4.7 provide a summary of the findings from the correlational and experimental studies, respectively. When statements are made about a significant finding, this is at a level of $p < .05$. It should be noted that, although some studies come from the same paper, all studies reported results from different datasets.

Table 4.6: Summary of Correlational Studies and Their Findings.

Authors	Country	Participant population	Sample Size (*n*)	Measure of Anthropo-morphism	Measures of Outcomes/ Controlled Variables	Findings & Effect Sizes
Apostol et al. (2013)	Romania	General population (adults and children, age: *M* = 36.54, *SD* = 12.63, range: 14 - 77)	2,683	*Belief in Animal Mind Questionnaire* (Hills, 1995)	Empathy: *Empathy to Animals Scale* (Powell, 2010); Attitudes: *Attitudes to Animals Scale* (Herzog Jr, Betchart, & Pittman, 1991)	Significant positive correlations were found between belief in animal mind and more positive attitudes toward animals (r = .30); a hierarchical regression showed belief in animal mind to be significantly predictive of positive attitudes toward animals (adjusted R^2_{adj} = 0.09) even when gender, age, pet ownership, education, residence, empathy to animals, empathic concern, and perspective taking were included in the analysis (although belief in animal mind was the third-strongest predictor after empathic concern and perspective taking)
Díaz (2016)	Spain	University students (age: *M* = 23.26; *SD* = 6.1)	481	Items from the *Attributes Questionnaire* (Herzog & Galvin, 1997) to measure five attitudes/beliefs toward species: affection for species and belief in animal consciousness, ability to suffer, to feel emotions, and worthiness of moral consideration, applied to 13 different animal species	A shorter version of the *Attitudes Toward the Use of Animals* (adapted from Meng, 2009); questions about diet (e.g., meat-eater / vegan); questions about intention to 1. become vegetarian and 2. become vegan in the next two years	Believing that animals are conscious, can feel emotions, and can suffer were each positively correlated with liking animals and believing animals to be deserving of moral consideration. Of the five types of attitude, deservingness of moral consideration showed the strongest and highest number of correlations with beliefs in the use of animals (higher moral consideration associated with lower belief in use of animals), in which 20/21 uses of animals showed correlations with moral consideration; affection toward species and three beliefs about animal mentation (they are conscious, can feel emotions and can suffer) together predicted moral consideration of species (R^2 = 0.47). When all variables were included together, only affection toward species and moral concern predicted intention to become vegetarian and vegan, albeit with low variance explained by the model (vegetarian: R^2 = 0.09; vegan: R^2 = 0.15)
Hawkins, Scottish Society for the Prevention of Cruelty to Animals, & Williams (2020)	Scotland	Primary school children (age: *M* = 9.7; *SD* = 1; range: 6.4 - 12.2)	1,217	*Children's Beliefs about Animal Minds* (Hawkins & Williams, 2016)	*Children's Attitudes towards Animal Cruelty Questionnaire* (both intentional and unintentional cruelty; adapted from Connor, Currie, & Lawrence, 2018)	Lower belief in animal mind was associated with higher acceptance of animal cruelty as a whole (r = 0.14) and higher acceptance of intentional cruelty specifically (r = 0.11)
Higgs et al. (2020)	UK	General population (age: *M* = 38; *SD* = 15.98; range 18 - 80)	317	*Belief in Animal Mind Questionnaire* (adapted from Hills, 1995)	*Animal Purpose Questionnaire* (developed as part of the study)	Belief in animal mind was found to be significantly predictive of lower agreement with the killing of animals even after controlling for gender, age, ethnicity, religion, eating orientation, education, working with animals, and being a scientist, contributing R^2 = 0.10 additional variance to the model

Authors	Country	Participant population	Sample Size (*n*)	Measure of Anthropo-morphism	Measures of Outcomes/ Controlled Variables	Findings & Effect Sizes
Knight et al. (2004)	UK	General population (age: *M* = 39.3; *SD* = 13.9)	96	*Belief in Animal Mind Questionnaire* (adapted from Hills, 1995)	A questionnaire about six different types of animal use (no reference is provided for this measure)	Higher belief in animal mind was associated with lower support for animal experimentation and less support for animal use (for personal decoration, entertainment, financial gain, animal management issues), and using animals in the classroom (lowest *r* = 0.46, highest *r* = 0.53), even when controlling for other factors (age, gender, pet ownership, meat eating, political stance, and living area)
Maguire Kannis-Dymand, Mulgrew, Schaffer, & Peake (2020)	Australia and Kingdom of Tonga	General population (age: *M* = 33.93; *SD* = 13.98)	45	Adapted *Individual Differences in Anthropomorphism Questionnaire* (Waytz, Cacioppo, & Epley, 2010) to ask questions about anthropomorphism of whales	Empathy: *Interpersonal Reactivity Index* adapted for animals (Norring, Wikman, Hokkanen, Kujala, & Hänninen, 2014); conservation behaviours: *Conservation Behavior Scale* (Schultz, 2005); connectedness to nature: *Connectedness to Nature Scale* (Mayer & Frantz, 2004)	Anthropomorphism was not uniquely predictive of conservation behaviour when connectedness to nature, perspective-taking and empathic concern were included in the regression model (only connectedness to nature was a unique predictor)
Manfredo, Urquiza-Haas, Carlos, Bruskotter, & Dietsch (2020)	United States	General population (no summary of sample age provided)	43,939	Adapted *Individual Differences in Anthropomorphism Questionnaire* (Waytz et al., 2010) to ask questions about anthropomorphism of wildlife; added two items to ask participants about extent to which they believe wildlife have consciousness and have free will	Values: 19-index survey about mutualism and wildlife values (Teel & Manfredo, 2010); Attitudes toward carnivores involved in human-wildlife conflict situations: bespoke items	A mediation analysis was consistent with a hypothesised model in which anthropomorphism reduces support for lethal management of carnivores largely via mutualism values

Authors	Country	Participant population	Sample Size (*n*)	Measure of Anthropo-morphism	Measures of Outcomes/ Controlled Variables	Findings & Effect Sizes
Riepe & Arlinghaus (2014)	Germany	General population (adults and children, age range: 14 - 92)	1,043	*Attributes Questionnaire* (Herzog & Galvin, 1997)	Values and Beliefs Relating to Recreational Fishing: Two wildlife values orientation scales (Teel, Dayer, Manfredo, & Bright, 2005; Manfredo, Teel, & Henry, 2009), adapted to ask specifically about values and beliefs pertaining to recreational fishing; Support for Animal Rights: adaptation of the *Animal Rights Scale* (Wuensch, Jenkins, & Poteat, 2002)	Anthropomorphism did not predict variance in attitudes toward recreational fishing in general but there was some evidence that it did negatively predict attitudes toward catch-and-release fishing
Tam (2013, Study 5: "Tam 1")[a]	Hong Kong	Undergraduates (age *M* = 20.55, *SD* = 1.51)	78	*Individual Differences in Anthropomorphism Questionnaire* (Waytz et al., 2010)	*Dispositional Empathy Toward Nature Scale* (Tam, 2013); a scale to measure public conservation behaviour (from the *Environmental Attitudes Inventory* (Milfont & Duckitt, 2010); a scale to measure private conservation behaviour (12 items adapted from past studies, such as Kaiser, Doka, Hofstetter, & Ranney (2003)	Anthropomorphism of animals, nonanimal natural entities, and nature, were associated with green behaviour frequency and environmental movement support (correlations ranging from *r* = 0.23 to *r* = 0.36); statistical support was reported for empathy toward nature mediating the association between anthropomorphism and conservation behaviour (full mediation for anthropomorphism of natural entities and nature; partial for anthropomorphism of animals)
Tam et al. (2013, Study 1: "Tam 2")	Singapore	Under-graduates (age: *M* = 21; *SD* = 3.1)	50	Amount of anthropomorphic content in pro-environmental posters generated by participants (who had been given no instructions to anthropomorphise in their posters)	Private Conservation Behaviour: bespoke items asking participants to indicate how likely they were to try green products and tell others about them; Support for environmental indicator of national development (bespoke item)	Those grouped as having produced an anthropomorphic poster had stronger product use intention (*d* = 0.58) and support for one indicator of nation development (environmental impact; *d* = 0.72) than those who were grouped as having produced a less anthropomorphic poster, and these two outcomes were also correlated with degree of researcher-rated "human-ness" of natural entities on the posters (product use intention: *r* = .29; environmental impact: *r* = .30). As would be expected, the two groups did not differ in their support for the other three indicators of nation development (economic output, life expectancy, and life satisfaction)

Authors	Country	Participant population	Sample Size (*n*)	Measure of Anthropo-morphism	Measures of Outcomes/ Controlled Variables	Findings & Effect Sizes
Tam (2014, Study 1: "Tam 3")	Hong Kong	Undergraduates (age: *M* = 21.10; *SD* = 1.13)	239	*Anthropomorphism of Nature Scale* (Tam, 2013)	Efficacy: bespoke items asking participants to rate their understanding of the environmental crisis, how predictable they believe the future of the environmental crisis to be, and how predictable they believe the future of nature to be; Action Efficacy: bespoke items asking participants to rate their beliefs about how impactful and effective their actions can be in helping nature/resolving the environmental crisis, and how confident they feel in their ability to help nature; Public Conservation Behaviour: 10 items to assess for environmental movement participation, adopted from the *Environmental Attitudes Inventory* (Milfont & Duckitt, 2010); Private Conservation Behaviour: one measure asking participants how frequently they performed 12 green behaviours (adapted from previous studies such as Kaiser et al. (2003), and one bespoke measure in which participants were shown four "green" products on the market and asked how much they would like to try/to tell their family and friends about each product	Anthropomorphism of nature was correlated with perceived capacity to understand (*r* = .21) and predict (*r* = .16) the environmental crisis, action efficacy (*r* = .33), environmental movement support (*r* = .19), green behaviour frequency (*r* = .22), and product use intention (*r* = .26); statistical evidence was provided in support of a hypothesised model in which action efficacy and capacity to understand the environmental crisis mediated between anthropomorphism of nature and environmental movement support, green behaviour frequency, and intention to use a green product
(Study 2: "Tam 4")	United States	General population (age: *M* = 32.03; *SD* = 12.37; range: 13 - 71) recruited online	177	*Anthropomorphism of Nature Scale* (Tam, 2013)	Personal and Collective Action Efficacy: bespoke items, in which personal action efficacy items were changed from "I" to "humans" to assess collective action efficacy (e.g., "What I/human beings do can be effective in protecting nature"); Public Conservation Behaviour: 10 items to assess for environmental movement participation, adopted from the *Environmental Attitudes Inventory* (Milfont & Duckitt, 2010); Private Conservation Behaviour: one measure asking participants how frequently they performed 12 green behaviours (adapted from previous studies such as Kaiser et al. (2003), and one bespoke measure in which participants were shown four "green" products on the market and asked how much they would like to try/to tell their family and friends about each product	Individual differences in anthropomorphism were correlated with environmental movement support (*r* = .18), green behaviour frequency (*r* = .18), intention to use green products (*r* = .16), personal action efficacy (*r* = .14), but not collective action efficacy. The authors reported statistical evidence in support of a hypothesised model in which personal action efficacy mediates between anthropomorphism of nature and all conservation behaviours (support for environmental movements; green behaviour frequency; intention to use green products); collective action efficacy was a less consistent mediator

Authors	Country	Participant population	Sample Size (*n*)	Measure of Anthropo-morphism	Measures of Outcomes/ Controlled Variables	Findings & Effect Sizes
Tam (2015b, Study 1: "Tam 5")	Hong Kong	Undergraduates (age: *M* = 19.87; *SD* = 0.84)	126	*Anthropomorphism of Nature Scale* (Tam, 2013)	Bespoke measure of pro-environmental behaviours asking for frequency of each of eight behaviours; Values: *Schwartz Values Questionnaire* (Schwartz, 1992); Personality: *Big Five Inventory* (John, Donahue, & Kentle, 1991)	Mind attribution to nature was correlated with self-reported pro-environmental behaviours (r = .24), and improved the prediction of pro-environmental behaviours beyond personality traits and values (R^2 change = .16)
(Study 2: "Tam 6")	Hong Kong	University staff members (age: *M* = 32.82; *SD* = 8.39)	181	*Anthropomorphism of Nature Scale* (Tam, 2013)	*Social Desirability Scale* (Stöber, 2001); observed pro-environmental behaviour	Mind attribution to nature was correlated with observed pro-environmental behaviour (participants' donations to the World Wide Fund for Nature Hong Kong; r = .21), and improved the prediction of observed pro-environmental behaviours beyond social desirability and demographic variables (R^2 change = .16)
(Study 3: "Tam 7")	Hong Kong	Undergraduates (age: *M* = 20.69; *SD* = 1.58)	62	*Anthropomorphism of Nature Scale* (Tam, 2013)	Bespoke measures of: pro-environmental behaviour intention and empathy toward nature (with two subcomponents: empathic concern and perspective-taking)	Mind attribution to nature was correlated with pro-environmental behaviour intention (r = .29). Results of a mediation analysis provided support for empathic concern and perspective-mediating the association between mind attribution to nature and pro-environmental behaviour intention, when gender and social desirability were controlled for
Tam (2019, Study 1: "Tam 8")	Hong Kong	University staff members (age: *M* = 32.86; *SD* = 8.37; range: 22 - 60)	176	*Anthropomorphism of Nature Scale* (Tam, 2013)	Two items to assess environmental guilt; two bespoke measures of participation in Earth Hour: 1. assessing intention to turn lights off during Earth Hour, and 2. assessing participation in Earth Hour in the past	Anthropomorphism of nature was found to be correlated with intention to participate in Earth Hour (r = .23), and there was support for environmental guilt as a mediator between these variables, when controlling for age and gender
Tam (2019, Study 2: "Tam 9")	Hong Kong	Undergraduates (age: *M* = 20.73; *SD* = 1.20; range: 18 - 25)	168	*Anthropomorphism of Nature Scale* (Tam, 2013); *Individual Differences in Anthropomorphism Questionnaire* (Waytz et al., 2010)	Bespoke scale of degree of emotional response to photos of environmental problems (nine emotions, including guilt, anger, and shame); three measures of pro-environmental behaviour intention: one measures of private-sphere pro-environmental behaviours (adopted from Tam, 2013); two measures of collective pro-environmental behaviours (the two subscales of the *Environmental Action Scale*; (Alisat & Riemer, 2015)	Anthropomorphism was correlated with pro-environmental behaviour intention (private-sphere: r = .24; participatory actions: r = .27; leadership actions: r = .35), and for the *Individual Differences in Anthropomorphism Questionnaire*, anthropomorphism of nature was the most consistent correlate with these variables and anthropomorphism of animals and inanimate devices less so. There was support for a mediational model in which environmental guilt mediated the association between anthropomorphism and pro-environmental behaviour intention
Tam (2019, Study 3: "Tam 10")	UK	General population (age: *M* = 25.64; *SD* = 5.55; range: 18 - 70) (recruited online)	255	*Anthropomorphism of Nature Scale* (Tam, 2013)	A scale to assess participants' levels of 11 different emotions; two measures of pro-environmental behaviour intention: a private-sphere and public-sphere pro-environmental measure (adapted from Bain et al., 2016); one measure of actual behaviour, in which participants had the option to donate to an environmental organisation	Anthropomorphism was correlated with pro-environmental behavioural intention (private-sphere: r = .23; public-sphere: r = .27) but not actual pro-environmental behaviour (donation: r = .04); a mediation analysis supported environmental guilt as a mediator between anthropomorphism and both intention and donation

[a]I chose a number system to refer to Tam's studies in the text for ease of reading.

Table 4.7: Summary of Experimental Studies and Their Findings.

Authors	Country	Participant population	Sample Size (*n*)	Measures of Outcomes/ Controlled Variables	Findings & Effect Sizes
Tam, Li, & Chao (2013, Study 3: "Tam 11")[a]	Hong Kong	Undergraduates (age: *M* = 20.88; *SD* = 1.3)	73	Connectedness to Nature: *Connectedness to Nature Scale* (Mayer & Frantz, 2004); Private Conservation Behaviour: bespoke items asking participants to indicate how likely they were to try green products and tell others about them; Support for Environmental Indicator of National Development (bespoke item)	Participants randomly assigned to read an anthropomorphised pro-environmentalism poster vs the control condition who read a non-anthropomorphised version had stronger product use intention (*d* = .48), and stronger support for country's adoption of an environmental impact indicator of nation development (*d* = .51); statistical evidence was provided in support of a hypothesised model in which connectedness to nature is a mediator between anthropomorphism of nature and 1. environmental movement support; 2. environmental indicator support
Tam (2015a, Study 1: "Tam 12")	United States	Online study recruiting Americans on an online jobs site (age: *M* = 31.92; *SD* = 12.07)	314	*Desirability of Control Scale* (Burger, 2013); 10 items to assess for environmental movement participation, adopted from the *Environmental Attitudes Inventory* (Milfont & Duckitt, 2010); items to assess participants' likelihood of performing 12 pro-environmental behaviours, adopted from previous studies (e.g., Tam, 2013)	Participants were randomised either to read an article about the environmental crisis referring to "Mr. Nature" (experimental condition) or "Nature" (control condition); while there was no main effect of Condition on the two outcomes (environmental movement participation and green behaviour intention), desire for control was a moderator of the relationship between Condition and these outcomes, i.e., there was an interaction effect in which anthropomorphised language led to an increase in these outcomes for those with high desire for control and a decrease in those with low desire for control (ηp^2 = .02)
(Study 2: "Tam 13")	Hong Kong	Undergraduates (age: *M* = 20.45; *SD* = 1.68)	101	10 items to assess for environmental movement participation, adopted from the *Environmental Attitudes Inventory* (Milfont & Duckitt, 2010); items to assess participants' likelihood of performing 12 pro-environmental behaviours, adopted from previous studies (e.g., Tam, 2013)	Participants viewed a poster with anthropomorphised content (experimental condition), compared with neutral content (control condition); while there was no main effect of Condition on the two outcomes (environmental movement participation and green behaviour intention), attachment style was a moderator of the relationship between Condition and these outcomes, i.e., there was an interaction effect in which anthropomorphised language led to an increase in these outcomes for those with strong attachment anxiety (without attachment avoidance) whereas the opposite was true for those with weak attachment anxiety (ηp^2 = .17). Attachment avoidance did not have a moderating effect

Authors	Country	Participant population	Sample Size (*n*)	Measures of Outcomes/ Controlled Variables	Findings & Effect Sizes
Wang & Basso (2019, Study 2)	United States	General population, recruited from online jobs website (age: *M* = 33.44, *SD* = 11.25)	162	Two bespoke items to assess: how tasty and how enjoyable the meat would be from a restaurant depicted in a vignette; a bespoke item to assess intention to purchase the meat product	Participants randomised to read one of the anthropomorphic vignettes of pigs (depicting pigs' friendships with each other, or with humans) had lower attitudes toward meat (*d* = 0.76 and *d* = 1.06, respectively) and lower intention to purchase meat (*d* = 0.60 and *d* = 0.98, respectively) than in the control condition (a vignette in which pigs were depicted in a free-range scenario), and the two anthropomorphic conditions were not different from each other on these outcomes; statistical evidence was provided in support of a hypothesised model in which attitudes to meat mediated the effect of the experimental manipulation on purchase intentions (R^2 = 0.66)
(Study 3a)	United States	General population, recruited from online jobs website (age: *M* = 37.53, *SD* = 10.67)	111	Two bespoke items to assess: how tasty and how enjoyable the meat would be from a restaurant depicted in a vignette; a bespoke item to assess intention to purchase the meat product; four items to assess anticipatory guilt and responsibility from imagining eating the depicted meat product (how guilty, accountable, responsible and ashamed they would feel; adapted from Ahn, Kim, & Aggarwal [2014])	Participants randomised to read the anthropomorphic vignettes of pigs (depicting pigs' friendships with each other) had lower attitudes toward meat (*d* = 0.59) and lower intention to purchase meat (*d* = 0.45) than in the control condition; support was found for a mediation model in which being exposed to anthropomorphism led to increased anticipatory guilt, leading to less favourable attitudes toward eating meat, which led to lower purchase intentions (R^2 = .56)
(Study 3b)	United States	General population, recruited from online jobs website (age: *M* = 35.12, *SD* = 9.16)	108	Two bespoke items to assess: how tasty and how enjoyable the meat would be from a restaurant depicted in a vignette; a bespoke item to assess intention to purchase the meat product; four items to assess anticipatory guilt and responsibility from imagining eating the depicted meat product (how guilty, accountable, responsible and ashamed they would feel; adapted from Ahn et al. [2014])	No differences were found between those randomised to read the anthropomorphic vignette (depicting cows as having friendships with other cows) and those who read a control vignette, on attitudes toward meat or purchasing intentions
(Study 3c)	United States	General population, recruited from online jobs website (age: *M* = 38.93, *SD* = 13.05)	167	Two bespoke items to assess: how tasty and how enjoyable the meat would be from a restaurant depicted in a vignette; a bespoke item to assess intention to purchase the meat product; four items to assess anticipatory guilt and responsibility from imagining eating the depicted meat product (how guilty, accountable, responsible and ashamed they would feel; adapted from Ahn et al., 2014)	Participants randomised to read one of the anthropomorphic vignettes of pigs (depicting pigs' friendships with humans) had lower attitudes toward meat (*d* = 0.76) and lower intention to purchase meat (*d* = 0.69) than in the control condition; support was found for two mediation models: 1. being exposed to anthropomorphism led to less favourable attitudes toward eating meat, which led to lower product use intentions; 2. being exposed to anthropomorphism led to increased anticipatory guilt, leading to less favourable attitudes toward eating meat, which led to lower purchase intentions (the model as a whole of both mediation paths accounting for R^2 = .67 of the variance)

[a]I chose a number system to refer to Tam's studies in the text given for ease of reading.

Tam's studies will henceforth be described according to the naming system used in Tables 4.6 and 4.7. I have compiled a list of Tam's studies in Table 4.8 and their references, for ease of reading.

Table 4.8: A list of Tam's Studies and Their References.

Study Number	Reference
Tam 1	Tam, K. P. (2013). Dispositional empathy with nature. *Journal of Environmental Psychology*, *35*, 92–104. (*Study 5*)
Tam 2	Tam, K. P., Lee, S. L., & Chao, M. M. (2013). Saving Mr. Nature: Anthropomorphism enhances connectedness to and protectiveness toward nature. *Journal of Experimental Social Psychology*, *49*(3), 514–521. (*Study 1*)
Tam 3	Tam, K. P. (2014). Anthropomorphism of nature and efficacy in coping withthe Environmental crisis. *Social Cognition*, *32*(3), 276–296. (*Study 1*)
Tam 4	Tam, K. P. (2014). Anthropomorphism of nature and efficacy in coping with the Environmental crisis. *Social Cognition*, *32*(3), 276–296. (*Study 2*)
Tam 5	Tam, K. P. (2015b). Mind Attribution to Nature and Proenvironmental Behavior. *Ecopsychology, 7*(2), 87–95. (*Study 1*)
Tam 6	Tam, K. P. (2015b). Mind Attribution to Nature and Proenvironmental Behavior. *Ecopsychology, 7*(2), 87–95. (*Study 2*)
Tam 7	Tam, K. P. (2015b). Mind Attribution to Nature and Proenvironmental Behavior. *Ecopsychology, 7*(2), 87–95. (*Study 3*)
Tam 8	Tam, K. P. (2014). Anthropomorphism of nature and efficacy in coping with the environmental crisis. *Social Cognition*, *32*(3), 276–296. (*Study 1*)
Tam 9	Tam, K. P. (2014). Anthropomorphism of nature and efficacy in coping with the environmental crisis. *Social Cognition*, *32*(3), 276–296. (*Study 2*)
Tam 10	Tam, K. P. (2014). Anthropomorphism of nature and efficacy in coping with the environmental crisis. *Social Cognition*, *32*(3), 276–296. (*Study 3*)

Study Number	Reference
Tam 11	Tam, K. P., Lee, S. L., & Chao, M. M. (2013). Saving Mr. Nature: Anthropomorphism enhances connectedness to and protectiveness toward nature. *Journal of Experimental Social Psychology*, *49*(3), 514–521. (*Study 3*)
Tam 12	Tam, K. P. (2015a). Are anthropomorphic persuasive appeals effective? The role of the recipient's motivations. *British Journal of Social Psychology*, *54*(1), 187–200. (*Study 1*)
Tam 13	Tam, K. P. (2015a). Are anthropomorphic persuasive appeals effective? The role of the recipient's motivations. *British Journal of Social Psychology*, *54*(1), 187–200. (*Study 2*)

It is important to note that, although many studies reported measuring "conservation behaviour", studies used measures of either broad pro-environmental actions, or conservation actions purely in the sense of energy/resource conservation (not nature/species conservation). Maguire et al. (2020) reported a "conservation behaviour scale" (taken from Schultz et al., 2005) which measured actions such as picking up litter that is not one's own and writing a letter to support an environmental issue. Only one item pertained specifically to species conservation, which related to whales. Tam's studies 1 – 4 and Tam 11 report measuring "conservation behaviour" but each study words items in terms of broader environmental actions. Tam 1, 3 and 4 measured "public conservation behaviour" by asking respondents to indicate their desire to support an environmentalist organisation and measured "private conservation behaviour" by asking for the occurrence of a range of pro-environmental behaviours that included the word "environment" or related to conservation only in the sense of resource/energy conservation, not conservation of nature and species. Tam 3 and 4 measured respondents' self-reported likelihood to try "green" products and to tell others about them, as did Tam 2. Tam 2 measured participants' support for an environmental indicator of national development. Tam 11, similarly to Tam 2, measured participants' likelihood of trying "green" products and telling others about them and support for an environmental indicator of national development. In the narrative summary that follows, I will specify when variables relate to the environmental or resource/energy conservation more broadly (pro-environmental) or more specifically to nature conservation and protecting non-human species (pro-nature). In the narrative summary I will use the term "sustainable" to refer generically to any variable relating to pro-environmental or pro-nature behaviours.

Studies were carried out between 2004 and 2020, taking place across four continents and several countries: Hong Kong, Singapore, Australia and the Kingdom of Tonga, United Kingdom, Germany, Spain, Romania, and United States. One study did not report a country in which it took

place, only reporting that data collection proceeded via an online jobs site (Tam 12). Thirteen studies investigated a general population sample, one included primary school children, eight included undergraduates, one included university students more broadly, and two included university staff members.

4.4.3 Narrative Summary (Qualitative Synthesis)

4.4.3.1 Is There a Reliable Association Between Anthropomorphism and Sustainable Variables? Eighteen studies reported correlational analyses. One study did not find the expected association between anthropomorphism and self-reported participation in whale conservation behaviour when other variables were controlled for (Maguire et al., 2020) ("Good" quality). Fourteen studies found anthropomorphism to be associated with all the sustainable variables that were measured. Two studies found anthropomorphism to be associated with some, but not all, sustainable variables: Díaz (2016) ("Fair" quality) did not find mind attribution to nature to predict willingness to adopt ethical vegetarianism or veganism when other variables were controlled for (affection toward species and moral concern); Riepe and Arlingaus (2014) ("Good" quality) did not find the expected association between anthropomorphism and attitudes toward recreational fishing; Tam 4 ("Good" quality) did not find an association between anthropomorphism and collective action efficacy. Figure 4.2 summarises the variables across studies that were found to be positively or negatively associated with anthropomorphism.

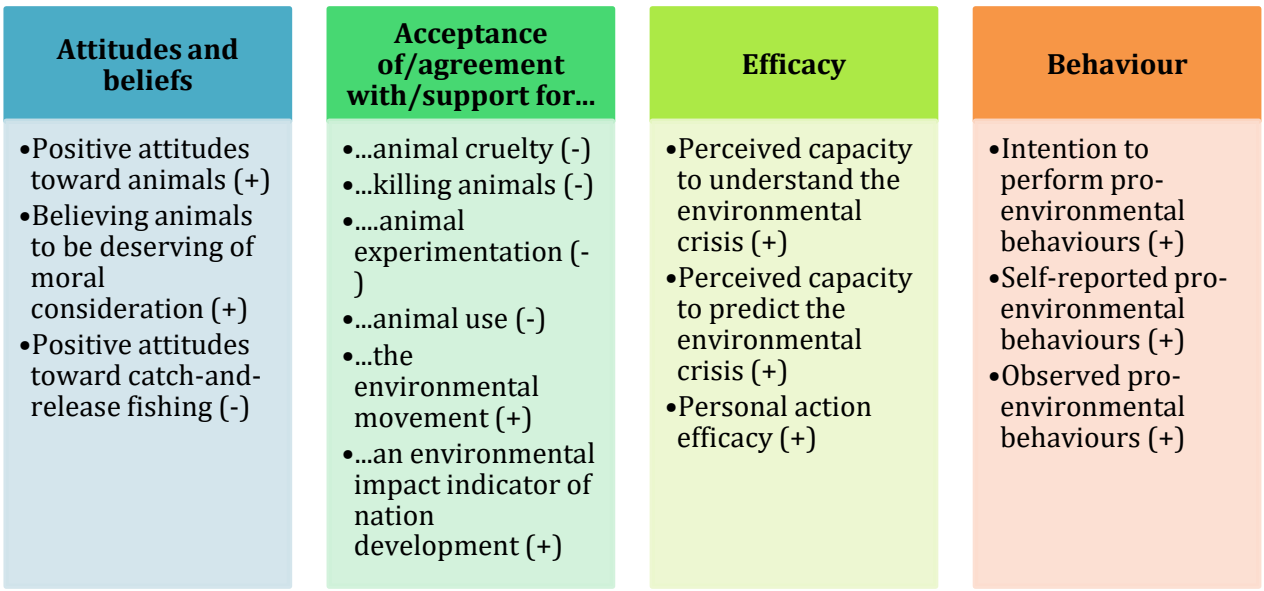


Figure 4.2: Sustainable outcomes that were found to be correlated with, or predicted by, anthropomorphism. (+) = positive association; (-) = negative association.

Of the 16 studies finding at least some support for associations between anthropomorphism and expected variables, six controlled for at least one other variable in analyses, either with mediation or regression analyses. Variables controlled for in regression analyses were as follows for "Good" quality studies: Apostol et al. (2013), controlling for gender, age, pet ownership, education, residence, empathy to animals, empathic concern, and perspective-taking; Tam 5, controlling for personality traits and values; Tam 6, controlling for social desirability and demographic variables. For "Fair" quality studies, variables controlled for in regressions were as follows: Díaz (2016), controlling for different kinds of anthropomorphism; Higgs et al. (2020), controlling for gender, age, ethnicity, religion, eating orientation, education, working with animals, and being a scientist; Knight et al. (2004), controlling for age, gender, pet ownership, meat eating, political stance, and living area. Nine studies controlled for variables with mediation analyses (see *Section 4.4.3.1.1*, below).

Correlational studies measured dispositional anthropomorphism, i.e., individuals' natural tendency to perceive non-human entities as having humanlike characteristics. All correlational studies (except for Tam 2, to be discussed below) measured mind attribution, i.e., perceiving nature/species to have mental experiences and capacities. One measure of mind attribution is the *Anthropomorphism of Nature Scale* (ANS) (Tam, 2013), in which respondents are asked to what extent nature has a mind of its own, free will, consciousness, intentions, and emotional experience. This scale has been reported to have good internal consistency and predictive validity (Tam, 2013). Eight studies by Tam used the ANS (Tam 3 – 10). These were all rated "Good" quality and controlled for other variables. These studies found that mind attribution to nature is associated with sustainable behaviour intention (five studies), action efficacy (two studies), and environmental movement support (two studies). Four studies found mind attribution to nature to be associated with self-reported sustainable behaviour. As for observed sustainable behaviour (in the form of donations made by participants during the study), whereas one study found mind attribution to be associated with this (Tam 6), one did not find evidence for this as a main effect (Tam 10) (but see *Section 4.4.3.1.1* for a mediation analysis that revealed an association).

Tam 9 used another measure alongside the ANS: the *Individual Differences in Anthropomorphism Questionnaire* (IDAQ), which was described in *Section 3.6.2:* this measure examines beliefs about the mental states/capacities of devices, nature, and animals (whether each target, e.g., a computer or an insect, has "a mind of its own", "free will"; "consciousness", "intentions", and "can experience emotions") (Waytz et al., 2010, p. 229). As described in *Section 3.6.2*, this measure has demonstrated good psychometric properties (Waytz et al., 2010). Tam 9 found the nature subscale (IDAQ-nature) and the ANS to have the highest correlations with sustainable behaviour intention, and the animals and devices subscales of the IDAQ (IDAQ-animals and IDAQ-devices) showed less consistent associations with measures of behaviour intention. Correlations

were found to be high between the IDAQ-nature and the ANS (r = 0.78) and low between the ANS and IDAQ-animals (r = 0.35)/IDAQ-devices (r = 0.42), suggesting that the IDAQ-nature and the ANS might measure the same construct. This paper also revealed a three-factor solution to the IDAQ according to its proposed subscales, providing statistical support to the idea that there can be separate tendencies to attribute a mind to nature, animals, and devices.

The IDAQ was used by another study (Tam 1) ("Good" quality) which found IDAQ-nature and IDAQ-animals both to be associated with green behaviour frequency and environmental movement support). The IDAQ was adapted by two other studies ("Good" quality) in which items were reworded to relate to wildlife(e.g., whether wildlife "have intentions") (Manfredo et al., 2020, p. 3) and a specific animal species: whales (e.g., "to what extent do whales have free will", p. 110) (Maguire et al., 2020, p. 110). The first found a significant role for mind attribution to wildlife in a mediation model (see *Section 4.4.3.1.1*). The second did not find mind attribution to whales to be associated with sustainable behaviour when other variables were included.

Another measure used by studies to assess mind attribution to animals was the *Belief in Animal Mind Questionnaire* (BAMQ) (Hills, 1995), which was used by Apostol et al. (2013); Hawkins and Williams (2016); Higgs et al. (2020); and Knight et al. (2004). The BAMQ asks four questions about belief that most animals are aware, can think and solve problems, and can feel emotions, and has high internal consistency (Cronbach's α = .90) (Hills, 1995). Of these studies the highest quality (Apostol et al., 2013) ("Good" quality), showed mind attribution to animals to be associated with positive attitudes toward animals when the researchers controlled for other variables. The three remaining papers ("Fair" quality) found those with higher mind attribution to animals to be less accepting of behaviours toward animals that would entail harming or using them in some way.

Two studies analysed mind attribution to animals by adapting the *Attributes Questionnaire* (Herzog & Galvin, 1997), which the authors validated through factor analysis and has been shown to have high internal consistency (Cronbach's α = .94) (Díaz, 2016). Riepe and Arlinghaus (2014; "Good" quality) analysed mind attribution to 10 animals by assessing beliefs in these animals' capacity to feel fear, pain, and to suffer; they did not find support for mind attribution's association with attitudes toward recreational fishing in general, but there was some support for its association with more negative attitudes toward catch-and-release fishing. Díaz (2016) ("Fair" quality) assessed three subcomponents of mind attribution (presence of consciousness, ability to suffer/feel pain, and ability to experience emotions) and analysed them separately. Díaz (2016) also measured another attribute that was classed as a kind of anthropomorphism: animals' worthiness of moral consideration. The three mind attribution subcomponents, combined with participants' ratings of affection toward animals, predicted participants' beliefs in animals' worthiness of moral

consideration. When the three mind attribution subcomponents, affection, and moral consideration were entered into a model to predict behaviour intention (to become vegetarian / vegan), only moral consideration and affection explained unique variance in the model.

Finally, Tam 2 (“Fair” quality) did not use a questionnaire-based measure of anthropomorphism but rated the amount of anthropomorphic content in sustainable posters generated by participants. Examples of anthropomorphic posters generated by participants showed physical elements similar to humans (e.g., a drawing of the Earth depicted with eyes and a mouth) and those that may have implied mind attribution (the Earth expressing emotion through frowning).

4.4.3.1.1 Mediation. Nine correlational studies conducted mediational analyses to investigate variables that might mediate the association of anthropomorphism with sustainable variables (all rated “Good” quality). The studies found evidence that mind attribution to nature is predictive of an array of sustainable outcomes via the following mediators: empathy toward nature (measured as general empathy as well as its separate components of empathic concern and perspective-taking), action efficacy, personal action efficacy, collective action efficacy, capacity to understand the environmental crisis, mutualism values, and guilt. Tam 9 assessed anger, shame, and anxiety, in addition to guilt, finding only guilt to mediate between mind attribution to nature and three types of sustainable behaviour: private-sphere, participatory actions, and leadership actions, in a Hong Kong undergraduate student sample. In a British undergraduate student sample, these findings were replicated, in which only guilt was a mediator between mind attribution to nature and three types of sustainable behaviour (private-sphere, public-sphere, and donation), whereas anger and anxiety were not (shame was not measured in this study). Figure 4.3 summarises the significant findings of mediators between mind attribution to nature and sustainable variables. One study also found mind attribution to act as a mediator (between value orientation toward wildlife and more negative attitudes toward catch-and-release fishing) (Riepe & Arlinghaus, 2014).

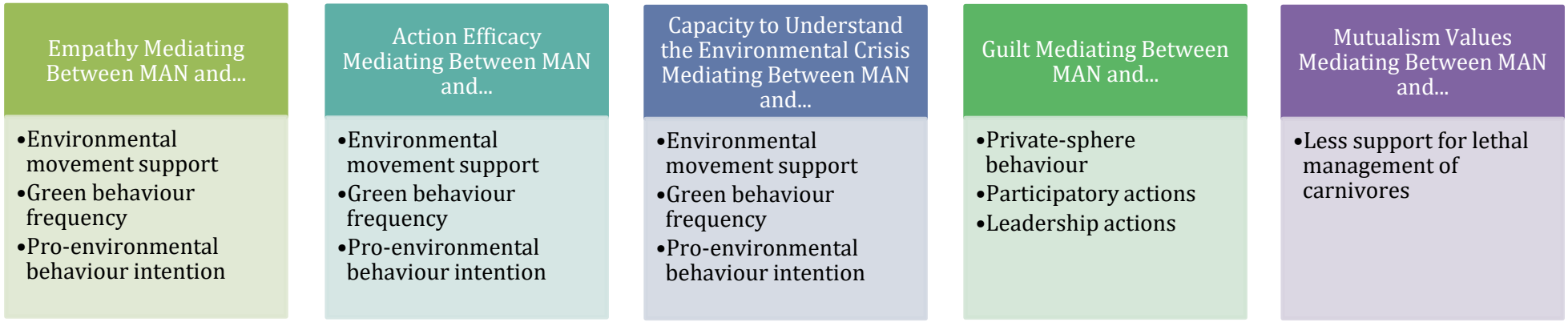


Figure 4.3: Mediation models in correlational studies explaining the association between mind attribution to nature (man) and an array of sustainable outcomes.

4.4.3.2 Is There Reliable Evidence That Manipulating Anthropomorphism Leads to Sustainable Outcomes?

Different methods were used for manipulating anthropomorphism among the seven experimental studies. Tam 11 manipulated anthropomorphism by showing participants either an anthropomorphised or a non-anthropomorphised poster depicting nature (generated by participants in Tam 2; e.g., a cartoon of the Earth with a human face, frowning). These same posters were shown to participants in Tam 13. Participants in Tam 12 read an article about the environmental crisis describing nature as "Mr. Nature" and using personal pronouns, whereas the control article used "Nature" and impersonal pronouns. In the four studies by Wang and Basso (2019), participants either read an anthropomorphic vignette of farm animals (pigs in studies 2 and 3a, and 3c; cows in 3b) which entailed describing them as having friendships with each other or with other humans, or read a control vignette (describing the animals in a free-range scenario).

One experimental study was rated "Good" quality (Tam 11) and found the manipulation to lead to stronger product use intention and stronger support for the nation's adoption of an environmental impact indicator of development. One of the remaining six experimental studies (all rated "Fair" in quality) did not find the expected effect of anthropomorphism on attitudes toward eating meat and intention to purchase meat (Wang & Basso, 2019, Study 3b). This study depicted anthropomorphism of cows, whereas the remaining studies by these authors depicted anthropomorphism of pigs and did find the expected effect of the manipulation in leading to lower attitudes toward eating meat and lower intention to purchase meat. The remaining two studies by Tam (12 & 13) did not find a main effect of the manipulation on sustainable behaviour and behaviour intention but did find an effect of the manipulation when attachment anxiety (in the absence of attachment avoidance) was low and when desire for control was low, respectively (see Figure 4.4 for a summary of significant findings in experimental studies).

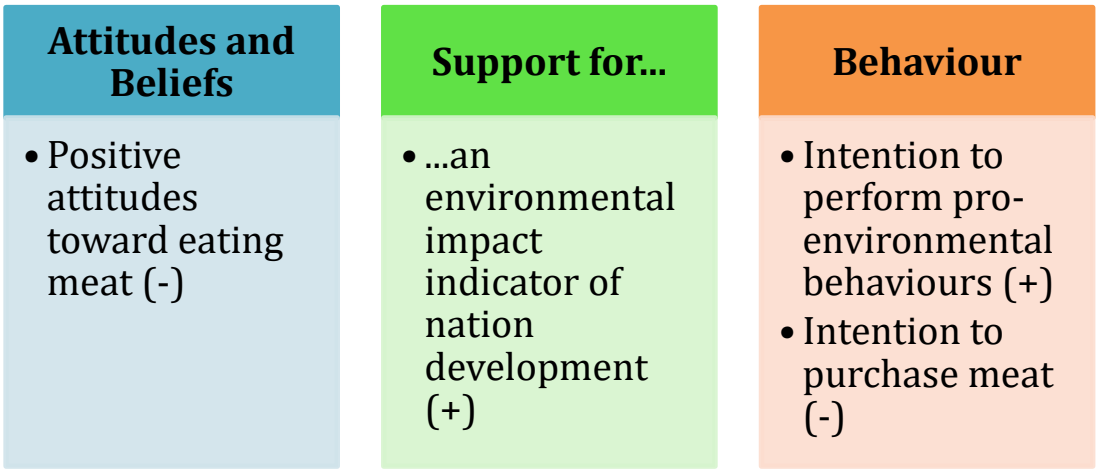


Figure 4.4: Sustainable outcomes that were found to be influenced by anthropomorphism. (+) = positive association; (-) = negative association.

4.4.3.2.1 Mediation. Four experimental studies conducted mediational analyses to investigate variables that might mediate the influence of anthropomorphism on sustainable outcomes (rated “Good”/”Fair” quality). The studies found evidence that inducing anthropomorphism influences sustainable behaviour, behavioural intentions, and support for environmentalism via the following mediators: connectedness to nature (Tam 11); attitudes toward meat (Wang & Basso, 2019; Study 2); anticipatory guilt (Wang & Basso, 2019; Study 3a); and guilt driving negative attitudes toward meat (Wang & Basso, 2019; Study 3c). Figure 4.5 summarises the findings from these studies.

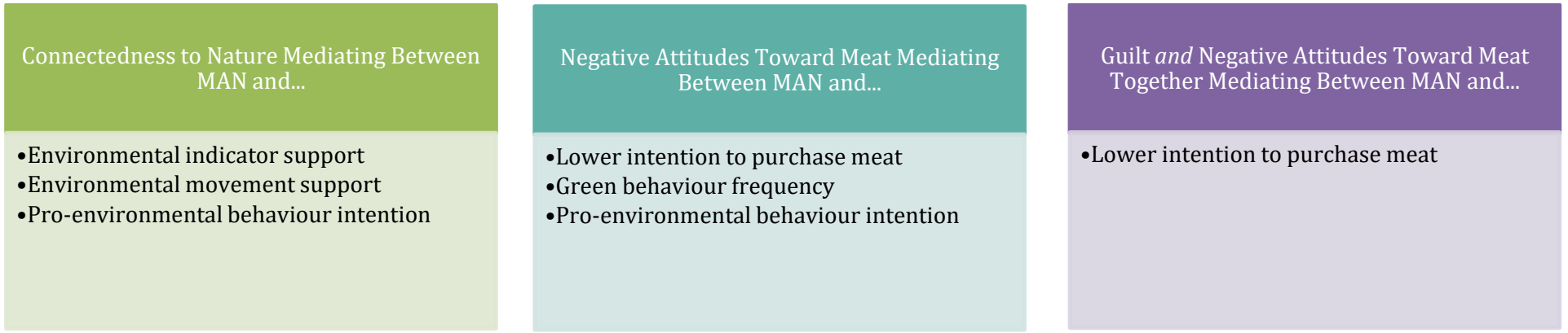


Figure 4.5: Mediation models in experimental studies explaining the association between mind attribution to nature (man) and an array of sustainable outcomes.

4.5 Discussion

This study is the first to take a systematic survey of the literature on anthropomorphism and its association with sustainable outcomes. There are experimental studies of at least adequate quality that agree in broad terms that manipulating anthropomorphism gives rise to expected changes on measured variables, implying that this could be a beneficial tool in some circumstances. The included literature was remarkably broad in terms of the countries represented, which enhances confidence in the generalisability of the findings across cultures and national contexts.

The highest quality experimental study (Tam 11) provides evidence that inducing anthropomorphism can strengthen sustainable behaviour intention (intention to use green products) and attitudes toward sustainable government policies (stronger support for an environmental impact indicator of nation development) via connectedness to nature. Guilt was another mediator that was reported by both experimental and correlational studies (of mixed quality). Tam 8 – 10 (rated "Good" quality) found correlational support for guilt as a mediator between mind attribution to nature and behavioural intention/observed behaviour, and two of Wang and Basso's (2019) experimental studies (3a and 3c, rated "Fair" quality) reported statistical support for a mediation model in which mind attribution to animals led to anticipatory guilt about eating meat, which led to less favourable attitudes toward eating meat and then to lower intention to purchase meat. Empathy toward animals/nature received support as a potential mediator from "Good" quality studies, although these were all correlational in nature. Apostol et al. (2013) showed empathy to animals to be the strongest predictor of positive attitudes toward animals, above mind attribution to animals. Two studies found empathy toward nature to be a mediator (Tam 1: empathy mediated between mind attribution to animals/nature and sustainable behaviour; Tam 3: empathy mediated between mind attribution to nature and sustainable behaviour intention).

Empathy, connectedness, and guilt are related in a variety of ways. Tam (2019) noted that they are each normally experienced in interpersonal relationships. Perceiving non-human species and nature to be humanlike may therefore invite these emotional/experiential responses. In addition, these interpersonal responses might all relate to the desire to treat others in a moral way; believing one has caused another harm leads to guilt (Zeelenberg & Breugelmans, 2008), which requires empathic capacity (perspective-taking) (Leith & Baumeister, 1998), and nature connectedness may allow more of the natural world to be encompassed within one's moral circle (Crimston, Bain, Hornsey, & Bastian, 2016). It seems reasonable that any experimental manipulation of anthropomorphism that influences one of these will influence the other two, yet no experimental study tested for all three mediators to compare their influence. It would be illuminating for future studies to consider these variables together to better understand whether one takes precedence

over another as a more influential or proximal predictor of sustainable outcomes. Another analysis of interest would be to consider the potential moderating role of these variables. While it appears these variables can be experimentally induced, empathy toward nature and connectedness to nature are dispositional traits (Mayer & Frantz, 2004; Tam, 2013), and people also vary in sensitivity to guilt (Melli, Carraresi, Poli, Marazziti, & Pinto, 2017). This raises the question of whether the relevance of each as a mediator depends on participants' baseline disposition; for example, people higher in dispositional empathy might be particularly prone to responding empathically to anthropomorphised content, leading to higher sustainable outcomes.

It is of note that such diverse ways of inducing anthropomorphism seemed to influence an outcome of interest. Tam 12 found that merely adding "Mr." to the description of nature had a discernible influence on sustainable outcomes. Although this could be considered a kind of anthropomorphism in terms of ascribing a human pronoun to nature which would imply similarity of other characteristics, it is a less explicit way of inducing anthropomorphism than the other experiments, which included written descriptions or illustrations that implied mental capacities more directly, such as motivations and emotions (e.g., animals forming friendships; a picture of the world frowning). It is therefore notable that Tam 12 was one of the two studies that did not find a main effect for anthropomorphism, and that the effect on sustainable outcomes depended on participants' levels of desire for control. It could be that this "weaker" from of anthropomorphism is what was responsible for a less robust finding.

Plausibility is another important consideration. "Mr. Nature" (Tam 12) is a simplistic depiction of nature's similarity to humans that was potentially perceived as too literal by participants. It is interesting that the suite of studies by Wang and Basso (2019) showed anthropomorphism of pigs to consistently lead to sustainable outcomes, whereas the same was not found with anthropomorphism of cows. The authors suggested that participants do not find the notion of cows with humanlike social qualities (e.g., friendliness) to be plausible, given common metaphors in English indicating that cows are moody or unfriendly (e.g., "moody cow"), or stupid. The authors noted that pigs are perceived as more intelligent by United States samples than other domesticated animals (Davis & Cheeke, 1998). Wang and Basso (2019) highlighted literature that suggests metaphors are only persuasive if their meaning is congruous with people's existing understanding (Basso & Oullier, 2011).

The only two correlational studies that did not find any unique association between anthropomorphism and sustainable variables focused on water-dwelling creatures: fish (Riepe & Arlinghaus, 2014) and whales (Maguire et al., 2020). It is possible that sea-dwelling creatures are not commonly perceived as having humanlike characteristics such as mental capacities. However,

in the study of Maguire et al. (2020) there are two additional reasons that could explain the lack of a significant finding. First, the authors included empathy and connectedness to nature in their model, which, as detailed above, appear to have a mediational role in explaining the influence of anthropomorphism; this might also explain the lack of a finding for mind attribution to nature. Second, the authors' measure of mind attribution related specifically to whales, whereas they had a generic measure of sustainable behaviour (with only one item out of thirteen pertaining to whale conservation); the lack of an expected finding may be due to a mismatch between the specificity of the measures.

The fact that such an array of sustainable outcomes was associated with anthropomorphism indicates that perceiving nature to be humanlike can have a generalised influence. Further research clarifying the contexts in which anthropomorphism affects sustainable outcomes in a broad way would be beneficial. It could be, for example, that mind attribution to nature as a whole is associated with similarly generic sustainable attitudes and behaviours, whereas mind attribution to specific types of animals may relate to a more confined set of variables that relate to those species. Indeed, Manfredo et al. (2020) found mind attribution to wildlife as a whole to be related to attitudes about lethal management of carnivores, in contrast to Maguire et al. (2020), who only considered mind attribution to whales and found this to have no unique effect on a generic measure of sustainable behaviour.

4.5.1 Implications for the Qualitative Study (Reported in Chapter 5)

As previously discussed, the sustainable variables that were described by studies in the present review largely refer to pro-environmental behaviours, i.e., where reference is made to the "environment" as a whole, as opposed to behaviours relating to species or species conservation. Where "conservation behaviours" are referred to, they entail resource conservation. A series of studies measured behavioural *intention* relevant to species: Wang and Basso (2019; Studies 2, 3a, and 3c) found attitudes toward eating meat/guilt to mediate between anthropomorphism and intention to purchase meat. No study measured pro-nature behaviour specifically. As such, the grounded theory study described in *Chapter 5* specifically explores psychological factors entailed in pro-nature behaviour.

The studies described in the present review, by and large, did not consider high-cost behaviours. The one exception is two studies by Tam (2019; Studies 2 and 3): both studies included private-sphere behaviours (personal resource and energy-conservation behaviours like reducing water and electricity use, and engaging in behaviours that would reduce one's greenhouse gas emissions, such as avoiding eating meat and recycling) as well as higher-cost behaviours occurring in the public sphere, such as volunteering with an environmental group or organising an

environmental petition or protest. As such, the grounded theory study of *Chapter 5* (as well as the subsequent chapters) will consider both lower-cost/private behaviours, as well as higher-cost behaviours/those with a social dimension.

4.5.2 Conclusion

This review summarises the highest quality evidence for anthropomorphism of non-human species and nature and its associations with sustainable variables. There is relatively good evidence that anthropomorphism increases connectedness to nature and that this in turn increases other sustainable attitudes and behaviours. Empathy and guilt have also received consistent support for their association with anthropomorphism, although experiments are needed to confirm whether the former is causally associated with anthropomorphism. The findings suggest that anthropomorphism might be a helpful tool for achieving public support for conservation in some circumstances, although more evidence is needed as to the limitations of this strategy in terms of which species or elements of nature are associated with sustainable outcomes when they are the focus of anthropomorphism, and whether anthropomorphism could backfire for some people, when presented in a certain way. Future work is needed to clarify any differential benefit of manipulating anthropomorphism in relation to pre-existing levels of dispositional nature connectedness, guilt, and empathy toward nature. To improve the quality of studies for any future reviews, correlational studies should focus on statistically controlling for correlations in relation gender and possibly age, and experiments should employ manipulation checks.

Chapter 5 Qualitative Findings: A Grounded Theory of Pro-Nature Behaviour

[This chapter is linked to a published paper: Williams, M. O., Whitmarsh, L., Haddock, G., & Mac Giolla Chríost, D. (2021). A grounded theory of pro-nature behaviour: from moral concern to sustained action. Sustainability, 13(16), 8944.]

5.1 Chapter Overview

Chapter 5 is the qualitative chapter of the thesis. In this chapter, I present the rationale for an exploratory investigation of psychological factors that drive pro-nature behaviour. I summarise the study methodology and then present my findings in the form of a grounded theory of pro-nature behaviours. Intrinsic value beliefs about particular species are theorised to be important for affording moral consideration to those species, whereas instrumental value beliefs impede this process. Generalised intrinsic value beliefs stimulate moral concern for nature, whereas external (usually social) triggers give rise to sporadic pro-nature behaviour. Sustained behaviour is supported by developing an internalised morality around this issue, as well as developing a pro-nature social group.

5.2 Introduction

As noted in *Chapter 1*, we are in an ecological crisis of our own making. More than two-thirds of monitored vertebrate species decreased in population size between 1970 and 2016 (WWF, 2020). Biodiversity loss and ecosystem decline are caused by human activities that lead to habitat loss, resource overuse, the introduction of invasive species, and climate change (Nielsen et al., 2021c). Although hundreds of governments are signing up to the United Nations' Sustainable Development Goals (United Nations, 2015), Nielsen et al. (2021a) noted that individual human behaviour will need to change in order to conserve biodiversity.

At the level of individual actors, very little is known about the factors that might facilitate or inhibit behaviour to conserve biodiversity. In *Chapter 1* it was noted that most of the research on sustainable behaviour has focused on pro-environmental behaviours which reduce carbon footprint and focus on the environment in general (pro-environmental behaviours) (Li et al., 2019) rather than behaviours that concern nature and non-human species more specifically (pro-nature behaviours) (Richardson et al., 2020). Richardson et al. (2020) have argued that we need to understand the factors giving rise to pro-nature behaviours if we are to develop a more sustainable way of interacting with nature.

There is a lack of theory to explain pro-nature behaviours, in contrast to pro-environmental behaviours, where well-known theories have been applied. For example, Yadav and Pathak (2017) tested the applicability of the theory of planned behaviour (TPB) (Ajzen, 1991) to pro-environmental behaviour. The researchers found that key variables in the TPB accounted for participants' purchase of green products: the intention to do so, which in turn was predicted by attitude toward the behaviour, subjective norm, and perceived behavioural control. Another theory is that of bounded rationality, in which humans' capacity for rational behaviour is limited by habits, heuristics, and emotions (Kahneman, 2003). Elements of this theory have received support in the case of pro-environmental behaviours, such as the role of habits and negative emotion in intention to reduce food waste (Russell, Young, Unsworth, & Robinson, 2017) and the dominance of subjective versus objective costs of recycling as a predictor of recycling behaviour (Lange, Brückner, Kröger, Beller, & Eggert, 2014).

One notable theory of pro-nature behaviour comes from Clayton, Fraser, and Burgess (2011), who proposed that concern toward nature depends on the belief that non-human species can experience "humanlike" emotions and cognitions (i.e., anthropomorphism, or mind attribution to nature in particular) (Epley et al., 2007). As discussed in *Chapter 4*, there is evidence that anthropomorphism of nature is associated with, and can influence, pro-environmental behaviours; however, there is much less evidence that this is influential for pro-nature behaviour. Another account of pro-nature behaviour is nature connectedness, in which the degree to which people see themselves as part of nature influences the value placed on nature, as natural entities will be included in the cognitive representation of oneself (Schultz, 2000). Richardson et al. (2020) showed connectedness to nature to be predictive of variance in pro-nature behaviour, while Hughes et al. (2018) reported an association between children's connectedness to nature and the probability of carrying out pro-nature behaviours.

As discussed in the previous chapters, a limited number of studies have adopted a qualitative approach to the area of pro-nature behaviours; there are only a handful of examples (Ranjan et al., 2019; Schenk et al., 2007), and these studies have focused in on specific groups, such as farmers. The current study is an attempt to better understand everyday pro-nature behaviours and the psychological and contextual factors that might encourage them, in order to bring new insights to a poorly understood area. The aim of this study is to take a grounded theory approach (Strauss & Corbin, 1990) to developing a theory that can explain pro-nature behaviours. The broad question being asked in this study is: "What psychological factors are associated with pro-nature behaviours?"

5.3 Method

5.3.1 Participants

Twenty participants were interviewed, with the only requirements that they be 18+ years of age and fluent English speakers. I began with a convenience sample of 11 undergraduate students recruited from a UK university. Students were all psychology students who received course credit for participation. Gifford and Nilsson (2014) reported that most studies had found younger participants to have more environmental concern than older groups, and it was reasoned that this group of participants would be most likely to evidence some of the pro-nature views and behaviours of interest in this study. Seven of these interviews took place in person and an additional four took place remotely due to Covid-19 restrictions. Students varied considerably as to whether they engaged in pro-nature behaviour, and those who did identified the following: eating a diet perceived to minimise the suffering of non-human species (e.g., a vegan diet), donating to conservation charities, and trying to convince others to engage in pro-nature actions.

A second - pro-nature - group was recruited via social media (six participants) as part of theoretical sampling (Charmaz, 2006), in order that the theory could better account for people who engage in regular pro-nature behaviour. This was achieved by advertising the study on “Facebook” groups centred around veganism, environmentalism, and climate change activism. Interviews took place remotely (via “Zoom”). These participants identified a variety of everyday pro-nature actions: eating a diet perceived to minimise the suffering of non-human species (e.g., a vegan diet), donating to conservation charities, choosing to pursue a conservation education, taking a job in the field of conservation, carrying out conservation projects, as well as social actions such as trying to convince friends and family to engage in pro-nature behaviours and asking local shopkeepers to change their practices.

A third contrasting group was recruited (animal workers; three participants) as part of theoretical sampling to investigate how potential differences in attitudes toward non-human species could be influential. The study was advertised on Facebook groups for abattoir/meat workers, farmers, and veterinarians. Their interviews took place remotely. There was one livestock veterinarian, one ex-farmer who provided environmental consultation to farmers, and one abattoir worker. Only one participant in this group evidenced pro-nature behaviours, which consisted of adopting animals that needed a home and raising a type of animal that was at risk of extinction.

I aimed to sample a diverse range of ages and to obtain a sample balanced by gender. The age range of the sample was 18 to 59 (M = 28.25 years; SD = 12.63; see Table 5.1). Fifteen participants were based in the UK (where the study was conducted), and there was one participant

based in each of the following countries: Australia, Belgium, Nigeria, Bangladesh, and Nepal. Four of the international participants were in the pro-nature group and one was in the animal workers group.

Table 5.1: Mean Age and Gender Makeup of Each Participant Group.

Group	Mean Age (*SD*)	Gender makeup
Undergraduates	20 (2.79)	7 women; 4 men
Pro-nature group	37 (12.26)	1 woman; 5 men
Animal workers	41 (15.87)	2 women; 1 man

The first interview took place on 13.02.2020 (face-to-face). The first remote interview took place on 12.08.2020. The final interview took place on 10.12.2020.

5.3.2 Procedure

Ethical approval to run the study was obtained from Cardiff University (reference: EC.19.11.12.5827RA). Participants read an information sheet and completed a consent form, and then a demographic information form (see *Appendix D*). The first seven participants completed a card-sort task (adapted from Doran, Böhm, & Hanss, 2018). Participants saw a row of cards, each one with the name of a non-human species and were asked to re-arrange the cards in order of most to least similar to humans (see *Appendix E* for the cards shown to participants). This prompted a conversation about species, and participants were then asked about the characteristics that they liked and disliked about different species, the empathy they felt for species, and the species that they would choose to protect over others and how they would do this (see Table 5.2).

The card sort task was discontinued following the seventh interview due to the move to online interviews during Covid-19; also, participants' responses had begun repeating similar themes during the task. Subsequent interviews instead covered the same topics through conversation and posing questions to participants.

I transcribed and coded the interview material in parallel with ongoing data collection, to allow for subsequent interviews to be adapted in order to elaborate on key theoretical concepts and address gaps. For example, the initial questions for interviews were adapted to include questions about feeling connected to nature, to ask about early life experiences with nature, and to ask about the social context surrounding participants' pro-nature attitudes and behaviour.

Interviews were terminated after 20 participants as the theory that I had developed was deemed to adequately account for the range of constructs and their properties (i.e., theoretical saturation) (Charmaz, 2006). This number is typical for grounded theory studies intended to generate new explanatory models (Thomson, 2010).

Table 5.2: Initial Interview Questions.

Interview Question
1. [Card sort task] Why did you rate the species over here as most similar to humans?
2. [Card sort task] Why did you rate the ones over here as least similar to humans?
3. Which species do you think are most similar to humans?
4. Which species do you think are least similar to humans?
5. Which species do you like the most?
6. Why do you like these species?
7. Which species do you like the least?
8. Why do you like these species less?
9. Which species do you feel most empathy for?
10. Why do you feel empathy for these species?
11. Which species do you feel least empathy for?
12. Why do you feel less empathy for these species?
13. If you knew that humans could destroy the habitat or environment of any of these species, which species would you most like to protect?
13.a. Why did you choose this species?
13.b. What lengths would you go to in order to protect this species?
14. Which species would you care least about protecting?
14.a. Why did you choose this species?
14.b. What lengths would you go to in order to protect this species?

5.3.3 Analysis of Interview Material

Grounded theory (Strauss & Corbin, 1990) is an inductive method that can be used to build an understanding of psychological or social processes. This methodology generates theory grounded in the close inspection of qualitative material; it seeks to understand "what is going on in the data" (Glaser, 1978, p. 94). Audio-recorded interviews were transcribed, and the resulting transcripts were analysed using NVIVO (2018). Grounded theory unfolded via a set of operations for developing theory from transcribed interviews, which were then used as a flexible guide for ensuring that the developing theory was grounded in the interview material. I carried out all of these stages and consulted with the supervisory team at various stages. The first stage was open coding, in which I identified a list of basic concepts in participants' interviews and created categories of codes. Axial coding followed, in which the relationships between categories were considered. Finally, selective coding involved the identification of a core category: a higher level of abstraction to which all other categories relate. *Appendix F* shows an example of open, axial, and selective coding for an excerpt of an interview transcript.

The grounded theory technique of line-by-line coding was employed to maximise a bottom-up focus on participants' material without referring to theory at an early stage, and the constant comparison method was used throughout to help elevate the codes to more abstract conceptual levels (Charmaz, 2006). I engaged in dialogue with the supervisory team, who assisted with identifying codes to represent the material, contributed to the sampling strategy and, following theory development, suggested relevant theories and empirical work to compare/contrast with the present study's findings.

In using memos (Charmaz, 2006) I attempted to bracket my own perspectives when building the theory. As an individual who strongly supports animal rights, I am aware that my own beliefs about the treatment of nature would likely influence theory development. One way of mitigating this was to remain curious about concepts that were novel to me, and not to ignore the instances in which participants' responses contradicted what I might have expected.

It appeared that every participant was describing an experience akin to empathy when discussing reasons to oppose harming species, and *empathic concern* had become a provisional central concept to explain why people objected to harming other species or went out of their way to help species; however, theoretical sampling (Charmaz, 2006) called on me to identify counterexamples, particularly as empathy was a concept I was explicitly raising with participants in earlier interviews. From a post-positivist rationale, I reasoned that I would need to determine whether concern for species could be present in the *absence* of an empathic response in order to limit confirmation bias (Nickerson, 1998). This was the main basis for theoretical sampling: I intended to

find participants for whom empathic concern for species might be absent to see whether concern for harming species would also be absent in these individuals (as would be suggested by my developing theory). *Participant 17* – an abattoir worker – provided a pivotal counterexample which challenged the developing theory: this participant expressed concern for species but denied any response to species' emotional experience (i.e., empathy). This participant reasoned from a *moral* standpoint that it was wrong to harm species. A process of comparing this new conceptual code with prior and subsequent interview material revealed that the concept of morality had far-reaching explanatory value (see *Section 5.4*) and was a better conceptual fit to the interview material than empathic concern. *Appendix G* provides two example memos to exemplify their use in conceptual and theoretical development at this stage.

5.4 Results and Theory

Two central concepts were identified as an explanation for pro-nature attitudes and behaviours: *moral consideration* (the extent to which particular species were perceived as worthy targets of moral behaviour) and *moral concern* (the extent to which participants objected to known harm caused to species by humans). All other key concepts related in some way to *morality* in the explanation of pro-nature attitudes and behaviour. First, my model identifies species factors that determine which species were considered worthy of moral consideration. Second, I describe factors that explain the presence or absence of moral concern for humankind's impact on other species, and pro-nature behaviour.

5.4.1 Which Species Attract Moral Consideration?

Species differed in whether they were considered worthy of moral consideration. I adapted Singer's (2011) concept of the *moral circle* to describe the set of species judged to be worthy of moral consideration. Two beliefs were found substantially to influence species' admission to the moral circle. Species with intrinsic value (i.e., deemed valuable in their own right and not merely for their usefulness to humans) were deemed worthy of moral consideration. Species that were perceived purely in terms of their instrumental value (either the harm they cause to humans or the benefits they could bring to human through their use) and had no perceived intrinsic value were not given moral consideration (see Figure 5.1).

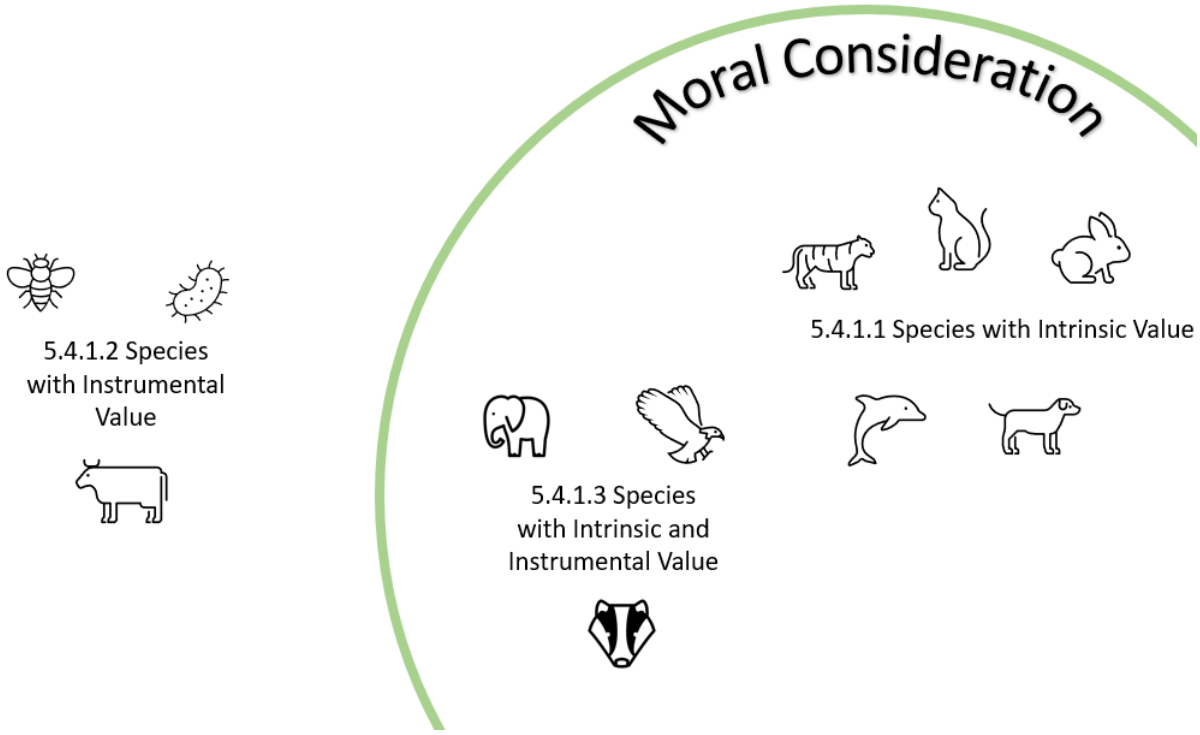


Figure 5.1: An illustration of the grounded theory (species-level factors as determinants of moral consideration). species in the diagram are those discussed by participants. numbers relate to corresponding sections in the narrative summary.

5.4.1.1 Intrinsic Value. Participants evoked intrinsic value (a species' value regardless of its usefulness to humans; Kortenkamp & Moore, 2001) to explain their objection to causing harm to the species. Other justifications for moral consideration of species resonated with the wider literature on intrinsic value: species' right to exist (Phillips, Beaumelle, Eisenhauer, Hines, & Smith, 2020), their right to be here, and objecting to humans' interference with the natural course of the species' evolution and causing their extinction (Lockwood, 1999).

"You know, why would you pay two thousand pounds for a dog when you could rescue one that's probably still young, got a load of life left in it, um we've got horses they're all rescue horses. Why not? We can…we can give those animals a better life. And I'd rather do that than spend thousands of pounds buying something that's just been bred to make people money." (Participant 20)

Most participants, across all groups, described intrinsic value beliefs toward specific creatures, including pets but also wild animals such as tigers and chimpanzees.

5.4.1.2 Instrumental Value. Instrumental value, by contrast, was a basis on which participants justified a lack of moral consideration for a particular species (in the absence of intrinsic

value). Instrumental value beliefs entail perceiving species in terms of their usefulness to humans, which some have argued is the conceptual opposite of intrinsic value (O'Neill, 2001). Perceiving species to be harmful to human interests was conceptualised as negative instrumental value, and perceiving species to have a beneficial use for humans was termed positive instrumental value. Species either perceived as negative or positive in terms of instrumental value (and where there was no perceived intrinsic value) were not afforded moral consideration.

To start with an example of negative instrumental value, *Participants 3* and *4* explained why they would be more protective of bees over wasps, and both accounts made the distinction between wasps' deliberate harm to humans, as opposed to bees' relative harmlessness.

As for positive instrumental value, one participant, who worked in an abattoir, justified killing cows on the basis that they could be used for human benefit (food) and had no intrinsic value. He indicated the role of social context in shaping his views:

"Always seen cows as meat and milk. I've just always grown up with steak, mince, burgers, milk…" (Participant 17)

This participant indicated that other species in general had intrinsic value, and opposed the poaching of beloved species on the basis that they lacked instrumental value:

"…why do it, same with other animals, like bears…what other animals get used for their skins…pointless killings…we don't eat them…we don't do anything with their meat, we just take their skin…there's no point killing them…" (Participant 17)

5.4.1.3 Intrinsic and Instrumental Value. Some species were described as having both intrinsic and instrumental value. These were deemed worthy of moral consideration, and where harm toward them was deemed justified this was to be done in a humane fashion. For example, the veterinarian considered badgers worthy of moral consideration and explained her support for culling (in order to prevent the spread of tuberculosis to cows) that would minimise their suffering:

"…and obviously it's only allowed to happen over a short period of time. So you don't traumatise badgers and their cubs and that sort of thing. So, yeah, it's one sentient animal versus another [cows], you know, it is a balance…" (Participant 16)

Other species perceived to have both types of value included elephants, mink, and predatory bird species, and there was a similar moral reasoning process that balanced the harms entailed in culling species against the harm that would come to humans or other species through non-action.

A vegan participant, who described a general belief that all species have intrinsic value, explored his reasons for considering it justifiable to kill wasps:

"I guess I didn't like the way they'd been in my wasp trap killing some of my moths really…uhm…so it's almost like a punishment in a way, I suppose it's a punishment thing…which I don't really agree with capital punishment anyway…yeah I'm not gonna do it anymore…it was wrong…" (Participant 15)

Here we can see the reasoning that brings wasps within the moral circle. The participant came to realise that his actions toward wasps based on their negative instrumental value were incongruous with his views about non-human species' intrinsic value.

5.4.2 Who Engages in Pro-Nature Behaviour?

The participants were categorised according to their degree of pro-nature behaviour. Some individuals expressed moral concern but engaged in no current pro-nature behaviour. Some described pro-nature behaviour that was sporadic. Finally, some individuals described sustained pro-nature behaviour. I conceptualised these groups of participants as representing three different stages of pro-nature behaviour development (see Figure 5.2) and the following sections describe the factors that appear to facilitate individuals to reach each stage.

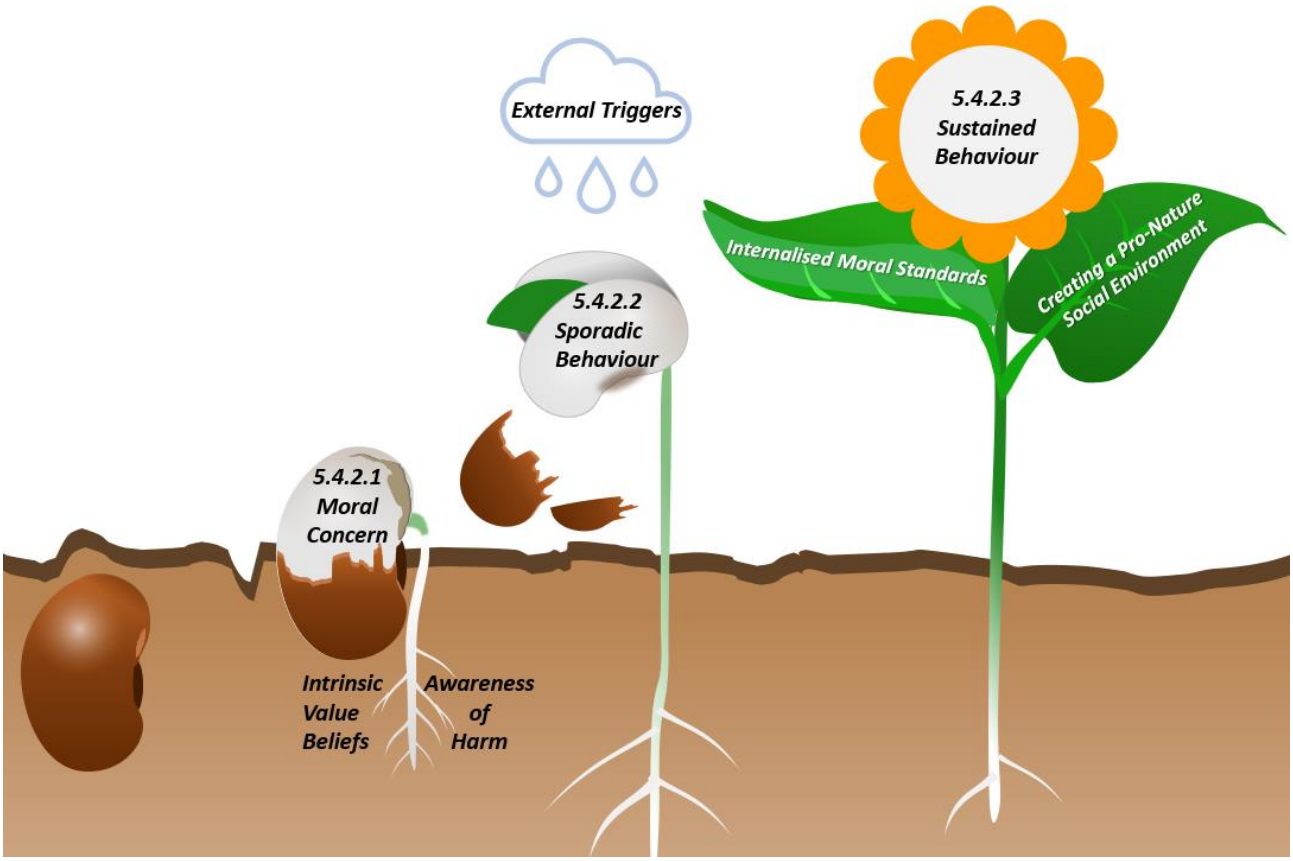


Figure 5.2: An illustration of the grounded theory (individual-level factors that explain differences in moral concern and sporadic/sustained pro-nature behaviour). numbers relate to corresponding sections in the narrative summary.

5.4.2.1 Moral Concern. Expressions of moral concern for the harmful actions of humans against non-human species came from everyone in the pro-nature group, four of the students, and two of the animal workers. Moral concern appeared to arise out of two factors in combination: (i) a general belief in the intrinsic value of non-human species and (ii) the awareness that humans are causing harm to these intrinsically valuable targets.

I define general intrinsic value beliefs similarly to the above definition of intrinsic value as applied to individual species: the belief that all non-human animals or species have value aside from their usefulness to humans (Kortenkamp & Moore, 2001).

"This is our planet, and we need to look after it…cos this is where we live this is our home this is everyone's home, and we're not the only ones living here, there's other animals, so we need to live together." (Participant 17)

Exposure to species in childhood, and having pets, were sometimes referred to as a source of developing a generalised belief in species' intrinsic value.

"…you realise that they [pets], I suppose, have got a right to live and have a nice life, and you can kind of extend that to all animals, so you think why…you know why are pets special, like…" (Participant 15)

The awareness of harm to species in the context of intrinsic value beliefs was associated with moral concern for the harm caused by humans to non-human species. Seldom did participants spontaneously express concern about harm where humans were not obviously culpable. The participants described a permeable boundary between their own and others' morality, expressing anger, frustration, guilt, and sometimes horror over humans' harmful behaviours toward other species.

"I personally think hunting is horrible, I wouldn't be friends with someone who is a hunter personally, it's not very nice it's disgusting, but these species need to be protected because they're part of the earth, they're not there to be hunted and killed." (Participant 13)

"You just feel guilty, like we're not the only species on the planet. And to wipe out millions of other species is just selfish." (Participant 19)

Some participants explained that the interconnectedness of nature is a motivator for moral concern and attitudes toward nature. I conceptualised this as contributing to the awareness of the harm that humans can and could cause other species through their actions.

"I'm not very spiritual, I do believe in the butterfly effect, I think there's a balance in nature that needs to be respected, that should be respected, in the sense that everything is connected, the water, the land…" (Participant 10)

Moral concern by itself was not associated with participants' actions to help nature but some participants described *avoiding* causing harm to species.

"It's just making sure that nothing I do directly affects trees, or try not to directly affect trees." (Participant 2)

5.4.2.2 Sporadic Behaviour. Three participants (all of them students) described sporadic pro-nature behaviour. Sporadic behaviours included making one-off donations to conservation charities, occasionally eating a diet perceived to minimise the suffering of non-human species (such as a vegan diet) or encountering a distressed animal in the real world and acting to

alleviate its suffering. External triggers appeared to facilitate these sporadic actions, such as witnessing a suffering creature, watching a documentary, and prompts to act from one's social circle.

"The people I live with at uni, a lot of them are vegetarians. And and they're always like telling me, like and like sending me to videos and things like that, and just sort of saying it would be really, really good if you did this." (Participant 18)

The participants also expressed motivation to be perceived positively by one's social circle, and not wanting to behave out of keeping with others' expectations.

"…with environmentalists like Greta Thunberg, it's kind of cool to support her and be 'right on'…" (Participant 14)

Externally-triggered behaviours appeared to require ongoing prompts, as evidenced in the following quote:

"But then again, I don't know whether I'd be able to maintain those behaviours when I do come home." (Participant 18)

5.4.2.3 Sustained Behaviour. Nine participants described sustained pro-nature behaviour (everyone in the pro-nature group, two students, and one animal worker). The following behaviours were described: eating a diet perceived to minimise the suffering of non-human species (e.g., not drinking milk), donating consistently to conservation charities, choosing to pursue a conservation education, taking a job in the field of conservation, carrying out conservation projects, rescuing animals in need of a home, and breeding species at risk of extinction. Some individuals described social actions to try and convince others to take up pro-nature behaviours, such as asking shopkeepers not to use plastic bags. Two factors set these individuals apart from the others: internalised moral standards and creating a pro-nature social environment.

All of those engaging in sustained pro-nature behaviour indicated that they had internalised a set of moral standards. Their behaviour was internally-motivated as opposed to externally-triggered. These participants described a sense of obligation or responsibility to act.

"I'm trying to do my best to make differences in my own life to kind of reduce the effect I have." (Participant 14)

Conversely, a lack of personal responsibility for addressing the harms caused by humans was a consistent theme across participants who did not engage in any pro-nature behaviour. These participants either expressed confusion about who should act or argued that only governments or big corporations could/needed to act and saw no role for themselves.

"…it's more up to the government of the countries to stop hunting them…" (Participant 17)

Some of the participants engaging in sustained pro-nature behaviour described it as a means of elevating self-esteem, or that they would experience guilt on a regular basis over aspects of their life that were not perceived to be nature-friendly. This is consistent with an internalised personal standard for self-evaluation. When asked what would happen to her behaviour if she were to move away from her pro-nature friends, one participant replied:

"Um I'd like to think it'd probably stay the same…because it is always…it is kind of a self-esteem boost to think that you are making change as well […] you can't really forget it once you've done all the research and all of that…I think the guilt would be there…" (Participant 14)

Another participant explained his reasons for not consuming animal products:

"It's an industry and uh these animals are made to give more and more and more milk and they're killed for beef, so it feels really bad, you know there's an instance in fact my you know when you have a cup of coffee or when you're having some milk to drink, you used to say you know you are drinking a cup of sin…" (Participant 11)

Most of the participants who engaged in self-motivated pro-nature behaviours described a process of creating a social environment comprising individuals with similar views. This was achieved in a variety of ways, including seeking out social groups, friends, and partners with pro-nature views, or by arguing in favour of pro-nature attitudes and behaviours with their existing circle of family and friends. Three of these participants were in the pro-nature group, one was a student, and one was an animal worker. These social connections often led to obtaining more information about how to behave in a pro-nature fashion.

"[Joining social media groups is] a way to meet people, I thought, meet likeminded people…that was my main motivation…for actually joining to be honest, I mean now it's not that at all, it's just useful as they tell you what products are available, what new products are out, where you get cheap vegan stuff on offer and stuff like that…" (Participant 15)

Hence, while the social milieu might be an external prompt for pro-nature behaviour for some, those who have internalised a moral standard of pro-nature identity may deliberately curate pro-nature social surroundings that align with and reinforce their own values and behaviours.

5.5 Discussion

The present study found many factors to be associated with variation in participants' pro-nature behaviour. While instrumental value is often described as valuing a species for what it can do

for humans, I used the concept more broadly to capture the fact that participants could either perceive a species as being detrimental to human interests or as being useful in some way to further human interests. This is similar to Serpell's (2004) concept of positive and negative utility. Species perceived in terms of either positive or negative instrumental value (in the absence of intrinsic value) were not granted moral consideration. It has been posited that instrumental value beliefs set up a conflict between the interests of other species and the interests of humans. Amiot and Bastian (2015) applied ideas on intergroup relations, such as the Social Identity Theory of Tajfel, Austin, & Worschel (1979), to human-animal relations, suggesting that we morally disengage from other species when engaging in inhumane conduct, in the way it has been suggested we do with other humans (Bandura, 2011). Using species sometimes means causing harm, and there is evidence that humans are motivated to create psychological distance between themselves and other species in a way that legitimises exploitation: Bastian, Loughnan, Haslam, and Radke (2012) showed that reminding people that an animal is used for food led to a denial of the animal's mental capacities, and that having an expectation that one was about to eat meat also led to a denial of animals' mental capacities. Bastian et al. (2012) proposed that such denial is a kind of psychological manoeuvre for reducing cognitive dissonance (Festinger, 1957), in which the disparity between a behaviour (causing harm to an animal) and an attitude (it is wrong to cause harm to things that have minds) creates psychological discomfort which motivates an attempt to resolve the disparity.

Two of the animal workers group in the present study justified harming species on the basis that this would bring some value to humans (eating meat) or would limit harm to human interests (culling badgers to protect livestock); the pro-nature group, on the other hand, expressed objections to exploiting species to benefit humans ("positive utility"; e.g., the large-scale dairy industry). However, even those in the pro-nature group discussed the occasional need to cause harm to species that were harmful to human interests ("negative utility"; e.g., culling invasive species). These results are aligned with previous findings that instrumental value beliefs are more concentrated among animal workers; for example, Hills (1993) found their sample of animal workers (farmers) to score particularly highly on instrumental value beliefs compared with their animal rights group sample. Hills (1993) also reported that famers had reduced empathy specifically for animals that had instrumental value for them, and this is echoed in the present study's findings, such as the abattoir worker's defence of valued species whilst seeming to keep an emotional detachment from livestock.

I adapted Singer's (2011) concept of the moral circle to illustrate the boundary between species that were granted moral consideration and those that were not. The contribution of this study is that believing in species' intrinsic value (i.e., their value in their own right, and not only for what they can do for humans) appears to grant species access to the moral circle, regardless of perceptions of the species' instrumental value. Instrumental value, by contrast, appears to exclude

species from the moral circle when species are not also perceived to have intrinsic value. There was one instance in which the expansion of moral consideration from humans to non-human species happened “live”: the participant who invoked his objection to a human law (capital punishment) as justification for his decision no longer to kill a particular species (wasps). In this example, it appeared as though instrumental value (in this case, the harmfulness of the wasp) was a justification for causing harm but realising that this was inhumane led to an intention to change the behaviour. This example resonates with work by Stone and colleagues on hypocrisy induction (summarised in Stone & Fernandez, 2008), in which it has been shown that highlighting the inconsistency between a person’s attitudes and their behaviour can lead to behaviour change.

Generalised beliefs about the intrinsic value of non-human species, coupled with awareness of harm caused to species by humans, appeared to distinguish those who expressed moral concern over the harm caused to species by humans from those who did not. Whereas external prompts appeared to account for sporadic pro-nature behaviour in some, those who engaged in sustained pro-nature behaviour described an internalised morality with respect to nature. This is consistent with research on motivation which distinguishes extrinsic and intrinsic motivation, the former driven by external factors, such as rewards, and the latter by internal factors, like values (Deci & Ryan, 2013). Another feature of this last group was that they sought to create a social environment of like-minded others.

The empirical literature on pro-nature behaviour supports many of the findings in the present study. The association between nature connectedness and pro-nature behaviour has been shown in one study to be mediated by concern for non-human species, as opposed to concern for human welfare (Gosling & Williams, 2010), consistent with the importance of moral concern in my theory. Previous research has shown that pet ownership is associated with concern for species preservation and less support for strategies that put human needs above those of wildlife (Shuttlewood, Greenwell, & Montrose, 2016). Chawla (2015) also summarised research findings in which concern for non-human species is enhanced by exposure to and exploration of nature in childhood. Pets were often mentioned by participants as influencing how they saw other species, consistent with Amiot and Bastian (2015), who noted that pets can become spokespersons for all species, leading to a generalisation of positive attitudes from pets to other animals (Bowd, 1984; Serpell & Jagoe 1995). The theory presented in this study offers a possible pathway for these influences: interaction with species, including pets, could facilitate the development of a generalised belief in the intrinsic value of non-human species.

The model I present in this study could be seen as an extension to the Value-Belief-Norm (VBN) model of Stern et al. (1999). As described in *Chapter 2*, the VBN model posits that values

(such as biospheric values) lead to a generalised worldview in which humans are seen to have an impact on the natural world, and more specific beliefs that (i) there are consequences of environmental decline for valued targets (such as other humans), and (ii) one is responsible for contributing to/alleviating these consequences. These beliefs lead to a personal moral norm, in which there is a sense of obligation to engage in a variety of pro-environmental behaviours. The internalised moral standard that I have proposed in my model is conceptually similar to the personal moral norm in the VBN model.

A feature of the grounded theory that is additional to the VBN model is that people who have formed personal standards of pro-nature behaviour act to bring their social environment in line with their personal beliefs, which leads to more sustained pro-nature behaviour. There are at least two mechanisms by which this might lead to sustained pro-nature behaviour. First, immersing oneself in a particular group would bring one into contact with a new set of social norms. It has been shown that social norms can be internalised as personal norms; for example, a meta-analysis by Klöckner (2013) showed that personal norms mediate the influence of social norms on pro-environmental behavioural intention. Second, pro-nature identity might also play a role. While participants did not spontaneously refer to identity, surrounding oneself with like-minded others implies holding a particular view of oneself and seeking contact with the in-group (cf. Tajfel et al.'s [1979] Social Identity Theory), and continued contact with a particular group may come to strengthen one's sense of identity (e.g., as an animal lover). Stern et al. (1999) noted that identity may be an important variable not measured in their survey validation of the VBN model, which could explain high-cost activism, and my findings indicate that this may be an important factor in sustained pro-nature behaviour. The frequent moral concern over human behaviour could also be explained by Social Identity Theory (Tajfel et al., 1979), in which humans are motivated to evaluate their own social group in a positive light as self-evaluation depends, in part, on social identity. Others' perceived immorality with respect to nature might threaten a positive sense of self.

The VBN model does not distinguish between sporadic and sustained behaviour, whereas the theory presented in the present study proposes that sporadic pro-nature behaviours can be triggered by external prompts, such as social messages. The role of triggers in the present study's theory has parallels with subjective norms in the Theory of Planned Behaviour (Ajzen, 1991), where the intention to perform a behaviour is shaped by perceptions of how one would be judged by important others for (not) performing the behaviour (injunctive norm) and perceptions of others' attitudes toward the behaviour (descriptive norm). The concept of identity could also explain the difference between the externally- and internally-motivated participants. Zunick, Teeny, and Fazio (2017) advanced the concept of the self-defining attitude, whose function is to help people to define their identity and to communicate their identity to others. Zunick et al. (2017) found that individuals

were more likely to advocate publicly for a self-defining attitude than an attitude that did not serve a self-defining function. In fact, the internalised moral standards I propose in my model could be reflective of self-defining attitudes, whereas externally-triggered behaviours might rely on attitudes about those behaviours that have a social-adjustive function i.e., those that support ongoing membership in a desired social group (Smith, Bruner, & White, 1956). Further work applying attitude functions in this area would help to clarify this. It would be interesting to investigate the influence of attitude functions on the success of hypocrisy inductions (Stone & Fernandez, 2008), as one might expect that individuals would be more motivated to resolve discrepancies between behaviours and self-defining attitudes than other kinds of attitudes.

It is notable that, while discussions about species' similarity to humans (cf. anthropomorphism) were used as a starting point for questions in the first interviews, this was not identified as an account of pro-nature behaviour in the theory. Participants were also asked about empathy, but this was not deemed to be sufficiently explanatory of pro-nature behaviour to be included in the theory. It might be that anthropomorphism and empathy intersect with some aspects of my theory. Seeing species as similar to humans may lead us to attribute to species the intrinsic value that we attribute to humans. Indeed, moral consideration of other species, which I propose rests on intrinsic value beliefs, has been shown to be predicted by the belief that animals have a mind (Díaz, 2016), and empathy toward nature entails perceiving other species as having their own experience (Tam, 2013). Quantitative investigations would be helpful to clarify the association between these concepts and how, together, they might predict pro-nature behaviour.

The theory advanced in the present study provides a potentially useful heuristic for conservation messaging tailored to individuals. For example, people who already believe in species' intrinsic value but who are yet to engage in pro-nature behaviour may be more persuaded by messaging focused on building awareness of harm caused to species by humans. For others, beliefs in species' intrinsic value may be more important to establish before introducing other messages. Chapman, Lickel, and Markowitz (2017) advocated for more research to test the power of tailoring messages to people's affective responses to environmental decline, highlighting anger as an emotion that motivates individuals to redress social injustice (Thomas, McGarty, & Mavor, 2009). Participants in the current study expressed anger, among other emotions, when discussing the impact of humans on other species, but more research is needed to clarify the role of emotion in motivating pro-nature behaviours. As previously discussed, the attitudes held by participants may have a variety of functions and tailoring on this basis may also be a fruitful avenue to explore; it is known that matching the content of persuasive messaging to the functional basis of an individual's attitude can lead to greater persuasion (Maio et al., 2018).

Conservation campaigns often use a “flagship” species to attract funding and rally support for a cause (McGowan et al., 2020). The present study provides a theory suggesting that those species deemed valuable in their own right, and not just as a means to an end for humans, might be particularly suited to a flagship role. To the best of my knowledge, the role of beliefs about intrinsic value in predicting support for conservation campaigns has not been empirically tested, which would be a valuable contribution to the literature.

Sarkar (2008) argued that attributions of intrinsic value are counterproductive to conservation as they would prevent undertaking necessary actions such as culling invasive species. This argument is not supported by the findings of the present study, for two reasons. For one, some species (e.g., mink) were attributed both intrinsic and instrumental value by the same participants. This mirrors the findings of Arias-Arévalo, Martín-López, and Gómez-Baggethun (2017) that people attribute both types of value to the Otún River watershed in Colombia. Secondly, participants described beliefs in species’ intrinsic value whilst also supporting measures to kill species in a process of utilitarian reasoning about the balance of harm associated with various options.

There is a broader debate within conservation biology as to the merits of appealing to people’s sense of what nature can do for them (instrumental value) versus valuing nature for its own sake (intrinsic value) (e.g., Kareiva, 2014). From a position of pragmatism, regardless of the reasons that conservation programmes wish to protect species, my results suggest that encouraging beliefs about the intrinsic value of non-human species could mobilise individuals to assist with these goals. Kareiva (2014) argued that appreciating what species can do for us could at times be helpful for conservation efforts; while this may be true in cases where species can benefit humans without being exploited, the present study highlights the importance of further specifying instrumental value to include *how* species can be beneficial, i.e., whether this would require some kind of exploitation.

5.5.1 Implications for the Quantitative Studies (Chapters 6 & 7)

The theory advanced in this study is merely one plausible account of the interview material and there are likely to be many other ways to account for participants’ responses. As such, the next step is to test facets of the theory, such as whether generalised intrinsic value beliefs predict sustainable behaviour (*Chapters 6* and *7*), and how instrumental value beliefs are associated with sustainable behaviour (*Chapter 7*).

The participants in the present study reported pro-nature actions spontaneously and there was no checklist of behaviours. It is likely that the participants did not identify the full range of pro-nature behaviours; for example, no participant mentioned voting for pro-nature parties. This study shed some light on pro-nature behaviours with a social dimension, but many of the behaviours

reported were private-sphere behaviours that would not necessarily be very costly. It would be useful for follow-up investigations of sustainable behaviour to explicitly investigate a range of behaviours differing in costliness (*Chapters 6* and *7*). Finally, participants did not always find it easy to separate motivations underlying pro-nature actions as opposed to pro-environmental behaviours more generally; further work is needed to establish whether these behaviours have different motivational bases, and quantitative approaches could help with this (*Chapter 7*).

5.5.2 Conclusion

In this chapter I have presented a grounded theory of pro-nature motivations and behaviour. Moral concern for non-human species was deemed a central factor to explain pro-nature behaviour, both sporadic and sustained. The grounded theory shares similarities with previous empirical findings and theories and includes novel proposals. I conclude that intrinsic value beliefs about non-human species are an important component of moral concern for nature. The study contributes to the ongoing debate about the relative value of intrinsic and instrumental value beliefs for promoting individuals' conservation behaviour and provides some nuance as to when these beliefs might help or hinder conservation efforts. Sporadic behaviour can result from external prompts to act, while sustained behaviour is associated with internalised moral standards and the creation of a pro-nature social environment. Further work would be beneficial to test facets of the model using quantitative methodologies.

Chapter 6 Quantitative Findings I: Exploring Predictors of Pro-Environmental Behaviour in a General Population UK Sample

[This chapter is linked to a published paper: Williams, M., Whitmarsh, L., Haddock, G., Mac Giolla Chríost, D. (2023). Credoau am werth cynhenid a pherthynol byd natur: sut maent yn cydberthyn ag ymddygiad cynaliadwy yn y Deyrnas Unedig? Gwerddon, 35, 26–46.]

6.1 Chapter Overview

Chapter 6 is the first of two quantitative surveys in this thesis and analyses the psychometric properties of measures of nature beliefs and sustainable behaviour in an approximately representative general population UK sample. The study explores how empathy toward nature and humans dissociate in predicting sustainable behaviour, and tests how an array of nature beliefs (intrinsic value beliefs, biospheric values, empathy toward nature and connectedness to nature) predict three kinds of pro-environmental behaviours (resource conservation, consumption, and high-cost). High-cost pro-environmental behaviour appears to be solely predicted by connectedness to nature and empathy toward nature.

6.2 Introduction

The interlinked crises of climate change and worldwide ecological decline require lifestyle changes in order to lessen humanity's impact on the environment (Intergovernmental Panel on Climate Change) (IPCC, 2018). While there is a public mandate for governments to enact environmentally-friendly policies in the UK (Whitmarsh et al., 2021) and internationally (Steentjes et al., 2021), support for policies drops sharply when costs to the individual are highlighted (Whitmarsh et al., 2021). A greater understanding of the psychological drivers of sustainable behaviour, including costly ones, is important to encourage public transition to a more sustainable lifestyle.

Governments and other organisations frame information to present problems, and their solutions, in ways most likely to inspire public consent for policies. Frames present problems in a particular light, including who is responsible and what should be done, and simplify information by focusing on specific aspects (Nisbet, 2009). Governments and policymakers often frame nature in terms of what it can do for humans (The United Nations Economic Commission, 2007); however, little is known about how the public perceives nature and the influence that different kinds of nature belief might have on sustainable behaviour.

The preceding chapters have identified a range of nature beliefs, but their prevalence in the UK, and their ability to predict pro-environmental behaviours in the UK public, is not understood. Many of the measures of these beliefs have not been thoroughly investigated for their psychometric properties in a UK sample. In this chapter I present a study that seeks to validate measures of nature beliefs (intrinsic value beliefs, biospheric values, empathy toward nature, and connectedness to nature) and a measure of pro-environmental behaviours in a general population, approximately representative UK sample. The study also provides an initial investigation of the unique associations of nature beliefs (when controlling for the influence of age and gender) with three different kinds of pro-environmental behaviours in the UK: resource conservation, consumption, and high-cost.

6.3 Method

6.3.1 Participants

Participants (*n* = 500) were recruited via the website “Prolific” (www.prolific.co), which provided a stratified sampling approach to generate an approximately representative sample of the UK population based on age and gender. The only inclusion criteria were that participants needed to be currently resident in the UK and at least 18 years of age. There were 255 women, 244 men, and one person who identified their gender as “Other”. The mean age of the sample was 44.6 (range: 18 - 81).

6.3.2 Measures

In addition to providing demographic data (gender and age), participants provided data for the following measures:

1. Items reflecting participants’ intrinsic value beliefs were taken from two measures, both indicating participants’ beliefs in non-human species’ right to exist (reflecting statements made by participants in the *Chapter 5* study, and in line with the concept of intrinsic value) (Phillips et al., 2020, p. 4). One instrumental value belief item was also included, as instrumental and intrinsic value beliefs are often considered conceptual opposites (O’Neill, 2001), so were seen as potentially two ends of a continuum (one factor).

    a. Participants completed the *New Ecological Paradigm Scale* (Dunlap et al., 2000), which measures an environmental worldview in which human actions can adversely impact the environment and other species. Participants indicate the extent to which they agree with statements, such as "We are approaching the limit of the number of people the earth can support". Participants respond to each item on a 5-point Likert scale from "strongly disagree" to "strongly agree"). This

measure has been found to have criterion validity, content validity, construct validity, and internal consistency (Dunlap et al., 2000). The item taken from this measure to reflect intrinsic value beliefs was: “Plants and animals have as much right as humans to exist”.

b. One intrinsic value belief item was chosen from the *Environmental Attitudes Questionnaire* (adapted from Rauwald & Moore, 2002), which assesses different types of attitude about the environment (moralistic/aesthetic, dominionistic, utilitarian, and humanistic); the item was “All life in nature has a right to exist” (participants were asked to rate the importance of this idea on a 10-point Likert scale, from “unimportant” to “very important”). Another item was taken from this measure to reflect instrumental value beliefs: “A dog trained for a task, like a hunting dog (or a dog to protect the house), is generally a better dog than one owned just as a pet” (participants were asked to rate the degree to which they agreed with this statement on a 10-point Likert scale, from “strongly disagree” to “strongly agree”).

2. Biospheric values were measured using items from the *Value Orientations Scale* (De Groot & Steg, 2008), which measures egoistic, altruistic, and biospheric values. Participants indicate how important various values are as guiding principles in their lives, e.g., the values of having wealth (egoistic), equality (altruistic), or preventing pollution (biospheric). Values are rated on a 9-point Likert scale in terms of their level of importance, from -1 (“opposed to my values”) to 7 (“extremely important”). There are 12 items in total, four for each value type. The scale has shown good construct validity and internal consistency (De Groot & Steg, 2008). As noted in *Section 2.3.5*, these three values have emerged as distinct factors when this measure’s construct validity has been examined. Furthermore, biospheric and altruistic values have different effects on outcomes such as pro-environmental behavioural intention when biospheric and altruistic goals conflict (De Groot & Steg, 2008).

3. Connectedness to nature was measured with the *Connectedness to Nature Scale* (Mayer & Frantz, 2004), which assesses a perception of being a part of nature. A sample item is the statement “I often feel a sense of oneness with the natural world around me.” The scale contains 14 items that are rated on a 5-point Likert scale (1 = “strongly disagree”; 5 = “strongly agree”). The scale has demonstrated good convergent validity, construct validity, internal consistency, and test-retest reliability (Mayer & Frantz, 2004).

4. Empathy toward nature was measured with the *Dispositional Empathy toward Nature Scale* (Tam, 2013). An example item is “I imagine how I would feel if I were the suffering animals and plants.” Items are answered according to a 10-point Likert scale from “strongly disagree” to “strongly agree.” There are 10 items in total. It has shown good construct validity, incremental validity, and internal consistency (Tam, 2013).

5. Empathy toward people was measured with the *Interpersonal Reactivity Index* (Davis, 1980), with items relating to four theoretical components: empathic concern, perspective-taking, personal distress, and fantasy. A sample item is the statement “I often have tender, concerned feelings for people less fortunate than me.” The scale contains 28 items that are rated on a 5-point Likert scale (1 = “does not describe me very well”; 5 = “describes me very well”). It has shown good test-retest reliability, and its subscales have shown good internal consistency and correlations with each other (Davis, 1980), although studies have differed in the numbers of factors extracted (e.g., three factors reported by Alterman et al. [2003] in contrast to the four reported in the original paper by Davis [1980]). The scale has good convergent and divergent validity (Alterman et al., 2003).

6. Self-reported pro-environmental behaviours were measured with the *Pro-Environmental Behaviours Scale* (Whitmarsh et al., 2017). Participants respond to each item on a 10-point Likert scale (from “not at all in the past year” to “at least once a day”) covering a range of household resource-conservation behaviours (e.g., recycling, turning off the tap when brushing one’s teeth), consumer (e.g., eating organic, local and seasonal food), and high-cost/public-sphere behaviours (e.g., doing something with others to address an environmental issue). The factors extracted may depend on national and cultural context (Whitmarsh et al., 2017).

6.3.3 Procedure

Ethical approval to run the study was obtained from Cardiff University (reference: EC.19.11.12.5827RA). Participants completed the measures via the survey site Qualtrics. After reading the information sheet, providing consent to take part, and completing demographic information (see *Appendix D*), participants were presented with the questionnaires in a randomised order. After completing the measures, participants saw a debrief screen with more information about the study. Participants were paid £8.22/hour *pro rata* for their participation. All data were collected on December 7, 2019.

6.3.4 Data Cleaning

All data cleaning and analysis took place using RStudio (2021). After reverse-scoring of items, missing data were dealt with. It has been recommended that, for large datasets, there should be no more than 5% missing data (Alice, 2015); one case had > 5% missing data and was removed from the dataset, leaving a final sample of n = 499.

Two cases were missing < 5% of data and multiple imputation was undertaken in order fill missing values and provide a complete dataset (Rubin, 1988). Multiple imputation employs an algorithm to create values for missing data and uses regression to predict the value of the missing data using other values in the dataset; it is an effective way of managing missing values in datasets (Graham & Hofer, 2000). Multiple imputation assumes that data are missing at random, which was confirmed to be the case for the dataset.

6.3.5 Power

The sample size was deemed sufficient for all planned analyses. For exploratory factor analyses, the minimum absolute sample size and ratio of observations per variable for each analysis was surpassed (often recommended as n = 100 and a minimum ratio of 5:1 cases per item; Hair et al., 2019). The sample was sufficient for regression analyses: G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) was used to calculate a minimum sample size for the regression analyses (with 6 predictor variables for each regression, a minimum sample size of 98 would be required for a medium effect size [f^2 = .15], α = .05, with 80% power to detect a true effect).

6.3.6 Assumption Checks

Data were checked for assumptions relevant to each analysis. Prior to conducting exploratory factor analyses and ordinary least squares (OLS) regressions, the data were tested to ensure they met the assumptions for this test (homoscedasticity and normality of residuals, no multicollinearity [Field, Miles, & Field, 2012], linearity, and additivity [Steyerberg, 2008]). All analyses were found to meet these assumptions, with the exception that some regression analyses deviated from the assumption of homoscedasticity. When homoscedasticity was violated (i.e., residuals showed heteroscedasticity: an unequal distribution at different values of the predictor variables), heteroscedasticity-consistent standard errors were calculated, which are a means of reducing bias in OLS regression that might otherwise result from heteroscedasticity and is a recommended adjustment to OLS regression in these circumstances (Hayes & Cai, 2007; Pek, Wong, & Wong, 2018). More detail about variables that did not meet the assumption of heteroscedasticity is provided in *Sections 6.4.4* and *6.4.5*.

Correlations between all variables were computed before regression analyses to explore relationships of interest between variables and to detect potential collinearity between predictor

variables, which might affect the results of regression analyses. Due to some variables showing slight deviation from normality, Spearman's correlations were conducted. Multicollinearity was assessed for each regression analysis using the variance inflation factor, which indicates the presence of multicollinearity when it is > 2.5 (Johnston, Jones, & Manley, 2018). There was no evidence of multicollinearity in any regression analyses.

The Kaiser-Meyer-Olkin (KMO) statistic was calculated for each measure on which exploratory factor analysis (EFA) was performed, which showed each measure to have adequate sample size (KMO >.5; Field et al., 2012). Bartlett's test of sphericity was also conducted on these measures, which found the correlations between items to be significant, as required for exploratory factor analysis (Field et al., 2012). Multivariate outliers were removed from the data prior to each EFA and regression analysis by calculating Mahalanobis distances, leverage, and Cook's distances (Tabachnick & Fidell, 2007). Mahalanobis distances calculate the distance from a data point to the other data points and determine whether a participant's scores are above a cut-off taking into account all of their scores (i.e., an outlier). Leverage is a measure of a case's influence over the regression slope that is being calculated and compares the change in the slope when the person's data are included versus when they are excluded; it determines a case to be an outlier if they are above a certain cut-off in terms of the amount of influence over the regression slope. Cook's distances measure a case's influence over the slope as well as its distance from the other data, and again a person's data are deemed an outlier if the value surpasses a cut-off. To avoid over-reliance on one measure of multivariate outliers, each case in the dataset was given a score of 1 for each of the three tests for which they were above the cut-off. When a participant scored 2 or more, they were deemed a multivariate outlier and their data were excluded from the analysis (a commonly used strategy: e.g., Fox, 2020; Katsioloudes, 2015).

6.3.7 Exploratory Factor Analysis

6.3.7.1 Procedure. EFA was deemed an appropriate method for exploring how items cluster together into *factors*, which can reflect putative real-world mechanisms (latent constructs) that give rise to patterns of responses on survey measures (Leandre, Fabrigar, & Wegener, 2012). EFA is similar to principal component analysis (PCA), which also reduces the number of variables to a smaller number of clusters (*components*), but they are fundamentally different methods in terms of the assumptions made about these clusters. PCA, unlike EFA, does not assume that its components reflect an underlying (latent) construct. EFA differentiates between common variance (shared by variables in a factor) and unique variance (not shared, and caused by something else: measurement error), whereas PCA assumes no measurement error and does not differentiate between different kinds of variance (Knekta, Runyon, & Eddy, 2019). EFA, for this reason, is

considered a superior method for exploring constructs that might underlie responses on measures (Leandre et al., 2012).

There are three common methods for deciding on the number of factors to be extracted in EFA:

- Scree plot inspection (Cattell & Vogelmann, 1977). This method first extracts factors from the data and calculates the eigenvalue for each factor, which is the amount of common variance in the variables explained by their factor. The scree plot is a graph of the eigenvalues on the y-axis against each factor (listed along the x-axis). The plot shows a curve of eigenvalues decreasing in value from left-to-right, and the point at which the curve suddenly tails off indicates the number of factors that should be retained. Inspecting scree plots has been found to be a reliable method for factor selection for sample sizes above 200 (Stevens, 2012). However, the method of visually inspecting a plot to determine the number of factors is subjective and researchers may disagree on the number of factors indicated by any given plot. Field et al. (2012) recommend using additional criteria for determining the number of factors to be extracted.

- Applying Kaiser's criterion (Kaiser, 1974). This is a convention in which all factors with an eigenvalue above 1 are retained, as this represents a substantial amount of variation explained by a factor (Field et al., 2012). This can be a reliable method under certain circumstances (e.g., when the sample size is higher than 250 and the average communality is > .6) (Stevens, 2012). This rule can lead to overestimations in the number of factors when there is sampling error (Field et al., 2012) and draws a somewhat arbitrary distinction between factors with eigenvalues just above and just below 1 (Fabrigar, Wegener, MacCallum, & Strahan, 1999).

- Parallel factor analysis (Horn, 1965). This is a method of creating an artificial dataset of random numbers using a Monte-Carlo simulation and compares the eigenvalues of the dataset to the eigenvalues of the actual data. Research has tended to show parallel analysis to be more reliable than other methods of determining the number of factors (e.g., Kaiser's criterion) (Silverstein, 1977, 1987; Zwick & Velicer, 1986).

There is no consensus in the literature on the single best method for determining the number of factors to account for variance among items, and the advice is usually to combine the above methods (Fabrigar et al., 1999; Field et al., 2012). In *Chapter 6*, all three methods were used for each factor analysis; when there was disagreement between the number of factors recommended by each method, EFAs were conducted multiple times to explore each different factor solution.

Principal axis factoring was used to extract the number of factors indicated by these methods, using an oblique rotation (Oblimin) as it was assumed that there would be some degree of correlation between factors (Costello & Osborne, 2005). A decision as to the appropriate number of factors to extract was made on the following bases:

- First, the table of factor loadings was inspected, which showed the amount of variance explained by each factor for each of its items. Items were removed one-by-one according to Tabachnick and Fidell's (2007) criterion for removing items with loadings <.32. Items with communalities of less than .2 were also removed (Child, 2006), where communality refers to the amount of common variance between a variable and the other variables, as opposed to variance that is not shared with the other variables (unique variance). Items that cross-loaded substantially (i.e., both items loaded on at least two factors at 0.32 or above and with difference of < .20 between the primary and secondary factor) were removed (Lu, Chow, & Loken, 2017). Items were removed until a stable factor structure was reached (i.e., all items loading .32 or above with no significant cross-loadings, and each having a communality of .2 or above). Where more than one factor solution reached a stable structure after item removal, factor solutions that required the least amount of item removal in order to reach their stable structure were favoured. Factor solutions were also favoured if each factor had at least three items, as factors with fewer than three items have been deemed less stable (Costello & Osborne, 2005).

- Stable factor solutions were only retained if they were theoretically plausible and interpretable with reference to latent constructs (Fabrigar et al., 1999).

6.3.7.2 Measures that Underwent EFA. Three of the measures in this study had not had their validity and reliability extensively tested on a general population UK sample: these were the *Connectedness to Nature Scale* (Mayer & Frantz, 2004), the *Interpersonal Reactivity Index* (Davis, 1980), and the *Dispositional Empathy toward Nature Scale* (Tam, 2013). A measure was also constructed for this study to reflect intrinsic value beliefs, which also underwent EFA to explore its factor structure (see *Section 6.3.2*). EFA was conducted on the *Pro-Environmental Behaviours Scale*, as no EFA has been previously reported for this measure in a UK context (only PCA) (Whitmarsh et al., 2017). Finally, the *New Ecological Paradigm* also underwent EFA in order to examine its factor structure ready for its use in testing an extended Value-Belief-Norm model (Stern et al., 1999) in *Chapter 7* (see *Section 7.2.2.2*); the authors of this measure (Dunlap et al., 2000) recommended that researchers inspect its factor structure at the outset as studies have tended to find a variety of different factor solutions, which may be sample-specific.

6.3.8 Multiple Regression

6.3.8.1 Procedure. To determine the unique contribution of each nature belief to variance in sustainable behaviour, multiple (linear) regression was used. Multiple regression entails estimating the value of the outcome variable (scores on a sustainable behaviour measure) for each level of the predictor (scores on the nature belief measure). Multiple regression typically uses the OLS method to calculate a line of best fit (a straight line on a graph in which the predictor is plotted against the outcome variable) by calculating the line in which the distance between each data point and the line is as small as possible (i.e., the residuals, or the deviation between the line and the observed data that it is designed to explain). The model estimated using OLS can then be compared to a baseline model that assumes no relationship between the predictors and the outcome; this model is specified as the mean score of the outcome for each value of the predictor variables.

Simultaneous ("forced entry") multiple regression was used, in which all predictors are entered into the model at the same time (Field, 2012). This provides an output giving the total amount of variance in the outcome explained by the predictors, as well as indicating which predictor(s) contribute a significant amount of unique variance to the model. Because predictor variables commonly correlate with one another, a multiple regression removes (i.e., partials out) any contribution to the outcome variable that is jointly determined by the variables, which gives an estimate of the unique remaining variance explained by each predictor, i.e., that does not overlap with the other variables.

Another common method is the hierarchical multiple regression (Field et al., 2012). This is a means of determining the contribution of predictors to a statistical model above and beyond the predictive power of other variables, in which multiple models are calculated with an increasing number of predictor variables. This can be a helpful method when there is prior theory as to which variable(s) should be predictive of the outcome (the first variable(s) to be entered into the model), and where the aim is to calculate the additional unique contribution made by a particular variable. However, this thesis was concerned with several conceptually overlapping variables, most of which had prior evidence for their prediction of sustainable behaviour, and there was no *a priori* reason to treat these in a hierarchical fashion.

6.3.8.2 Predictors and Outcome Variables. For each regression there were six predictors: gender; age; intrinsic value beliefs; biospheric values; empathy toward nature; connectedness to nature. Three regressions were conducted, one for each type of pro-environmental behaviour: resource-conservation; consumption; high-cost.

6.3.8.3 Dominance Analysis. The RStudio package "*dominanceanalysis*" (V.2.0.0; Navarrete & Soares, 2020) was used to determine the relative importance of predictors in each regression (Azen & Budescu, 2003). Dominance analysis examines the R^2 values of all possible predictor combinations and performs pairwise comparisons of all predictors to measure their relative importance, i.e., which is dominant over the others. The output provides a separate R^2 value for each predictor which indicates its individual contribution to the variability of the outcome.

6.4 Results

6.4.1 Exploratory Factor Analysis

All measures included in the study underwent EFA. A summary of the final factors for each measure is now provided (see *Appendix H* for a list of final items and excluded items for each measure, including standardised factor loadings, and a description of the process of arriving at a final factor solution for each).

For the *Dispositional Empathy Toward Nature Scale* (Tam, 2013), a theoretically-interpretable one-factor solution was chosen (in keeping with previous research) (Tam, 2013), retaining all 10 items of the original measure (Cronbach's α = .96).

For the *Interpersonal Reactivity Index* (Davis, 1980), a three-factor solution was chosen. The factors consisted of items labelled Empathy (E; a combination of items from the Empathic Concern [EC] and Perspective-Taking [PT] subscales of the original measure of Davis [1980]), Personal Distress (PD), and fantasy (F)[1]. This is consistent with research that has found one factor containing EC and PT subscales and separate F and PD factors (Alterman et al., 2003; Siu & Shek, 2005). Davis (1980) argued that the EC and PD factors reflect the emotional reactions of empathy, whereas PT and F involve a more cognitive aspect of taking others' perspectives (in real life or in fictional situations). It is notable that the E factor in the present study combines the EC and PT items, covering both emotional and cognitive aspects of empathy. This finding is in line with the results of Cliffordson (2001) in which a factor was found containing items reflecting both aspects of empathy. The E factor in the present study was not highly correlated with the PD factor (r = -0.05) or the F factor (r = 0.37) (Cohen, 1988), which was very similar to the subscale intercorrelations reported by Alterman et al. (2003). It has been argued that the F and PD factors of the *Interpersonal Reactivity Index* measure broader features that are correlated with empathy – namely, imagination and emotional regulation –

[1]E items: 2-4, 8, 9, 14-15, 18, 21, 22, 28; PD items: 6, 10, 17, 19, 24, 27; F items: 1, 5, 16, 23, 26

as opposed to measuring empathy *per se* (Baron-Cohen & Wheelwright, 2004). These scales were therefore not included in statistical analyses, in line with the approach of some previous research (Péloquin & Lafontaine, 2010). This also provided the advantage of making the *Interpersonal Reactivity Index* items in the present study as conceptually similar to empathy toward nature as possible (as measured by the *Dispositional Empathy Toward Nature Scale*) (Tam, 2013), except for one's focus on humans and the other's focus on non-human species[2]. The E factor (henceforth: empathy toward people) had a Cronbach's α value of .84.

A one-factor solution was chosen for the *Connectedness to Nature Scale*, consistent with previous research (Mayer & Frantz, 2004). Two items from the original measure were removed due to low factor loadings (items 12 and 14). Cronbach's α for this measure was .90.

A three-factor solution was chosen for the *Value Orientations Scale*, consistent with its theoretical latent constructs and the findings of previous research (De Groot & Steg, 2008). The three factors were egoistic, altruistic, and biospheric values[3]. Due to this study's focus on nature beliefs, only the biospheric scale was included in analyses[4]. Cronbach's α for the biospheric values was .92. A one-factor solution was found for intrinsic value beliefs, which had quite a low value for Cronbach's α (.59); this is to be expected with only two items (Tavakol & Dennick, 2011).

Although the *New Ecological Paradigm* was not included in analyses in this chapter, it underwent exploratory factor analysis using this chapter's data to explore its factor structure ready for inclusion in the analyses of *Chapter 7* (as part of a test of the Value-Belief-Norm model of Stern et al. [1999]; see *Section 7.2.2.2*). A one-factor solution was found for this measure, consistent with

[2]Of the 28 items in the original measure, 22 items were retained and 6 removed due to cross-loadings/low factor loadings. The E subscale consisted of original items in the EC (minus item 20) and PT (minus items 11 and 25) subscales. The F subscale included items from the original F subscale minus items 7 and 12. The PD subscale included items from the original PD subscale minus item 13.

[3]Egoistic items: 1-4; altruistic items: 5-8; biospheric items: 9-12.

[4]Egoistic, altruistic, and biospheric items were the same as those found in previous factor analyses (De Groot & Steg, 2008). Egoistic items relate to values about personal wealth, power, authority, and influence; altruistic values reflect valuing equality, peace, social justice, and being helpful to others; biospheric values reflect valuing pollution prevention, unity with nature, protecting the environment, and respecting the Earth.

some previous studies (as summarised by Dunlap et al., 2000). Three items were removed for having communalities below .02: items 1, 6, and 9. Cronbach's α for this measure was .86.

For the *Pro-Environmental Behaviours Scale* (Whitmarsh et al., 2017), a three-factor solution was chosen. This required the removal of two items due to low factor loadings/cross-loadings (items 12 and 16), yielding a stable factor solution. These three factors were consistent with the categories reported for the original measure (Whitmarsh et al., 2017): low-cost energy/resource conservation and waste reduction behaviours (henceforth: resource-conservation behaviours); mostly consumer behaviours (henceforth: consumption behaviours); and committed/"public-sphere" behaviours (henceforth: high-cost behaviours)[5]. The resource-conservation factor had a Cronbach's α value of .58, which is considered low; due to a small number of items, it was decided that all would be retained as none seemed to be a better or worse reflection of resource-conservation behaviours. Consumption and high-cost behaviours had Cronbach's α values of .81, and .84, respectively. Each factor was significantly correlated with the other. More detail on each factor and the endorsement of their items in the sample is provided below:

1. Resource-conservation behaviours were named as such as items described behaviours that would conserve energy (e.g., turning off lights when not in use) or limiting waste of resources such as food/water. These behaviours appeared to be more household-related and low-cost in terms of effort, finances, and social costs. 90.5% of the sample reported performing each of these behaviours at least 2-3 times in the past month, on average.

2. Consumption behaviours generally described actions relating to the purchase of products (e.g., food) that are considered to be more environmentally-friendly (e.g., organic food, food with less packaging) or limiting the purchase of new products. These behaviours would not be considered particularly socially or financially costly, or costly in terms of effort entailed. 47.13% of the sample reported performing each of these behaviours at least 2-3 times in the past month, on average.

3. High-cost behaviours described actions that are more costly in terms of effort (e.g., getting involved in conservation work) and may be more socially costly (e.g., attending a protest). These behaviours might also entail a degree of additional financial cost (e.g., as they might involve travel to new places). These were all behaviours that would take place in the public-

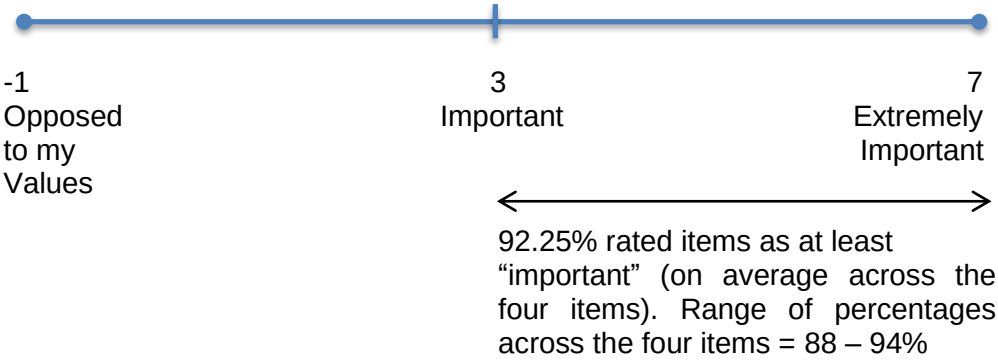
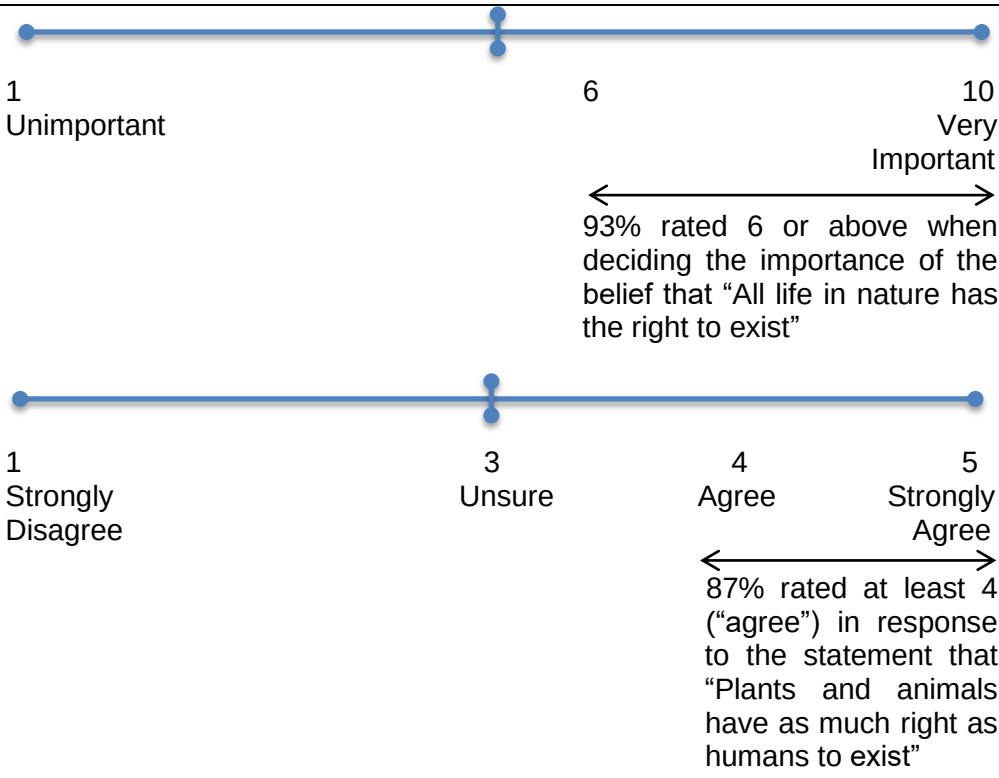
[5]Resource-conservation pro-environmental behaviours: items 1-6; consumption pro-environmental behaviours: items 7-11 and 13-15; high-cost pro-environmental behaviours: items 17-22.

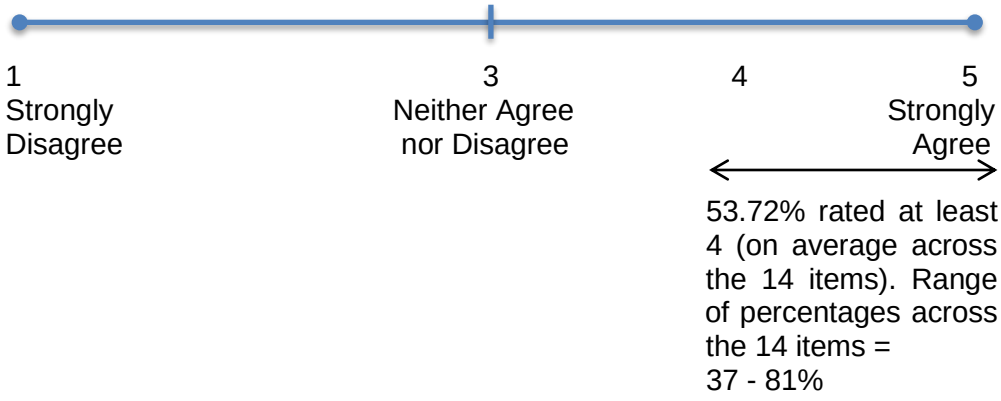
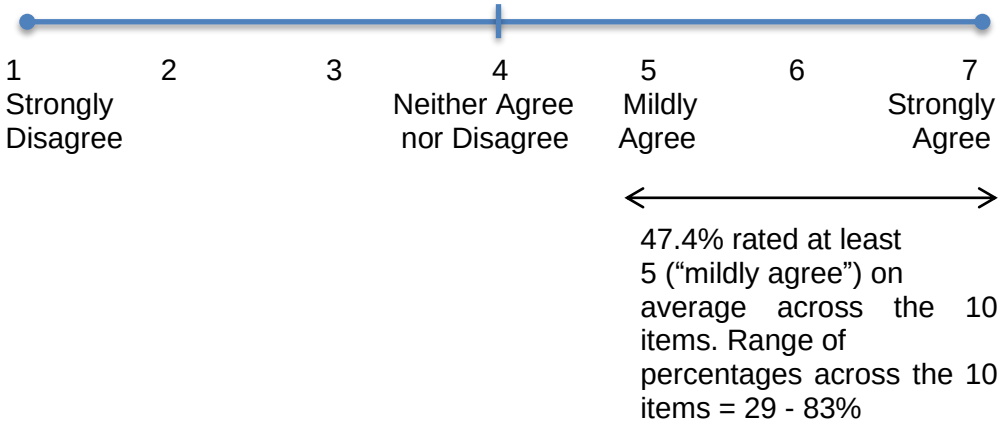
sphere, in that they described actions taking place with others, most of which would not have a direct impact on the environment but would have a wider, systemic impact. In this sense they could also be considered more impactful behaviours (Nielsen et al., 2021b). 3.83% of the sample reported performing each of these behaviours at least 2-3 times in the past month, on average.

6.4.2 Prevalence of Beliefs and Sustainable Behaviour

Table 6.1 summarises the sample's endorsement of items on nature belief measures. Participants appeared to endorse biospheric values and intrinsic value belief items more highly than items reflecting connectedness to nature and empathy toward nature.

Table 6.1: Percentage Endorsement for Each Nature Belief Measure.

Belief/*Measure*	Likert scale and proportion of sample endorsing items
Biospheric values *Value Orientations Scale* (De Groot & Steg, 2008)	
Intrinsic value beliefs *New Ecological Paradigm Scale* (Dunlap et al., 2000) *Environmental Attitudes Questionnaire* (adapted from Rauwald & Moore, 2002)	

Connectedness to nature *Connectedness to Nature Scale* (Mayer & Frantz, 2004)	
Empathy toward nature *Dispositional Empathy toward Nature Scale* (Tam, 2013)	

For scales with a midpoint indicating a negligible level of agreement in either direction (on the *Connectedness to Nature* and *Dispositional Empathy toward Nature* scales, a score of 3 and 4, respectively, indicating "neither agree nor disagree"; on the intrinsic value belief item "Plants and animals have as much right as humans to exist", a score of 3 indicating "unsure"), a one-sample t-test was conducted comparing the sample's mean score with the scale's midpoint score:

1. On the *Connectedness to Nature Scale* (Mayer & Frantz, 2004), participants' scores were significantly higher than the midpoint (M = 3.55, SD = 0.03), $t(498) = 16.941$, $p < .001$, d = 0.76), indicating that the sample expressed a significant level of agreement with the items overall.

2. On the *Dispositional Empathy Toward Nature Scale* (Tam, 2013), participants' scores were not significantly higher than the midpoint (M = 4.05, SD = 0.07), $t(498) = 0.82$, p = .41, d = 0.04), indicating no significant level of agreement or disagreement with the items overall.

3. For the intrinsic value belief item “Plants and animals have as much right as humans to exist”, participants’ scores were significantly higher than the midpoint (M = 4.38, SD = 0.04), $t(498) = 34.25$, $p < .001$, $d = 1.53$), indicating that the sample expressed a significant level of agreement with the statement.

Figure 6.1 shows the proportion of the sample reporting a frequency of sustainable behaviour above the midpoint on the *Pro-Environmental Behaviours Scale* (Whitmarsh et al., 2017), separately for resource-conservation, consumption, and high-cost behaviours. The low rates of performing high-cost behaviours are consistent with their conceptualisation as relatively higher-cost than the other two categories of behaviour. *Appendix I* provides bar charts indicating the distribution of participant responses for each item on all measures of nature beliefs and sustainable behaviour.

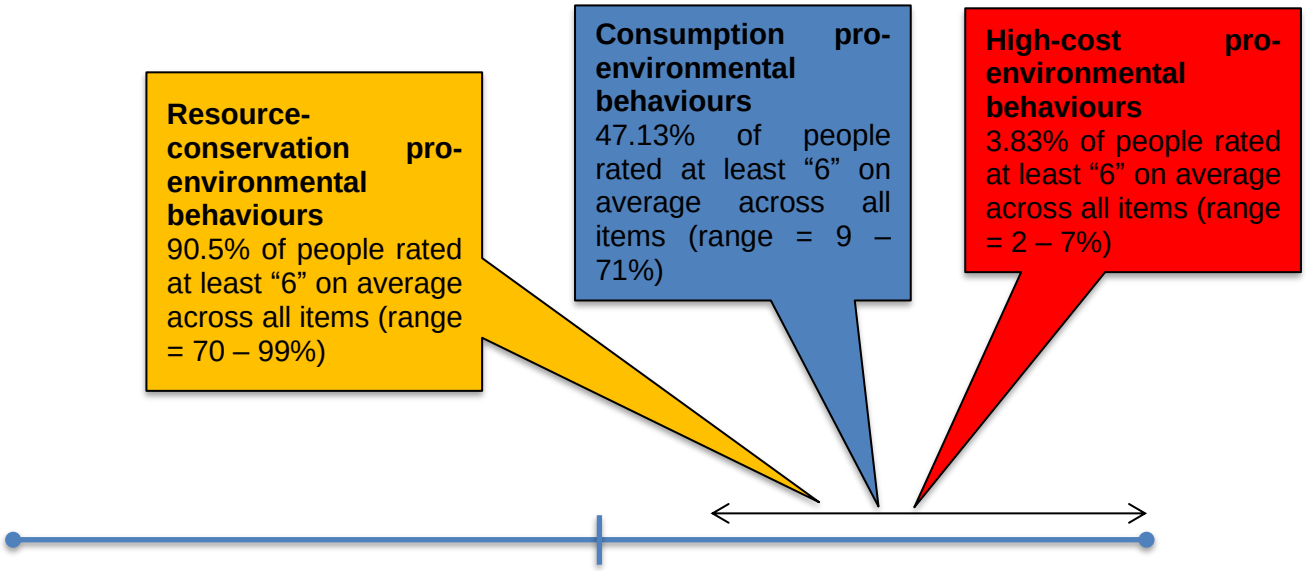


Figure 6.1: Percentage of participants selecting scores above the midpoint for each pro-environmental behaviour[6].

6.4.3 Correlations and Group Comparisons

Analyses were conducted to examine the distribution of scores for each variable. Age showed a bimodal distribution (after excluding one participant who chose "Other" for gender). Empathy toward nature and connectedness to nature showed normal distributions, whereas biospheric values and intrinsic value beliefs showed markedly negative skew. Consumption behaviours were normally distributed, resource-conservation behaviours showed marked negative skew, and high-cost behaviours showed marked positive skew. Due to these deviations from a normal distribution,

[6]All possible response options on the *Pro-Environmental Behaviours Scale* (Whitmarsh et al., 2017) were:

Not at all in the past year (1)	About once in the past year (2)	About 2 to 3 times in the past year (3)	About 4 to 6 times in the past year (4)	About once a month (5)	About 2 to 3 times per month (6)	About once a week (7)	About 2 to 3 times per week (8)	About 4 to 6 times per week (9)	At least once a day (10)

Spearman correlations were conducted on all nature beliefs, age, and pro-environmental behaviours (Table 6.2).

Spearman correlations showed significant relationships between all nature beliefs. Older participants showed higher biospheric values, more frequent resource-conservation and less frequent high-cost pro-environmental behaviours. Mann-Whitney tests were conducted to compare men and women on each nature belief (Table 6.3). Women had higher empathy toward nature, intrinsic value beliefs, as well as more frequent resource-conservation and consumption pro-environmental behaviours.

Table 6.2: Spearman Rank-Order Correlations (Cronbach's α Coefficients Along the Diagonal).

							Pro-Environmental Behaviours		
	Age	Empathy toward nature	Empathy toward people	Connectedness to nature	Biospheric values	Intrinsic value beliefs	Resource-conservation	Consumption	High-cost
Age	-								
Empathy toward nature	-0.04	(.96)							
Empathy toward people	0.03	0.39**	(.84)						
Connectedness to nature	0.07	0.58**	0.40**	(.90)					
Biospheric values	0.09*	0.47**	0.36**	0.59**	(.92)				
Intrinsic value beliefs	0.07	0.41**	0.34**	0.44**	0.59**	(.59)			
Resource-conservation pro-environmental behaviours	0.12**	0.12**	0.20**	0.20**	0.21**	0.17**	(.58)		
Consumption pro-environmental behaviours	-0.03	0.35**	0.27**	0.42**	0.39**	0.29**	0.44**	(.81)	
High-cost pro-environmental behaviours	-0.12**	0.25**	0.16**	0.32**	0.22**	0.12**	0.18**	0.54**	(.84)

Note. n = 499. *p < .05. **p < .01.

Table 6.3: Mann Whitney U Tests Comparing Men (M) and Women (W) on Subscale Scores.

Subscale	Median (M)	Median (W)	*U* (*p*)
Empathy toward nature	3.80	4.30	27180*
Connectedness to nature	3.50	3.67	28106
Biospheric values	5.25	5.50	29272
Intrinsic value beliefs	6.50	7.00	27050**
Resource-conservation pro-environmental behaviours	8.83	9.17	27164*
Consumption pro-environmental behaviours	4.81	5.38	26498**
High-cost pro-environmental behaviours	1.17	1.17	29797

Note. n = 498. *p < .05. **p < .01.

6.4.4 Analysis 1: Regression of Empathy Toward People and Empathy Toward Nature on the Three Types of Sustainable Behaviour

Standard OLS regressions were conducted with two types of empathy as predictors (empathy toward people and empathy toward nature) and three types of sustainable behaviour as outcomes (see Table 6.4). Because residuals for resource-conservation and high-cost behaviours showed some deviation from the assumption of heteroscedasticity, regressions were performed with heteroscedasticity-consistent (HC) standard errors (Pek et al., 2018)[7].

Table 6.4 shows that only empathy toward people independently predicted resource-conservation behaviours. Both empathy toward people and toward nature independently predicted consumption behaviours. Only empathy toward nature independently predicted high-cost behaviours. The R^2 values denote the variance in the outcome variable explained by the overall model, which can be categorised as weak for resource-conservation and high-cost behaviours, and moderate for consumption behaviours (Cohen, 1988).

[7]Additional OLS regressions without HC standard errors were also performed for resource-conservation and high-cost behaviours; the same pattern of overall model significance was found for both analyses, as well as the same pattern of significance for individual predictors.

Table 6.4: Simultaneous Regressions of Empathy Toward People and Empathy Toward Nature on Three Types of Pro-Environmental Behaviours, Showing Standardised Beta Coefficients (and Standard Errors).

	Pro-environmental behaviours		
	Resource-conservation[a]	Consumption	High-cost[a]
Empathy toward people	0.22*** (0.05)	0.16*** (0.05)	-0.01 (0.05)
Empathy toward nature	0.00 (0.05)	0.28*** (0.05)	0.25*** (0.05)
Observations	492	489	487
R^2	0.05	0.14	0.06
F Statistic	14.86*** (df = 2; 489)	40.20*** (df = 2; 486)	17.37*** (df = 2; 484)

Note. ***$p < .001$.
[a]Analyses conducted with HC standard errors.

6.4.4.1 Dominance Analysis. Dominance analyses were undertaken to determine the individual contribution of each type of empathy in each model, expressed as R^2 (see Table 6.5). All effect sizes were "weak" (Cohen, 1988). R^2 values show that empathy toward nature had the highest effect size for consumption pro-environmental behaviours.

Table 6.5: R^2 Values of Significant Predictors, in Descending Order for Each Outcome.

Outcome: Resource-conservation pro-environmental behaviours	
Empathy toward people	.05
Outcome: Consumption pro-environmental behaviours	
Empathy toward nature	.09
Empathy toward people	.05
Outcome: High-cost pro-environmental behaviours	
Empathy toward nature	.05

6.4.5 Analysis 2: Regression of All Variables on the Three Types of Sustainable Behaviour

Standard OLS regressions were conducted with six predictors (sex, age, intrinsic value beliefs, biospheric values, connectedness to nature, and empathy toward nature) as predictors of three types of pro-environmental behaviours (see Table 6.6). Regressions with HC standard errors were performed for resource-conservation and high-cost behaviours[8]. The variance inflation factor was <2.5 for all variables, indicating no substantial multicollinearity (Johnston et al., 2018).

No predictor was uniquely predictive of resource-conservation behaviours. Only biospheric values and connectedness to nature predicted consumption behaviours. Being a woman predicted higher frequency of consumption behaviours than being a man, and higher age was predictive of a lower frequency of consumption behaviours. High-cost behaviours were only predicted by connectedness to nature and empathy toward nature. R^2 values indicate weak effect sizes for the overall models of resource-conservation and high-cost behaviours, and a moderate for the overall model of consumption behaviours (Cohen, 1988).

[8]Additional OLS regressions without HC standard errors were also performed for resource-conservation and high-cost behaviours; the only difference was that intrinsic value beliefs were significantly predictive of resource-conservation behaviours at the $p < .05$ level.

Table 6.6: Simultaneous Regressions of Nature Beliefs and Demographic Variables on the Three Types of Pro-Environmental Behaviours, Showing Standardised Beta Coefficients (and Standard Errors).

	Pro-environmental behaviours		
	Resource-conservation[a]	Consumption	High-cost[a]
Women	0.12	0.19*	-0.02
	(0.09)	(0.08)	(0.09)
Age	0.08	-0.08*	-0.09
	(0.04)	(0.04)	(0.04)
Connectedness	0.12	0.19***	0.14*
	(0.06)	(0.05)	(0.06)
Empathy	-0.07	0.07	0.14*
	(0.06)	(0.05)	(0.06)
Biospheric values	0.12	0.22***	0.10
	(0.06)	(0.06)	(0.06)
Intrinsic value beliefs	0.11	0.06	-0.08
	(0.07)	(0.05)	(0.06)
Observations	488	487	489
R^2	0.08	0.22	0.08
F Statistic	7.06*** (df = 6; 481)	22.85*** (df = 6; 487)	6.63*** (df = 6; 482)

Note. *p<0.05; **p<0.01; ***p<0.001.
[a]Analyses conducted with HC standard errors.

6.4.5.1 Dominance Analysis. Dominance analyses were undertaken to determine the individual contribution of each nature belief in each model, expressed as R^2 (see Table 6.7). R^2 values show that biospheric values had the highest effect size compared with other predictors for consumption pro-environmental behaviours. Empathy toward nature and connectedness to nature had the same effect size for high-cost pro-environmental behaviours. The lowest effect size of all were the demographic predictors of age and gender, explaining 1% of the variance in consumption pro-environmental behaviours. The highest effect size of all was biospheric values, predicting 7% of the variance in consumption pro-environmental behaviours. All effect sizes were “weak” (Cohen, 1988).

Table 6.7: R^2 Values of Significant Predictors, in Descending Order for Each Outcome.

Outcome: Consumption pro-environmental behaviours	
Biospheric values	.07
Connectedness to nature	.07
Women	.01
Age	.01
Outcome: High-cost pro-environmental behaviours	
Empathy toward nature	.03
Connectedness to nature	.03

6.5 Discussion

This study explored the distribution of nature beliefs and sustainable behaviour, and predictors of sustainable behaviour, in an adult general population UK sample. The results demonstrated that engagement with resource-conservation pro-environmental behaviours were reported by respondents at a very high frequency, with few people not engaging in these behaviours. This is unsurprising; many of the resource-conservation behaviours in this study are highly normalised with fewer barriers to adoption (such as recycling) (Thomas & Sharp, 2013). High-cost behaviours (e.g., taking part in an environmental protest) were reported at a very low frequency, presumably due to external barriers (i.e., costs) that make it harder to perform them (Diekmann & Preisendörfer, 2003). Consumption behaviours (e.g., buying produces with less packaging) were performed at a level of frequency in between resource-conservation and high-cost behaviours. Consumption behaviours likely involve more financial barriers than resource-conservation behaviours (e.g., buying organic products) and entail behaviours that involve a degree of inconvenience (e.g., avoiding eating meat might not be feasible in every restaurant and might limit dietary options); on the other hand, they might not entail as many structural barriers as high-cost behaviours.

Older participants showed significantly higher biospheric values, in line with previous work (Sargisson et al., 2020), significantly higher levels of resource-conservation behaviours, and significantly lower levels of high-cost behaviours. Women showed significantly higher levels of empathy toward nature (reflecting previous findings: Tam, 2013) and intrinsic value beliefs, in contrast to previous work finding no gender differences (Wickizer, 2016), and a significantly higher

frequency of resource-conservation and consumption behaviours. Biospheric values and intrinsic value beliefs were endorsed by a majority of participants. There was less frequent endorsement of items reflecting connectedness to nature and empathy toward nature.

This study was the first, to my knowledge, to test differential contributions of empathy toward people and empathy toward nature to sustainable behaviour. Empathy toward nature was found to be significantly predictive of high-cost and consumption pro-environmental behaviours beyond the influence of empathy toward people and was the only predictor of high-cost pro-environmental behaviours when only these two predictors were included in the model. Empathy toward nature did not significantly predict resource-conservation behaviours beyond the contribution of empathy toward people. This pattern suggests that humans are motivated to engage in some pro-environmental behaviours due to their empathic responses to non-human species, and not simply due to their empathy toward other people.

This study is also novel in its exploration of the unique contribution of an array of nature beliefs to different kinds of sustainable behaviour. Analyses showed that all nature beliefs, except for intrinsic value beliefs, explained unique variance in at least one type of sustainable behaviour when the other nature beliefs, as well as age and gender, were controlled for. It might be that the conceptual overlap of intrinsic value beliefs and biospheric values (Dietz et al., 2005) meant that the former made no additional contribution to sustainable behaviour beyond the latter. Resource-conservation behaviours were significantly predicted by a combination of predictors, but no predictor appeared to explain unique variance. Diagnostics did not reveal multicollinearity among predictor variables; however, four out of the six variables approached significance (three had $p < .06$; one had $p < .09$) and could therefore have explained substantial variance in the outcome in combination without passing the threshold of significance as individual predictors. The combined effect of predictors on resource-conservation behaviours was small; the lack of variance in these behaviours (with the vast majority of participants performing them frequently), might explain why there was little variance to predict. Furthermore, resource-conservation behaviours might have become so habitual and so easy to perform (e.g., due to home collection of recycling by councils) that psychological factors make little additional contribution to them. The combined effect of predictors on high-cost behaviours was small, which could be due to the lack of variance overall in high-cost behaviours, with the vast majority of participants reporting them at a very low frequency. The effect size of the overall model predicting consumption pro-environmental behaviours was markedly higher than either resource-conservation or high-cost behaviours, which could be due to there being more variance in consumption behaviours.

The results are consistent with and build upon the existing literature on the importance of a range of nature-related beliefs in sustainable behaviour (Katz-Gerro et al., 2017; Mackay & Schmitt, 2019). The fact that biospheric values both received very high endorsement from the sample and predicted a higher frequency of self-reported consumption behaviours implies that it may be helpful for message framing for the general population to include information about how the climate and ecological crises pose a threat to nature and not just to humans.

An interesting finding in the present study is that high-cost behaviours can be explained by nature beliefs and, specifically, connectedness to nature and empathy toward nature; when high-cost behaviours are studied, psychological factors tend not to be predictive of them (Lee et al., 2014). My findings build on the previous findings of Martin et al. (2020), who found a moderation effect in which nature connectedness increased the impact of watching nature programmes on costly conservation behaviour (such as volunteering for conservation causes) whereas its impact was less evident in the case of less costly household behaviour (such as recycling). Connectedness to nature and empathy appeared to be less strongly endorsed in my sample than other nature beliefs, implying that framing messages to the general population from the perspective of connectedness or empathy may not be as effective.

It is important to consider why connectedness and empathy might be uniquely predictive of high-cost pro-environmental behaviours. Tam (2019) noted that both connectedness and empathy normally take place in interpersonal relationships. High-cost environmental behaviours in the study were mainly public-sphere actions involving socialising with and relating to other people (e.g., writing to a politician; setting up a recycling scheme at work). This raises the question if connectedness to nature and empathy toward nature reflect a general social orientation and explaining why they predict predominantly social behaviours. However, findings from the present study do not support this: empathy toward people (arguably a better reflection of the value someone might derive from social relationships with other people) was not independently predictive of high-cost behaviours when empathy toward nature was included in the model.

Some researchers consider connectedness to nature and empathy as reflective of relational value, i.e., value derived from one's relationship with nature (Elliott, 2020), which is considered distinct from intrinsic and instrumental value (Pascual, 2017). Connectedness to nature is the most common way of measuring beliefs about the relational value of nature (dos Santos & Gould, 2018; Knippenberg, De Groot, Van Den Born, Knights, & Muraca, 2018; Stålhammar & Thorén, 2019; Kleespies & Dierkes, 2020). Kleespies and Dierkes (2020) argued that care toward nature is another facet of relational value. Empathy toward nature encapsulates this notion, as it entails both taking another being's perspective and experiencing an emotional response to this (Smith, 2006). Klain,

Olmsted, Chan, and Satterfield (2017) explored statements reflecting relational value and noted that the most strongly endorsed statements were those referring to groups that people were a part of (e.g., family, community). These researchers argued that social processes such as group identity could be central to relational value.

It is possible that connectedness to nature and empathy toward nature are particularly predictive of high-cost pro-environmental behaviours as they indicate a sense of affiliation with the natural world as a kind of social group. Whereas connectedness to nature involves seeing oneself as part of nature, empathy toward nature entails experiencing the emotions attributed to other species, i.e., identifying with another being or group of beings. Davis, Conklin, Smith, and Luce (1996) found that, when people were encouraged to take the perspective of another person, this led to the other being included in participants' self-concept. Mackay et al. (2021) argued that a social identity approach could be relevant for understanding how connectedness to nature influences sustainable behaviour. Turner and Reynolds's (1987) Self-Categorisation Theory is a part of the social identity paradigm and an influential tool for understanding group membership and its consequences. According to Turner and Reynolds (1987), in any given situation people can move from a personal identity to a collective identity, in which they conceive of themselves primarily as a member of a particular social group. Smith (1993) proposed an extension of Turner et al.'s (1987) Self-Categorisation Theory by considering the emotional ramifications of identifying with a group that is being harmed by another group. If an individual feels a sense of kinship with nature, we might expect anger to arise from the perceived injustice to nature (the in-group) at the hands of humans (Smith, 1993). Stanley, Hogg, Leviston, and Walker (2021) reported that anger about the climate crisis is a more powerful predictor of sustainable behaviour than anxiety or depression about this topic. Panno, De Cristofaro, Oliveti, Carrus, and Donati (2021) found moral anger (at other people's lack of respect for the environment) to mediate between personality traits (openness to experience; honesty-humility) and pro-environmental behaviours. Guilt has also been found to mediate between the effect of learning about human-caused environmental harm (versus naturally-occurring harm) and actual pro-environmental behaviours (Rees, Klug, & Bamberg, 2015).

In *Chapter 4* it was noted that participants frequently expressed moral concern, guilt, and anger over the behaviour of other humans, and it was theorised that this resulted from participants' self-evaluation depending on their evaluation of the in-group's actions (Tajfel et al., 1979). For those who identify with nature as a social group, it may be that this gives rise to more intense feelings, e.g., guilt and anger from the knowledge that one belongs to a group that is being caused harm by another group (humans). Rees et al. (2015) found that presenting information in terms of human-caused as opposed to naturally-occurring environmental damage led to significantly higher actual pro-environmental behaviours (signing an environmental petition); those higher in connectedness to

nature were particularly responsive to the manipulation. A social identity approach could explain why high-cost behaviours in particular could result from affiliation with nature as a social group: as noted by Mackay et al. (2021), identifying with a group can influence people to undertake more costly and self-sacrificing behaviours (Becker & Tausch, 2015).

Another implication of nature as a group identity is the influence it might have on other beliefs known to influence pro-environmental behaviours. Martin and Czellar (2017) argued that valuing the biosphere would reasonably be a natural consequence of perceiving oneself to be part of it and provided evidence that connectedness to nature is predictive of biospheric values, which mediated its influence on pro-environmental behaviours. Identifying with nature would also be expected to enhance a personal obligation to act (i.e. personal moral norm) in order to protect the in-group. Richter and Hunecke (2022) provided evidence that connectedness to nature predicts personal norms. Insofar as connectedness and empathy are influential due to fostering a sense of group identity with nature, a messaging strategy to explore would be framing the ecological crisis as a problem for "us all" rather than separating humans from other species; however, this may work better as a strategy targeted for people high in these traits, as these experiences were not endorsed by a large majority of the sample.

Biospheric values, by contrast, are less obviously linked to identifying with the natural world. A useful concept for understanding their association with pro-environmental behaviours in the present study might be the social-adjustive function of attitudes (discussed in *Chapter 4*), i.e., attitudes that support ongoing membership in a desired social group (Smith et al., 1956). In this sense, biospheric values might be more relevant to one's affiliation with other people than with nature. While it would be unrealistic to assume that biospheric values perform a primarily social-adjustment function for every individual, Petty and Wegener (1998) theorised that some attitudes may serve a similar function for a majority of people, and I would argue that biospheric values serve this function for many. First, biospheric values were very prevalent in my sample, and data from the European Social Survey presented by Bouman, van der Werff, Perlavicitude, and Steg (2021) showed biospheric values to be highly endorsed across 28 European nations. Perceiving others in one's group to have stronger biospheric values is associated with more self-reported pro-environmental behaviours, and this effect is amplified for those who identify more strongly with their group (Bouman, Steg, & Zawadzki, 2020); this also implies a primarily social-adjustive function for biospheric values. It is noteworthy that biospheric values did not predict high-cost behaviours in the present study, which are less socially normative according to the prevalence data, whereas consumption behaviours (half of which were reportedly performed reasonably frequently by a majority of the sample) were predicted by biospheric values. A social-adjustive function (Smith et al., 1956) of biospheric values might also explain these observations, i.e., these values might be held

primarily in order to conform with what are perceived to be prevailing values in society, and also predict behaviours that are also considered to be socially desirable.

6.5.1 Implications for the Second Quantitative Study (Chapter 7)

It is helpful at this juncture to reconsider the inclusion of items measuring intrinsic value beliefs, as it was notable that intrinsic value beliefs were not found to predict any pro-environmental behaviours. A concept that is related to intrinsic value is existence value, which refers to the benefit derived from the knowledge that nature (or a particular species) exists; as nature is valued for the benefit it provides us, even a psychological or emotional one, existence value frames nature as an ecosystem service (Davidson, 2013). It has been argued that existence value and intrinsic value are mutually incompatible concepts: the first centres on nature's usefulness to humans and the latter centres on benefits to nature (Davidson, 2013) (cf. biospheric values). Participants in *Chapter 5* appeared to justify moral concern for nature mainly on the grounds of its intrinsic value, such as nature's right to life, nature's right to be here, and objecting to humans' interference with the natural course of a species' evolution (Lockwood, 1999; Phillips et al., 2020), and there was less to suggest that moral concern was founded on existence value. This is consistent with the argument that intrinsic value is a basis for moral concern, whereas existence value is not (Davidson, 2013). For this reason it was decided that it would be helpful to include intrinsic value as a construct in the following study. Nonetheless, the way in which intrinsic value is measured might need to be reconsidered: the present study measured intrinsic value beliefs with two items, both referring to the concept of right to life, but perhaps a more precise measure is needed that refers directly to the concept of nature being valuable in its own right (Wickizer, 2016). It was therefore decided that the second quantitative study should measure intrinsic value beliefs in a more direct manner.

In the present study I included an item to reflect instrumental value beliefs, but this was not found to load onto the same factor as the intrinsic value belief items, challenging the view that these are two concepts that are opposite ends of a continuum. The item chosen to represent instrumental value beliefs in this study was also deemed, on reflection, not to tap this idea directly; the phrase "A dog trained for a task, like a hunting dog (or a dog to protect the house), is generally a better dog than one owned just as a pet" was deemed more reflective of utilitarian attitudes about a particular species (Kellert, 1985), rather than a broader belief about the instrumental value of nature. It was decided that instrumental value beliefs would be explored using more precise questioning in the second quantitative study (Wickizer, 2016).

Wickizer (2016) found evidence for sentience as an important component of intrinsic value's influence on attitudes, which would imply that mind attribution to nature and non-human species is an additional variable to include in future investigations of intrinsic value (even though this was not

found to be an important concept in the grounded theory study of *Chapter 5*). Mind attribution to nature has been found to be an influential variable in predicting pro-environmental attitudes and behaviours (see *Chapter 4*).

As noted in *Section 2.4.2*, there is a gap in the literature as to predictors of pro-nature behaviours (Richardson et al., 2020). The grounded theory of *Chapter 5* proposed factors associated with pro-nature behaviours, but I argued that it would be useful to consider a fuller range of pro-nature behaviours that those spontaneously mentioned by participants in *Chapter 5*. Items reflecting pro-environmental behaviours in the present study specifically refer to the environment in general as opposed to nature. The measure of pro-environmental behaviours also denotes behaviours without specifying the intended target of the behaviour (e.g., recycling), which means that it is difficult to determine whether the intended beneficiary of these behaviours would be the environment in general or natural entities such as other species. As such, I decided to include a quantitative measure of pro-nature behaviours in the second quantitative study, as well as pro-environmental behaviours.

Finally, it would be helpful to further test the possibility that identity and self-categorisation as belonging to nature can explain some of the findings in the present study, i.e., in which empathy toward nature and connectedness to nature were uniquely predictive of pro-environmental actions. I also concluded in *Chapter 5* that identity-based processes appeared to have some role to play in pro-nature behaviour. It would also be useful to include a measure of actual behaviour in the second quantitative study, rather than relying purely on self-reported measures.

6.5.2 Conclusion

The present study is the first to explore an array of nature beliefs and their unique associations with different kinds of sustainable behaviour. I have presented novel findings: connectedness to nature and empathy toward nature were found to be predictive of high-cost behaviours, whereas other nature beliefs were not. Empathy toward nature was found to be uniquely predictive of high-cost behaviours beyond the influence of empathy toward people. Biospheric values independently predicted consumption behaviours. Intrinsic value beliefs did not independently predict any sustainable behaviour. The study's results point to the usefulness of exploring messaging that frames environmental information in terms of human-caused harm to nature, and framing humans as part of the environmental system that is being harmed. This area of research would benefit from future work investigating the concept of intrinsic value beliefs more directly, including instrumental value beliefs, and including mind attribution to nature as a predictor. It would also benefit from investigating the predictors of pro-nature behaviours and looking at actual behaviour.

Chapter 7 Quantitative Findings II: Testing Hypotheses about Predictors of Pro-Environmental and Pro-Nature Behaviour in a UK Student Sample

7.1 Chapter Overview

Chapter 7 presents the second quantitative study of this thesis, which took place in a UK student sample. This study examines the contributions of all nature beliefs identified in the preceding chapters (mind attribution to nature, intrinsic value beliefs, biospheric values, instrumental value beliefs, empathy toward nature, and connectedness to nature) to three kinds of pro-environmental behaviours, four kinds of pro-nature behaviours, and one observed behaviour. Some findings from *Chapter 6* are replicated (e.g., biospheric values are found to be predictive of consumption behaviours). Novel findings are presented for predictors of pro-nature behaviours, and two general patterns for high-cost behaviours (both pro-environmental and pro-nature) is that they are (i) only positively predicted by nature beliefs that are arguably associated with identifying with nature (connectedness to nature/empathy toward nature), and (ii) only negatively predicted by instrumental value beliefs.

7.2 Introduction

As discussed in *Chapter 1*, it is important to understand the influence of nature beliefs on sustainable behaviour. Public messaging initiatives should also be considerate of pre-existing beliefs, in order to frame information in a way that will resonate with and persuade audiences. Understanding the role of nature beliefs might also indicate which beliefs should be fostered in systems such as education.

Section 1.4 highlighted that legislation and public information campaigns frame information about nature in terms of nature's instrumental value, i.e., what it does for or takes away from humans, such as the Lawton review (Lawton et al., 2020) and The Well-being of Future Generations (Wales) Act (2015). The grounded theory study of *Chapter 5* highlighted that it is possible to consider nature's value beyond what it does for or takes away from humans; intrinsic value beliefs reflect the view that nature and non-human species are valuable in their own right (Mathews, 2016), and are closely related to the concept of biospheric values, in which one's actions are considered on the basis of perceived benefits and costs to the environment as a whole (Stern, 2000). *Chapter 6* included these beliefs, alongside connectedness to nature and empathy toward nature, in analyses of belief prevalence and influences on sustainable behaviour. The present chapter analyses these beliefs

alongside two additional ones (mind attribution to nature and instrumental value beliefs) to consider what unique contribution each might make to sustainable behaviour in a UK sample.

In *Chapter 3* it was noted that pro-nature behaviours have been neglected in favour of broader pro-environmental behaviours (Richardson et al., 2020). The systematic review of *Chapter 4* reported studies that tended not to consider pro-nature behaviours. While *Chapter 5* focused on pro-nature behaviours as opposed to pro-environmental behaviours, *Chapter 6* only included the latter. The predictors of pro-nature behaviours have not received much consideration in quantitative studies; the present study includes them, alongside pro-environmental behaviours.

The previous chapters have focused on self-reported sustainable behaviour. It is common for studies on sustainable behaviour to assess behaviour-adjacent constructs such as intention to perform the behaviour or, when assessing behaviour, to do so indirectly via self-report. Kormos and Gifford (2014) undertook a meta-analysis of the association between objectively-measured and self-reported environmental behaviour and found that 79% of the variance in their association is unexplained. One potential reason that self-report does not overlap fully with actual behaviour is social-desirability bias, which is a tendency for participants to overreport socially desirable behaviours rather than more accurate responses (Callegaro, 2008). A meta-analysis by Richman, Kiesler, Weisband, and Drasgow (1999) found computerised data collection to limit social desirability bias when compared with data collected by an interviewer. Milfont (2009) found that, while social desirability has a weak influence on self-reported environmental attitudes, it does not seem to have a significant effect on self-reported sustainable behaviour. Another problem with self-reported behaviours is that they rely on memory, which can be inaccurate (Warriner, McDougall, & Claxton, 1984). This study aims to explore the association between nature beliefs and a measure of actual behaviour: specifically, whether nature beliefs explain variance in whether participants choose to read information about nature conservation.

Chapter 6 found that connectedness to nature and empathy toward nature were predictive of high-cost pro-environmental behaviours, where no other variable was. It was theorised that their unique contribution to such high-cost behaviours is due to their being associated with a sense of group affiliation with the natural world. It was noted that group affiliation has implications for emotional reactions to the knowledge that humans are harming nature, biospheric values, and personal norm, all of which could partially explain the influence of connectedness and empathy on high-cost sustainable behaviour. This possibility is explored in the current chapter.

7.2.1 Hypothesis-Driven Analyses

This final study includes all the aforementioned nature beliefs, alongside age and gender, to consider their unique contributions to pro-environmental behaviours and pro-nature behaviours. Some of the predictor and outcome variables included in this study were quantitatively explored in *Chapter 6*, and *Chapter 7* takes a hypothesis-driven approach to see whether these findings are replicable. There are also additional variables in this study that were not explored in *Chapter 6* and hypotheses about their contribution to pro-environmental behaviours and pro-nature behaviours will also be tested in this study. The present study reports findings from a sample of UK students, whereas the study reported in *Chapter 6* used a general UK population sample; students were chosen in the present study as a convenience sample, and were sampled solely from the UK in a way that would be demographically as similar to the sample reported in *Chapter 6* as possible (see *Section 7.3.5*). The following subsections provide some background to each of the nature beliefs included in the present study and the hypotheses associated with each.

7.2.1.1 Mind Attribution to Nature. Mind attribution to nature was identified in *Chapter 4* as being reliably associated with different kinds of sustainable behaviour and adjacent constructs (such as attitudes and behavioural intention), and its influence appeared to be mediated by empathy and connectedness to nature. For example, a high-quality study (Tam, 2013) showed empathy toward nature to mediate the association between mind attribution to nature and pro-environmental behaviours in an undergraduate sample in Hong Kong. Another study (Maguire et al., 2020) in an Australian and Tongan sample found that mind attribution did not predict pro-environmental behaviours when connectedness to nature was included in the model. In the present study, *it was hypothesised that mind attribution to nature would not predict any pro-environmental behaviours when included alongside other variables (H1).*

It would not be expected for mind attribution to nature to make a strong contribution to pro-nature behaviours independently of empathy and connectedness, which would also presumably mediate its effects on pro-nature behaviours. Mind attribution to nature was not a key feature of participants' responses in the grounded theory of pro-nature behaviours reported in *Chapter 5*, nor did many studies report pro-nature behaviours specifically in the systematic review reported in *Chapter 4*. The most relevant study reported in *Chapter 4* was that of Apostol et al. (2013), who showed that mind attribution to nature was predictive of positive attitudes toward animals, although there were no behavioural outcomes, and it was a weaker predictor than empathy. As such, mind attribution was included as a control variable for other conceptually-related predictors in analyses of pro-nature behaviours, and there were no specific hypotheses about any association between mind attribution and pro-nature behaviours.

7.2.1.2 Biospheric Values. Biospheric values are a consistent predictor of sustainable behaviour (Katz-Gerro et al., 2017). In *Chapter 6*, consumption pro-environmental behaviours were predicted by biospheric values. It was argued in *Chapter 6* that the fact biospheric values were so highly endorsed in the sample and predicted consumption behaviours (also reported by the sample quite frequently) as opposed to less normative behaviours (high-cost pro-environmental behaviours) could be due to their fulfilling a social-adjustive function (Smith et al., 1956). As such, *it was hypothesised that biospheric values would predict consumption pro-environmental behaviours (H2).*

While resource-conservation behaviours are also socially normative, in *Chapter 6* these were not predicted by biospheric values (or any variable), which may be due to their having few psychological barriers to adoption given their habitual nature and the structural support for their performance; as such, there were no hypotheses about the influence of biospheric values on resource-conservation pro-environmental behaviours. Previous chapters have not found any evidence for the link between biospheric values and pro-nature behaviours. There were no hypotheses in the present study about their association.

7.2.1.3 Intrinsic Value Beliefs. *Chapter 6* did not find intrinsic value beliefs to be associated with any pro-environmental behaviours, and it was proposed that this could be because they are too conceptually similarity to biospheric values (Dietz et al., 2005) and therefore make no additional contribution to sustainable behaviour. *Hypothesis 3 was that intrinsic value beliefs will not be predictive of any pro-environmental behaviours (H3).*

In *Chapter 5*, participants indicated that moral concern for harm caused to species by humans was linked to believing other species to have intrinsic value. While moral concern by itself did not appear to explain pro-nature behaviour, some participants explained that their moral concern for species led them to *avoid* causing harm to species. *Hypothesis 4 was that intrinsic value beliefs will be predictive of behaviours that entail avoiding causing harm to other species (H4)*.

7.2.1.4 Instrumental Value Beliefs. In *Chapter 5*, instrumental value beliefs, in the absence of intrinsic value beliefs, appeared to exclude species from moral consideration. Participants appeared to justify using/harming other species by viewing those species purely in terms of their usefulness/harmfulness to humans (i.e., their instrumental value), and perhaps denying or ignoring any intrinsic value that species might have. Instrumental value beliefs have not previously been subjected to quantitative investigation of their associations with sustainable behaviour, but the results of *Chapter 5* indicate that they might interfere with some of the psychological foundations for sustainable behaviour. *Chapter 5* did not specifically examine different levels of behavioural costliness; as such, in the present study, *hypothesis 5 was that instrumental value beliefs would be*

negatively predictive of at least one pro-nature behaviour or pro-environmental behaviour, but there were no predictions about any specific types of behaviour (H5).

7.2.1.5 Empathy Toward Nature. The systematic review of *Chapter 4* found evidence for empathy toward nature as predictive of pro-environmental behaviours and to mediate between anthropomorphism/mind attribution to nature and these behaviours. In *Chapter 6*, empathy was a predictor only of high-cost pro-environmental behaviours. It was theorised that, as empathy entails identifying with nature, it might increase a sense of affiliation with nature as a social group, motivating higher-cost behaviours. *Hypothesis 6 is that empathy toward nature will be predictive of a higher frequency of high-cost pro-environmental behaviours (H6)*. There has been less research on empathy's link with pro-nature behaviours. Hills (1993) found that animal rights supporters showed higher empathy toward animals than an urban sample and a sample of farmers. Insofar as empathy relates to group membership with nature we would expect it to be predictive of costly behaviours geared toward nature and non-human species. As such, *hypothesis 7 is that empathy toward nature will be predictive of a higher frequency of high-cost pro-nature behaviours (H7).*

7.2.1.6 Connectedness to Nature. The systematic review of *Chapter 4* found strong evidence for connectedness to nature as a predictor of pro-environmental behaviours and to mediate the association between anthropomorphism/mind attribution to nature and these behaviours. In *Chapter 6*, connectedness to nature predicted consumption and high-cost pro-environmental behaviours. Connectedness to nature entails identifying with nature, and as such might exert its influence via a sense of group affiliation with nature, explaining its predictiveness of costly behaviours (Mackay et al., 2021). Other research has suggested that connectedness to nature may also be particularly predictive of high-cost pro-nature behaviours: Martin et al. (2020) found that nature connectedness increased the impact of watching nature programmes on costly pro-nature behaviours (such as volunteering to undertake conservation work) whereas its impact was less evident in the case of less costly behaviour (such as recycling). I would expect connectedness to predict high-cost pro-nature behaviours for the same reason as high-cost pro-environmental behaviours. *Hypothesis 8 is that connectedness to nature will be predictive of a higher frequency of high-cost pro-environmental behaviours (H8). Hypothesis 9 is that connectedness to nature will be predictive of a higher frequency of high-cost pro-nature behaviours (H9).* As I do not expect that connectedness to nature has a social-adjustive function, I do not expect this study to replicate its relationship with consumption pro-environmental behaviours.

7.2.2 Exploratory Analyses for High-Cost Behaviours

In *Chapter 6* I argued that, if connectedness to nature and empathy toward nature are associated with a sense of group membership with the natural world, we might expect them to

influence high-cost sustainable behaviour via a variety of pathways. First, I will consider the consequences of group membership on high-cost behaviours via eco-emotions (emotions in response to the knowledge that humans are harming non-human species). Second, I will consider how group membership might influence high-cost behaviours via its influence on variables found in the Value-Belief-Norm model (Stern et al., 1999): biospheric values and personal norms.

7.2.2.1 Eco-Emotions. In order to understand why connectedness to nature and empathy toward nature might be uniquely associated with high-cost behaviours, I will explore the emotional mediators of this association. It was discussed in *Chapter 6* that, according to an extension of Turner et al.'s (1987) Self-Categorisation Theory, there are emotional consequences to affiliation with a group that is being harmed by another group (Smith, 1993). If connectedness and empathy are associated with a sense of affiliation with nature as an in-group, then considering the impact of another group (humans) on the in-group might be expected to cause anger (Smith, 1993) and lead to more action on behalf of the in-group. It is also possible that the experience of guilt at the knowledge that one is both part of the group causing harm (humans) and the harmed group (nature) would be stronger.

There is existing evidence for the role of guilt as a mediator for the influence of connectedness to nature on sustainable outcomes. Rees et al. (2015) found that feeling more connected to nature intensified the impact of human-caused environmental damage (versus naturally-occurring damage) on actual pro-environmental behaviours, and guilt was found to mediate the effect of the manipulation on behaviour. Anger has not received as much support as a mediator; the results of the systematic review presented in *Chapter 4* indicate that, while guilt mediated the influence of inducing anthropomorphism on sustainable outcomes, there was no such evidence for anger. Nonetheless, some research has indicated that anger might play an important role in sustainability; Stanley et al. (2021) showed anger about human-caused environmental harm to be a bigger predictor of pro-climate activism than depression or anxiety in response to the knowledge of human-caused environmental harm. To my knowledge, anger has not been examined as a potential mediator between connectedness to nature/empathy toward nature and sustainable behaviour. Neither guilt nor anger have been explored as mediators specifically for high-cost behaviours, or for pro-nature behaviours. In this study I will explore whether these two eco-emotions (anger/guilt at the knowledge that human impacts are harming non-human species) mediate the influence of two nature beliefs (empathy toward nature/connectedness to nature) on two kinds of high-cost behaviours (high-cost pro-environmental behaviours/high-cost pro-nature behaviours) (see Figure 7.1). As there will be 2 x 2 x 2 combinations of predictors, mediators, and outcomes, eight mediation models will be analysed.

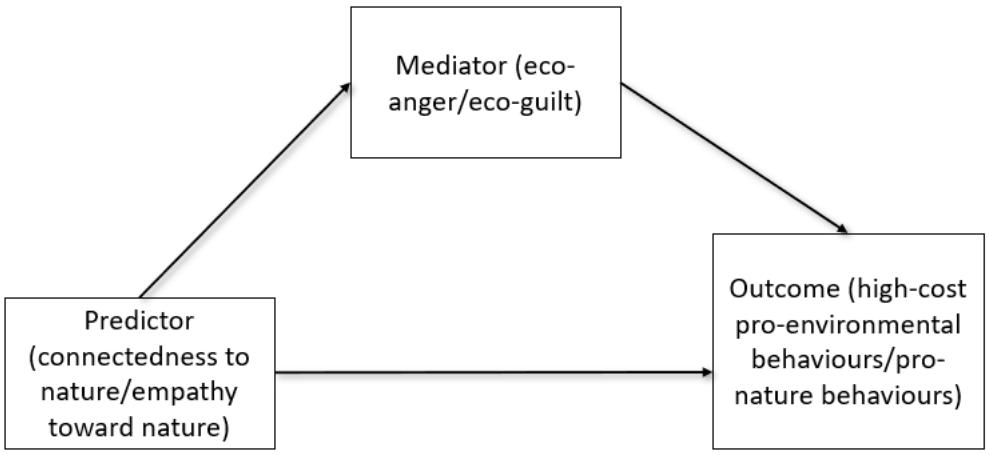


Figure 7.1: An illustration of the mediation models to be tested (adapted from Baron & Kenny, 1986).

7.2.2.2 Testing an Extended Value-Belief-Norm Model. The ability of the Value-Belief-Norm (VBN) model (Stern et al., 1999) to explain the impact of connectedness and empathy on high-cost behaviours will be explored. The VBN model has received repeated empirical support for its ability to explain pro-environmental behaviours (Van Riper & Kyle, 2015), but to date there has been little empirical investigation of its ability to predict high-cost behaviours.

It was argued in *Chapter 6* that identifying with nature could influence sustainable behaviour via biospheric values. Martin and Czellar (2017) found that people who see nature as part of their identity develop biospheric values over time, and that biospheric values in part explain the influence of connectedness on pro-environmental behaviours. Although biospheric values were not found to be predictive of high-cost behaviours in *Chapter 6*, according to the VBN model they are part of a sequence leading to the development of a sense of obligation (personal norm) to engage in sustainable behaviour, which is seen as an immediate precursor to engaging in sustainable behaviour.

There is evidence that personal norms are important for high-cost pro-nature behaviours: *Chapter 5* indicated that an internalised moral standard differentiated between those engaging in sustained pro-nature behaviours and those who were not engaging in pro-nature behaviours, or only engaging in pro-nature behaviours in response to external prompts. In *Chapter 6* it was proposed that group affiliation with nature might increase a sense of obligation to one's social group, i.e., might enhance personal norms, thereby leading to high-cost behaviours. Richter and Hunecke (2022) showed connectedness to nature to be predictive of personal norms and suggest that a daily feeling of connectedness toward nature could trigger a sense of obligation toward the environment. Therefore, the association of empathy and connectedness with a nature-based group identity might

lead them to impact pro-environmental behaviours/pro-nature behaviours more directly (via their influence on personal norms) as well as via biospheric values, which are more distally linked to sustainable behaviour according to the VBN model. The model that will be tested is shown Figure 7.2.

It is reasonable to assume this developmental sequence of events: connectedness to nature and empathy toward nature are both considered dispositional tendencies or traits (Tam, 2013; Zylstra et al., 2014). As such, they could temporally precede the development of values, beliefs, and personal norms about the natural world.

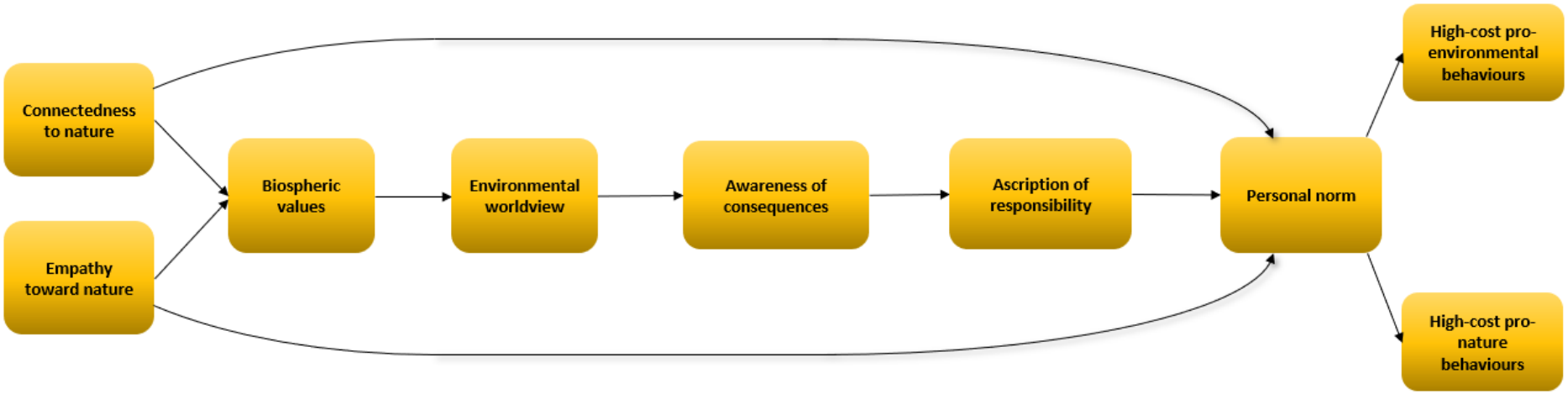


Figure 7.2: The extended value-belief-norm model.

7.2.3 Exploratory Analysis of Actual Behaviour

I highlighted in the introduction to this chapter that previous chapters have analysed associations between nature beliefs and self-reported sustainable behaviour. This study will explore whether nature beliefs predict actual behaviour relating to sustainability. Participants were given the option to read a 3-minute article on nature conservation (see *Section 7.3.2* for detailed wording) and could choose either "Yes" or "No". Participants were not shown the article regardless of their choice, as the information of interest was whether they chose to read the article. This method of measuring actual behaviour was chosen as it was easier and less costly to measure than many other kinds of actual behaviour: Kormos and Gifford (2014) summarised three types of field observations of sustainable behaviour, which are informant-reports, data collection by trained observers, and using devices to measure behaviour. The method used in the present study was deemed suitable for large-scale survey data collection due to its low cost and participant burden, and its ease of administration (Lange & Dewitte, 2019).

7.3 Method

7.3.1 Participants

Participants were recruited via two routes: Cardiff University students signed up to take part via an Electronic Management System (EMS) and received course credits for their participation (n = 346). The only inclusion criterion was that participants needed to be at least 18 years of age. As most of the participants in this sample were women, additional participants were recruited from the website "Prolific" (www.prolific.co) (n = 230). The only inclusion criteria were that participants needed to be students currently residing in the UK, at least 18 years of age, who identify as men. In the full sample there were 254 men, 293 women, 11 people who identified as non-binary and 5 people who preferred not to provide their gender. The mean age was 20.27 (range: 18 – 48).

7.3.2 Measures

In addition to providing demographic data (gender, age, and ethnicity), participants provided data for the following measures:

1. Mind attribution to nature was measured with the *Individual Differences in Anthropomorphism Questionnaire* (Waytz et al., 2010), which looks at people's beliefs about whether a target has five different mental states/capacities ("a mind of its own", "free will"; "consciousness", "intentions", and "can experience emotions", p. 229). This measure applies these states to devices (e.g., a computer), nature (e.g., the ocean), and

animals (e.g., an insect). This measure has demonstrated good construct validity and reliability (internal consistency and temporal stability) (Waytz et al., 2010).

2. Intrinsic value beliefs were measured using one item from Wickizer (2016): “Non-human species have inherent value, above and beyond their utility to humans”. Participants rated the item on a 5-point Likert scale from “strongly disagree” to “strongly agree”. This item was different from the items used for the *Chapter 6* study, as it was decided that this item was a more precise measure of intrinsic value beliefs.

3. Instrumental value beliefs were measured using item from Wickizer (2019): “Non-human species are only valuable if humans get to utilize them in some way”. Participants rated the item on a 5-point Likert scale from “strongly disagree” to “strongly agree”.

4. Participants completed an eco-emotions measure (adapted from Clayton & Karazsia, 2020) in which they rated how the issue of humans having a negative impact on other species made them feel. Participants indicated to what extent this issue led them to feel each of the following 11 emotions, from “not at all this way” to “a great deal”: sad; scared; alone; angry; pessimistic; guilty; helpless; hopeless; isolated; frustrated; resigned.

5. Pro-nature behaviours were measured with the *Pro-Nature Behaviours Scale* (Barbett et al., 2020). This scale covers a range of behaviours relating specifically to nature conservation, including actions that directly help species (such as “I plant pollinator-friendly plants”) and those that would help with nature conservation more indirectly (such as “I vote for parties/candidates with strong pro-nature conservation policies in elections”). Barbett et al. (2020) found that their measure had four factors: behaviours relating to planting (e.g., planting pollinator-friendly plants), behaviours relating to wildlife (e.g., avoiding using insecticide), individual engagement behaviours (e.g., voting for nature or wildlife conservation-friendly legislation), and organised engagement (e.g., volunteering with a conservation organisation). Participants indicate the frequency of performing each behaviour on a 7-point scale (from “never” to “always”). This measure has shown good internal reliability, test-retest reliability, and construct validity (Barbett et al., 2020).

Three measures were developed to reflect *awareness of consequences*, *ascription of responsibility,* and *personal norm*, which are key facets of the Value-Belief-Norm model of Stern et al. (1999):

6. The measure of *awareness of consequences* of human actions/impacts on nature and the environment was developed included 10 items, reflecting 10 human actions/impacts.

Participants indicated the extent to which they agreed or disagreed that a range of human activities and impacts cause problems for other species each item answered on a 5-point Likert scale (from “strongly disagree” to “strongly agree”). The first step was to identify the range of human actions/impacts on nature and the environment which might be of concern to participants. The 10 items were developed from the following sources:

a. Human impacts on nature and the environment described by participants in the grounded theory study (*Chapter 5*) (deforestation; hunting and poaching; the pet breeding industry; the large-scale meat and dairy industry; littering; the use of single-use plastics; the animal fur industry).

b. Additional human impacts included in the measure of Stern et al. (1999) (climate change; the release of toxic substances in air, water, and soil).

c. An additional impact (the spread of non-native species) that was included in a measure in the study of Van Riper and Kyle (2014) (which assessed the suitability of the VBN model as an explanation for pro-environmental behaviour in a national park).

7. An *ascription of responsibility* measure was developed to represent each of the 10 human actions/impacts on nature and the environment represented in the awareness of consequences items, with wording taken from the study of Van Riper and Kyle (2014) and Steg, Dreijerink, and Abrahamse (2005) to ask participants about the extent to which they felt responsible for each impact (from “strongly disagree” to “strongly agree”) (e.g., “I feel jointly responsible for the release of toxic substances into air, water, and soil”).

8. A measure of *personal norm* was developed, i.e., a sense of personal obligation to address human actions/impacts in some way. There were 11 items, reflecting the 10 human actions/impacts included in the *awareness of consequences/responsibility* measures, and an additional item adapted from Steg et al. (2005): “I feel obliged to bear other species in mind in my daily behaviour”. Participants indicated the extent to which they agreed or disagreed with a range of statements (from “strongly disagree” to “strongly agree”) (e.g., “I feel a sense of personal obligation to do what I can to stop the disposal of toxic substances into air, water, and soil”)

The following measures were also included to measure biospheric values, connectedness to nature, empathy toward nature, environmental worldview, and pro-environmental behaviours, in that order (previously included in the *Chapter 6* study and described in *Section 6.3.2*):

The *Value Orientations Scale* (De Groot & Steg, 2008)

The *Connectedness to Nature Scale* (Mayer & Frantz, 2004)

The *Dispositional Empathy toward Nature Scale* (Tam, 2013)

The *New Ecological Paradigm* (Dunlap et al., 2000)

The *Pro-Environmental Behaviours Scale* (Whitmarsh et al., 2017)

Finally, before the end of the study participants were told they had the option to read an article about nature conservation. They received the following information: *"Before the end of the study you have the option to read an article on the topic of nature conservation, which will take about 3 minutes to read. After you read the article you will be directed to the end of the study. If you choose not to read the article, this will take you immediately to the end of the study. Whether you choose to read this optional article has no effect on whether you will receive [your credits/payment]."* Participants chose either "I would like to read the 3-minute article on nature conservation" or "No, I would prefer not to read the 3-minute article on nature conservation". Regardless of their choice, participants were not directed to read an article on nature conservation and they were taken to the end of the study on submitting their choice.

7.3.3 Procedure

Ethical approval to run the study was obtained from Cardiff University (reference: EC.21.09.14.6399RA). Participants completed the measures via the survey site Qualtrics. After reading the information sheet, providing consent to take part, and completing demographic information (see *Appendix D*), participants were presented with the questionnaires in a randomised order. After completing the measures, participants saw a debrief screen with more information about the study. Participants were paid £7.50/hour *pro rata* for their participation. All data from Cardiff University students were collected between October 1st and December 9th, 2021. All data from Prolific participants were collected on December 8th, 2021.

7.3.4 Data Cleaning

The datasets of the Cardiff university and Prolific student samples were combined (n = 576). Similar data cleaning processes were followed as for the *Chapter 6* study (see *Section 6.3.4*). All data cleaning and analysis took place using RStudio (2021). After reverse-scoring of items, missing data were dealt with. All cases with more than 5% missing data (n = 16) were removed (Alice, 2015), leaving a total final sample of n = 560.

Twenty-three cases were missing < 5% of data and multiple imputation was undertaken in order fill missing values and provide a complete dataset (Rubin, 1988). Multiple imputation assumes that data are missing at random, which was confirmed to be the case for the dataset.

7.3.5 Dividing the Data File

Exploratory factor analysis (EFA) was conducted on all measures in this study whose factor structure had not been examined in *Chapter 6*. Confirmatory factor analysis (CFA) was also conducted for a subset of variables to be entered as latent constructs in the structural equation model (SEM). As it is recommended that EFA be conducted prior to CFA, and that these analyses be conducted on different datasets (Worthington & Whittaker, 2006), the dataset was randomly split into two segments, following the guidance of Kyriazos (2018): 20% (*n* = 112) for conducting EFA to explore the constructs measured by questionnaires in the study; 80% (*n* = 448) to conduct regression analyses, CFA and the SEM. Table 7.1 shows the demographics of the separate samples resulting from the data split, and the demographics of the *Chapter 6* study sample, for comparison.

Table 7.1: Demographics of the Two Samples in the *Chapter 7* Study Resulting From the 20%/80% Data Split, Alongside the Demographics of the Sample in the *Chapter 6* Study.

	Dataset for EFA (20%; *n* = 112)	Dataset for remaining analyses (80%; *n* = 448)	Data from *Chapter 6* (*n* = 499)
Age	Mean age: 19.96; range: 18 - 27	Mean age: 20; Range: 18 - 48	Mean age: 44.6; range: 18 - 81
Ethnicity	White: 78; Asian: 24; Black: 1; Mixed: 4; Other: 3; Prefer not to say: 2	White: 327; Asian: 77; Black: 15; Mixed: 19; Other: 8; Prefer to describe in own words: 1; Prefer not to say: 1	White: 393; Asian: 39; Black: 25; Mixed: 15; Other: 27
Country of residence	(Outside university term-time) UK: 101; non-UK: 11	(Outside university term-time) UK: 388; non-UK: 60	UK: 499
Gender	Men: 56; Women: 52; Non-binary: 4	Men: 198; Women: 241; Non-binary: 7; Prefer not to say: 2	Men: 243; Women: 255; Other: 1

7.3.6 Power

The sample size was deemed sufficient for all planned analyses. For exploratory factor analyses on 20% of the sample (*n* = 112), the minimum absolute sample size and ratio of observations per variable for each analysis was surpassed (often recommended as *n* = 100 and a minimum ratio of 5:1 cases per item) (Hair, Black, Babin, & Anderson, 2018).

The 80% dataset (*n* = 448) was sufficient for regression analyses: G*Power (Faul et al., 2007) was used to calculate a minimum sample size for the regression analyses (with 8 predictor variables for each regression, a minimum sample size of 109 would be required for a medium effect size [f^2 = .15], α = .05, with 80% power to detect a true effect). This dataset was sufficient for mediation analyses: Fritz and MacKinnon (2007) recommend a minimum sample size of 71 for a bias-corrected bootstrap of the indirect (ab) mediation path, where both a and b paths have a medium-sized standardised beta coefficient (b = 0.39), at a power of 80% and α = .05. The dataset was also sufficient for confirmatory factor analysis and structural equation modelling: Kline (2015) recommends a sample size of no lower than 200 for SEM. Soper's (2020) sample size calculator (based on Westland, 2010) was used to determine a minimum recommended sample size for the full structural equation model: with three latent variables and 21 manifest variables (see *Section 7.4.5.2.2*), a power of 80%, α = .05, and at a medium effect size (*r* = .3; Cohen, 1988), a sample size of *n* = 400 was recommended.

7.3.7 Assumption Checks

Data were checked for assumptions and multivariate outliers were removed in the same way as for the *Chapter 6* study (see *Section 6.3.6*). All measures were found to meet assumptions of normality, additivity, homogeneity of variance and multicollinearity as required for exploratory factor analysis (EFA) and regression. The KMO statistic was calculated for each measure, which showed each measure to have adequate sample size for EFA (KMO >.5) (Field et al., 2012). Bartlett's test of sphericity was also conducted, which found the correlations between items to be significant, as required for exploratory factor analysis (Field et al., 2012).

For regression analyses, OLS regressions were conducted where assumptions were met. When the assumption of homoscedasticity was violated (i.e., residuals showed heteroscedasticity: unequal distribution at different values of the predictor variables), heteroscedasticity-consistent (HC) standard errors were calculated (Hayes & Cai, 2007; Pek et al., 2018). More detail about variables that did not meet the assumption of heteroscedasticity is provided in *Section 7.4.4*. The additional assumption that was assessed as adequate for confirmatory factor analysis/structural equation modelling was sample size (Kline, 2015) (see sample size calculation in *Section 7.3.6*).

7.3.8 Exploratory Factor Analysis

The procedure was the same as that described in *Section 6.3.7.1*. EFA was conducted on 20% of the sample (*n* = 112) (see *Section 7.3.5*).

7.3.8.1 Measures that Underwent Exploratory Factor Analysis. The measure of mind attribution to nature has not had its validity and reliability extensively tested in a UK context

(the *Individual Differences in Anthropomorphism Questionnaire;* Waytz et al., 2010) and EFA was conducted to determine its factor structure in a UK sample. The *Pro-Nature Behaviours Scale* (Barbett et al., 2020) has been validated in a general population UK sample; however, EFA was conducted on this measure in the present study to determine its factor structure in a UK student sample. Finally, EFA was conducted on three measures that reflect the beliefs in the Value-Belief-Norm model (Stern et al., 1999): *awareness of consequences*, *ascription of responsibility*, and *personal norm* (see *Section 7.3.2).*

7.3.9 Multiple Regression

7.3.9.1 Procedure. The procedure for multiple (linear) regression was the same as that described in *Section 6.3.8.1*. A binary logistic regression was also used in an exploratory analysis of predictors of a binary outcome (whether participants asked to read an article on nature conservation; see *Section 7.4.5.3*). This is similar to linear regression, but as the outcome in logistic regression is categorical, this violates the assumption of linearity; logistic regression overcomes this by expressing the relationship between the predictors and the outcome in logarithmic terms (Field et al., 2012). Instead of ordinary least squares (OLS) estimation of the regression line, logistic regression uses maximum-likelihood estimation (MLE) to choose a model in which, when the observed values of the predictor variables are entered into it, makes the observed values of the outcome variable most likely to have occurred. This allows for the calculation of the probability of an outcome (e.g., choosing to read the article) were the model accurate, compared with a baseline model; in linear regression, in the baseline model each value of the predictor variable is assumed to correspond to the mean value of the outcome variable, whereas in the baseline model for logistic regression, each value of the predictor variable is assumed to correspond to the outcome that occurs most frequently (e.g., if most people choose to read the article [score of 1], then the outcome of the baseline model is 1).

7.3.9.2 Predictors and Outcome Variables. For each hypothesis-drive regression there were eight predictors: gender; age; mind attribution to nature; intrinsic value beliefs; instrumental value beliefs; biospheric values; empathy toward nature; connectedness to nature. Seven regressions were conducted, one for each outcome: resource-conservation pro-environmental behaviours; consumption pro-environmental behaviours; high-cost pro-environmental behaviours; high-cost pro-nature behaviours; personal pro-nature behaviours; doing-for-wildlife pro-nature behaviours; avoiding-for-wildlife pro-nature behaviours.

The same eight predictors were entered into an exploratory binary logistic regression with one outcome: whether people chose to read an article on nature conservation at the end (“Yes”) or not (“No”).

7.3.9.3 Controlling the False Discovery Rate. Whereas *Chapter 6* took an exploratory approach to identify variables that were potentially associated with sustainable behaviour, conducting multiple tests inflate types I error in which predictors are deemed statistically significant when there is no effect in reality. While this was deemed an acceptable risk for an exploratory study, the study of *Chapter 7* takes a hypothesis-driven approach, where the aim is to determine with a degree of accuracy whether nature beliefs predict specific behaviours. Correctly identifying significant predictors requires an approach that limits type I error whilst maintaining sufficient power to detect true effects (i.e., limiting type II error).

A variety of procedures have been devised for limiting type I error. The Bonferroni method is frequently used, in which the criterion *p* value is divided by the number of tests, making it a stricter test of significance. As the number of tests increase, the Bonferroni becomes a highly conservative method, reducing the number of type I errors but inflating the number of type II errors, i.e., leading true effects to go undetected (Hochberg, 1988). An alternative to the Bonferroni is the Benjamini-Hochberg procedure (Benjamini & Hochberg, 1995). This procedure keeps the expected proportion of type I errors (the false-discovery rate) at a constant (in the study, this was set at 5%). Benjamini, Heller, and Yekutieli (2009) described a formula for adjusting the *p* value of a finding in order to keep a constant false-discovery rate among all the findings, which takes into account each *p* value's rank compared with the other values. The Benjamini-Hochberg method is used in the study of *Chapter 7* as a way of increasing confidence that the significant findings are truly significant (we can expect only 5% of the significant findings for each regression to be false-positives) without overly reducing the power to detect true findings.

7.3.9.4 Dominance Analysis. Dominance analysis was employed in the same way as described in *Section 6.3.8.3,* to examine the R^2 values of all possible predictor combinations and performs pairwise comparisons of all predictors to measure their relative importance, i.e., which is dominant over the others. The output provides a separate R^2 value for each predictor which indicates its individual contribution to the variability of the outcome.

7.3.10 Mediation Analysis

7.3.10.1 Procedure. The existence of mediation can be tested with two regressions: 1. The predictor (X) must predict the mediator (M) (path a); 2. M must predict the outcome (Y) while controlling for X (path b) (Baron & Kenny, 1986). Baron and Kenny (1986) also suggested that there should be a significant total effect from X to Y (path c), and that there should no longer be a direct path (X predicting Y) once M is included in the model (path c') (these authors used 'c' to denote both c and c' paths, but I follow Shrout & Bolger [2002] in using two separate letters); however, only paths

a and b are necessary to consider. Figure 7.3 shows an illustration of a mediation model, including paths a, b, c, and c'.

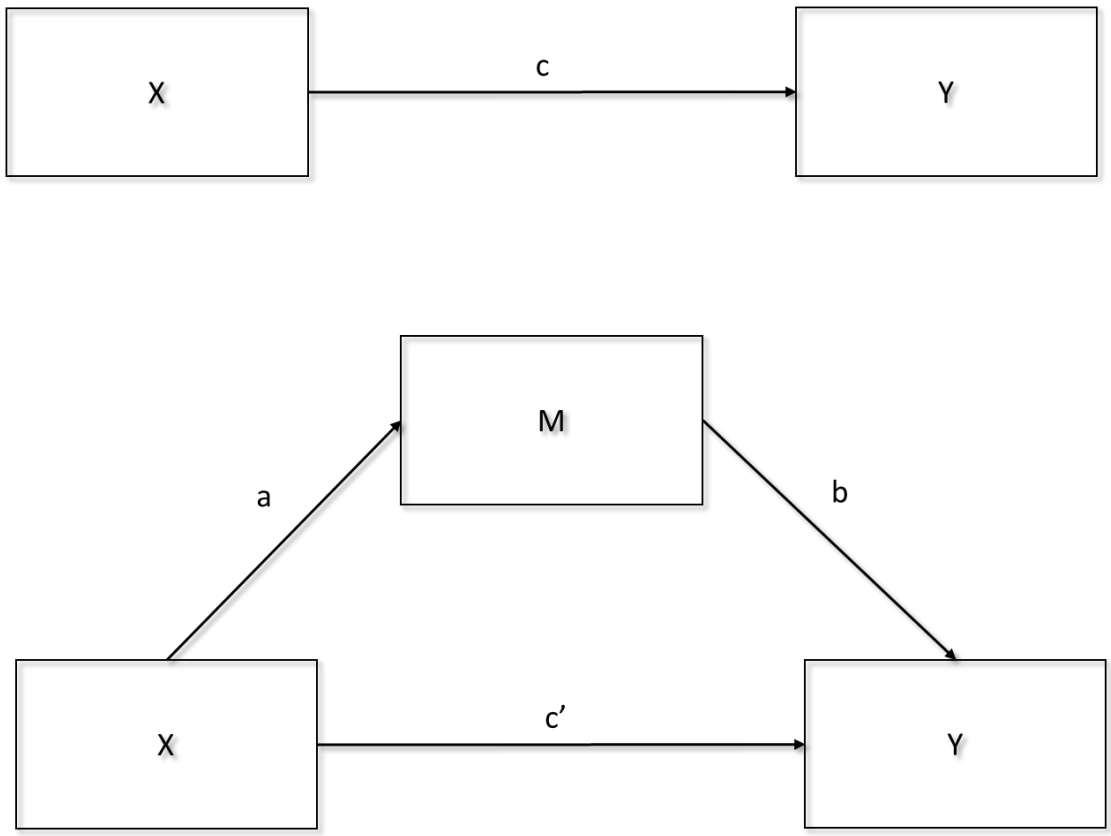


Figure 7.3: An illustration of mediation. The direct path (top diagram) between a predictor (X) and an outcome (Y) and an indirect path (bottom diagram) in which the influence of X on Y is transferred at least partially via a mediator variable (M). Adapted from Baron and Kenny (1986).

Fritz et al. (2012) recommended against only considering the significance of paths a and b as they can be underpowered and do not estimate the indirect effect. Bootstrapping is commonly used in conjunction with the above method in order to test the significance of the indirect effect (Hayes, 2009). Bootstrapping entails resampling observations from the data (with replacement) to estimate the values of path a and path b, repeating this process many times. Each time a and b are sampled, their product is calculated (the indirect effect), and confidence intervals can be generated to determine, with 95% confidence, whether the indirect effect is likely to be zero. These confidence intervals can be calculated with a correction for bias (bias-corrected confidence intervals; BCa 95% CI), as the distribution of scores obtained from bootstrapping will inevitably only be an approximation of the indirect effect.

Robust mediation analysis was undertaken in the current study (Alfons, Ateş, & Groenen, 2018) using the "*ROBMED*" package in RStudio (Alfons, Ateş, & Groenen, 2022). This entailed using

MM-regression estimators of the indirect effect with regression (rather than using the usual OLS estimators). MM-estimators are more robust to deviations from normality as they estimate coefficients using the central parts of the distribution, whereas OLS estimators are more influenced by deviations from normality (such as skewness or outliers). The second feature of robust mediation is using a fast-and-robust bootstrap which repeatedly samples and replaces data but, unlike a standard bootstrap, is less prone to oversampling outliers when sampling data and is less computationally demanding. Robust mediation can outperform OLS when its assumptions, such as normality and heteroscedasticity, are not met (Alfons et al., 2018; Wilcox, 2004). Bootstrapping proceeded with 5,000 samples.

7.3.10.2 Predictors, Mediators, and Outcome Variables. Following the findings presented in *Chapter 6*, potential mediators of the unique relationship between connectedness to nature/empathy toward nature and high-cost sustainable behaviour were examined in the present study. According to Smith (1993), guilt and anger are two emotions that can arise when one perceives harm to an out-group from one's in-group or when one perceives harm to one's in-group from an out-group, respectively. It was argued in *Chapter 6* that connectedness to nature and empathy toward nature might involve a sense of affiliation with nature as a social group, and hence might be associated with feelings of anger/guilt, which could explain their unique influence on high-cost behaviour. To test whether these emotional responses can explain the influence of connectedness/empathy on high-cost behaviours, eco-guilt and eco-anger (emotions in response to the knowledge that humans are harming non-human species) were examined as potential mediators of the relationship between connectedness/empathy and high-cost pro-environmental/pro-nature behaviours. Eight exploratory mediation analyses were conducted:

1. Connectedness to nature predicting eco-anger, predicting high-cost pro-environmental behaviours

2. Connectedness to nature predicting eco-anger, which predicts high-cost pro-nature behaviours

3. Connectedness to nature predicting eco-guilt, which predicts high-cost pro-environmental behaviours

4. Connectedness to nature predicting eco-guilt, which predicts high-cost pro-nature behaviours

5. Empathy toward nature predicting eco-anger, which predicts high-cost pro-environmental behaviours

6. Empathy toward nature predicting eco-anger, which predicts high-cost pro-nature behaviours

7. Empathy toward nature predicting eco-guilt, which predicts high-cost pro-environmental behaviours

8. Empathy toward nature predicting eco-guilt, which predicts high-cost pro-nature behaviours

7.3.11 Structural Equation Modelling

Chapter 7 presents the results of a structural equation modelling (SEM) approach to extending the Value-Belief-Norm (VBN) model (Stern et al., 1999). SEM consists of a measurement model and a structural model. The measurement model consists of individual confirmatory factor analyses, in which manifest (observed) variables such as scores on questionnaire items behave as indicators, as they are theorised to reflect an underlying latent (unobserved) variable (and can also be theorised to covary with one another). In the measurement model, SEM quantifies the degree of loading of each indicator on its theorised latent factor, i.e., determines the extent to which variance in the indicator can be explained by the latent factor (Kline, 2015). The structural model then quantifies the degree to which different latent variables (and stand-alone, manifest variables) predict and covary with one another, and the pattern of theorised interactions can be compared with what is found in the actual pattern of covariance between all the variables (the covariance matrix).

Following the guidance of Kline (2015), prior to conducting a full structural equation model, each individual structural model (confirmatory factor analyses) was first validated. These then became the latent variables to be included in the pathways specified by the structural model. SEM takes into account the measurement error of latent variables, as the residual variance that is not explained by each latent variable is calculated; this makes it a more realistic model of the phenomenon under investigation than analyses that do not contain latent variables (Kline, 2015). Including latent variables is more appropriate for measures that have not been previously well-validated (Kline, 2016), as was the case for the three latent variables to be included in the structural equation model (awareness of consequences, ascription of responsibility, and personal norm). The structural equation model presented in *Chapter 7* (Figure 7.2) includes a mixture of latent variables (and the individual questionnaire items they predict) and single-item variables that represent the mean of their questionnaire score (i.e., manifest variables). There are multiple methods for estimating parameters in a structural equation model or confirmatory factor analysis. The diagonally-weighted least squares (DWLS) method was used as this has been shown to be a more precise

estimate for ordinal data (such as the Likert-scale data collected in the study) (Li, 2016; Mindrila, 2010).

The statistical output of structural equation modelling can be used to determine the significance of individual regression paths between variables. Hair et al. (2018) proposed that a well-fitting confirmatory factor analysis model can be indicated in part by the factor loadings. These should be significant, but also should be above .5. The output also provides goodness-of-fit estimates to indicate how well the theorised structural model fits the data overall. A variety of different indices are used. For SEM (including confirmatory factor analysis), Hair et al. (2018) proposed the use of the following fit indices (for samples above 250), each with its own strengths and weaknesses:

The χ^2 test assesses the difference between the covariance matrix that would be expected from the theorised model and the actual covariance matrix found in the data; although a non-significant *p* value suggests a better fit, this is not considered a good test of fit by itself as it is highly sensitive to sample size (Fan et al., 2016).

RMSEA (Root Mean Square Error of Approximation) provides a measure of "badness-of-fit", which helps to detect model misspecification. It is not as sensitive to sample size as the χ^2 test, and a lower value indicates a better model fit. SRMR (Standardized Root Mean Square Residual) is another measure of "badness-of-fit". In both cases, a lower value indicates better fit (Kline, 2015).

CFI (Comparative Fit Index) shows the amount of variance that the model explains in covariance matrix, where a higher value is indicative of a better model fit (Fan et al., 2016). The CFI ranges from 0 to 1. It is relatively insensitive to model complexity (Hair et al., 2018). The RNI (Relative Non-Centrality Index) takes an equivalent approach to the CFI, but its values can surpass 1 (Hair et al., 2018). TLI (Tucker-Lewis Index) is similar to the CFI but is more biased by model complexity. Its values can exceed 1, and a higher value indicates better model fit (Kline, 2015).

For individual confirmatory factor analyses the composite reliability score was reported, which is the ratio of the variance explained by the latent factor to the total variance that can be explained (Kline, 2015); it is a measure of internal consistency which, unlike Cronbach's α, weights the individual items by their factor loadings (Hair et al., 2018). Composite reliability scores should be above 0.7 but not above 0.95 (Hair et al., 2018). The average variance extracted was also reported, which is the average squared standardized coefficients for indicators loading on the same factor (Kline, 2015); it indicates the average proportion of variance that the latent factor explains for its indicators, and it should be 0.5 or higher (Hair et al., 2018).

7.4 Results

7.4.1 Exploratory Factor Analysis

All measures included in the study (that had not been included in the study reported in *Chapter 6*) underwent EFA (see *Section 7.3.2* for a full list of measures). A summary of the final factor structure for each measure is now provided (see *Appendix H* for a list of final items and excluded items for each measure, including standardised factor loadings, and a description of the process of arriving at a final factor solution for each).

The *Individual Differences in Anthropomorphism Questionnaire* (Waytz et al., 2010) was used to measure mind attribution to nature. A two-factor solution was retained. One factor contained a mixture of technology/nature (Cronbach's α = .88), and the other contained only animals (Cronbach's α = .87); only the latter was used for analyses given its direct relevance to the current research.

EFA was conducted on three measures that reflect key facets of the Value-Belief-Norm (VBN) model (Stern et al., 1999): *awareness of consequences* (AC), *ascription of responsibility* (AR), and *personal norm* (PN). One factor was retained for AC (Cronbach's α = .87) and PN (Cronbach's α = .92), whereas two factors were retained for AR, one including more items relating specifically to animals (AR-Animals; e.g., animal fur, hunting and poaching, and pet breeding; Cronbach's α = .86) and the other relating to the environmental issues more broadly (AR-Environment; e.g., deforestation and climate change; Cronbach's α = .82). As exploratory factor analyses did not reduce the number of items for the AC and PN measures (which were to be included as latent variables in the SEM) it was decided that one factor would be chosen for AR, and AC and PN would be parcelled (Kenny, 2016) in order to use only the five items corresponding to the thematic content of the chosen AR factor. The first factor of AR was chosen (AR-Environment; items 1, 3, 5, 8, and 10) as its items reflected broader environmental impacts and it was reasoned that this would likely reflect broader beliefs and thus explain variance for a broader range of behaviours. This left five items per variable, which is considered a good number for each latent variable included in confirmatory factor analysis (Kenny, 2016). For the AR-Environment factor, participants were asked to indicate the extent to which they agree or disagree that they feel jointly responsible for the following five human-caused activities and impacts: deforestation and the loss of tropical forests; the large-scale meat and dairy industry; the release of toxic substances into air, water, and soil; climate change; the use of single-use plastics (Cronbach's α = .82). For AC, they were asked to indicate their agreement or disagreement that these five human activities/impacts cause problems for other species (items 1, 2, 3, 7, and 9; Cronbach's α = .75), and, for PN, that they feel a personal obligation/that people like

them should do whatever they can to prevent/take action to stop each of these five human activities/impacts (items 3, 4, 7, 8, and 10; Cronbach's α = .84)[9].

A four-factor solution was chosen for pro-nature behaviours. This reflects the findings of Barbett et al. (2000) who also found four factors; however, high-cost pro-nature behaviours were more clearly located in one factor in my analysis (Cronbach's α = .89) (rather than being spread across factors as found in Barbett et al., 2000). Another factor found in my analysis was personal pro-nature behaviours (Cronbach's α = .85). Barbett et al. (2000) found two factors differentiating between planting behaviour and behaviour relating to wildlife, whereas the related factors in my analysis had a slightly different distribution of items forming factors better differentiated by whether they described acts of commission (doing-for-wildlife PNBs; Cronbach's α = .86) or acts of omission (avoiding-for-wildlife PNBs; Cronbach's α = .82)[10] (each of which is significantly correlated with the other):

1. Doing-for-wildlife describes acts of commission, mainly to do with planting certain kinds of plants (e.g., those with berries, or native plants). These appear to be mainly private-sphere behaviours in that they could take place in solitude. One item describes providing food for wild animals. These were not considered very high in cost; although they involve manual labour and therefore some effort, these potentially involve small adjustments to normal, routine gardening activities and would likely take place at home. There may be some financial cost involved in buying, e.g., plants and fertiliser. In total, 15% of the sample reported performing these behaviours frequently, on average.

2. Avoiding-for-wildlife describes acts of omission that would protect wildlife (e.g., avoiding using insecticide). These behaviours appear mainly to be private-sphere, as they could take place in solitude. These could be considered similar to resource-conservation behaviours as they do not

[9]Later in the thesis, confirmatory factor analyses are performed to confirm the factor structure of the ascription of responsibility (AR-Environment) items, and the items in the awareness of consequences and personal norm factors corresponding to the content of the AR-Environment items. These items are then included in a structural equation model. These analyses are repeated on the *other* AR factor [AR-Animals] and items in the awareness of consequences and personal norm factors corresponding to these items, for comparison (see *Footnotes 11* and *12*).

[10]Doing-for-wildlife pro-nature behaviour items: 6-9 and 18; avoiding-for-wildlife pro-nature behaviour items: 14-16; personal pro-nature behaviour items: 4-5 and 13; high-cost pro-nature behaviour items: 1, 3, and 10-12).

necessarily entail any special effort, and would not necessarily entail a financial or social costs. In total, 40.33% of the sample reported performing these behaviours frequently, on average.

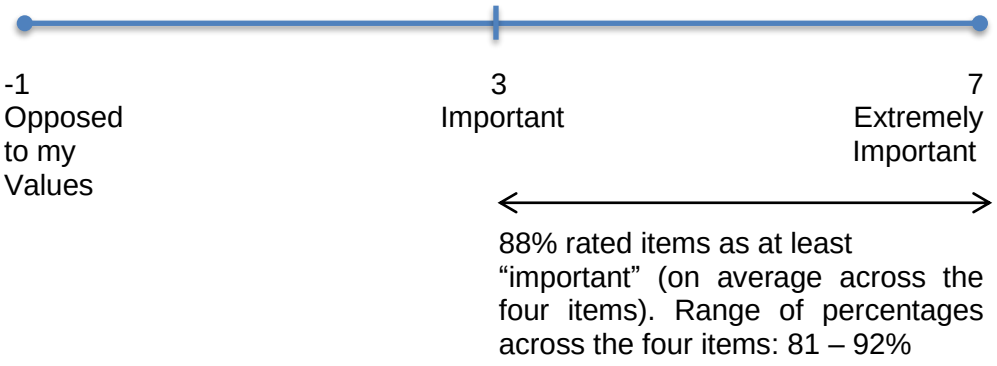
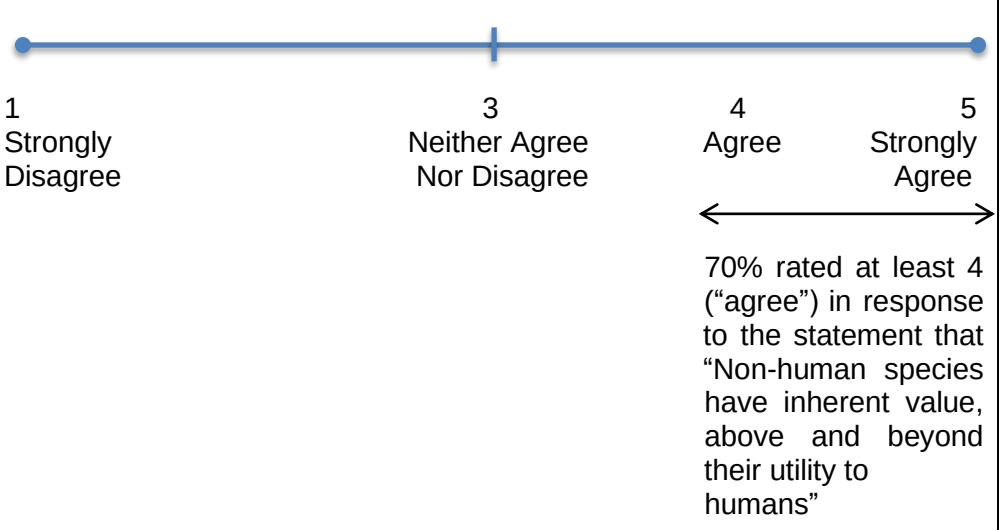
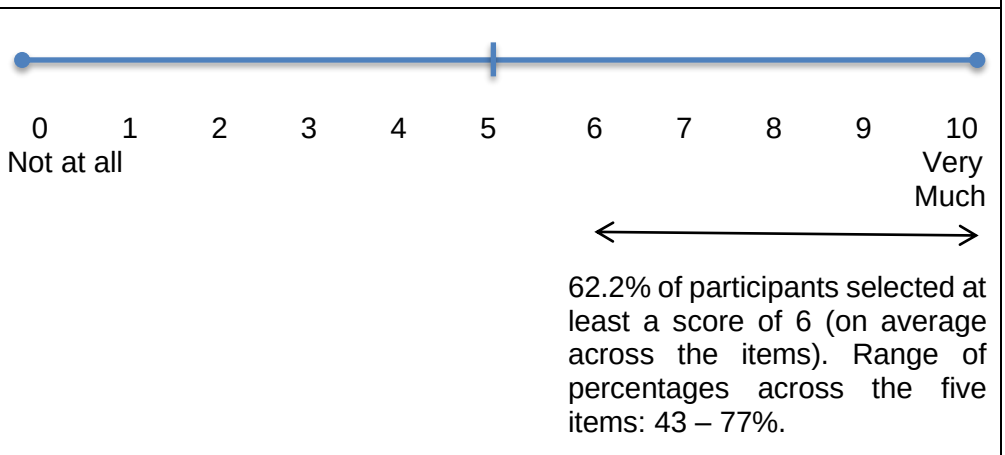
3. Personal pro-nature behaviours were those that would not entail much effort or social cost, such as voting for nature-friendly legislation or parties/candidates and signing petitions to support nature conservation. They would also not necessarily require much travel and would likely not be financially costly. In total, 25% of the sample reported performing these behaviours frequently, on average.

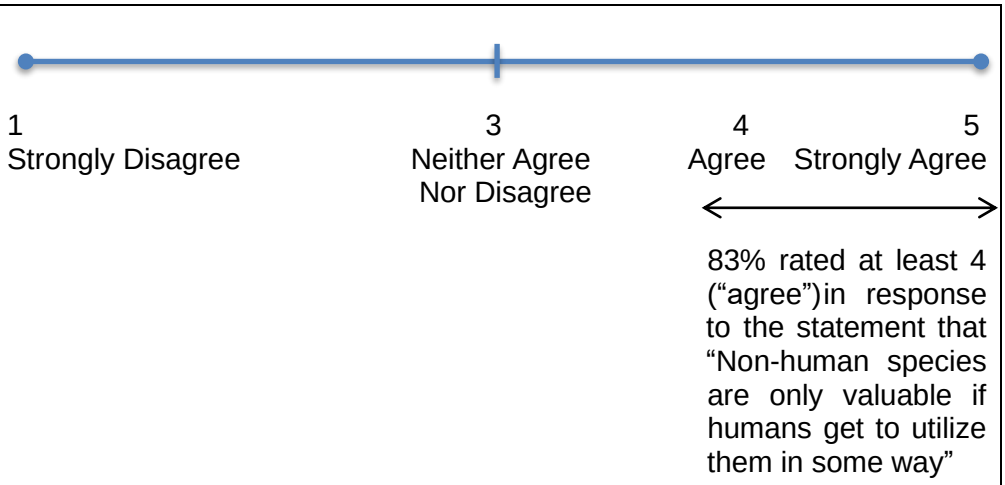
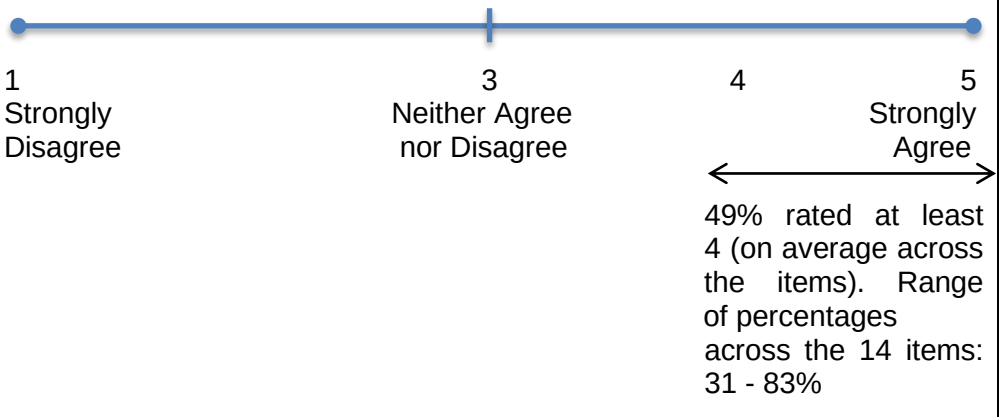
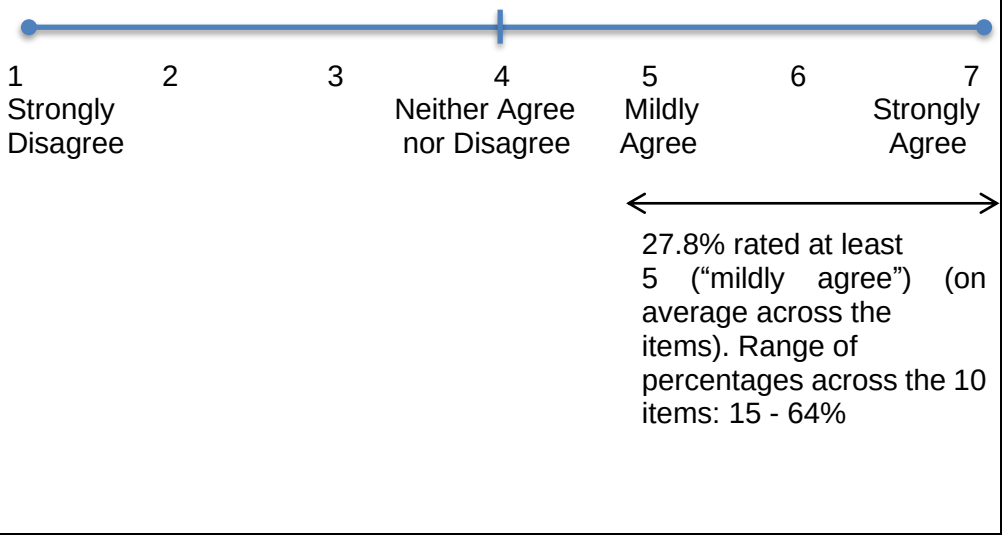
4. High-cost pro-nature behaviours were deemed very similar to high-cost pro-environmental behaviours (described in *Chapter 6*) in that they entail actions that are effortful (e.g., volunteering one's time with organisations and attending meetings) and many involved public-sphere behaviours that would help the environment indirectly via political actions leading to system change (e.g., attending local council meetings about nature conservation); in this sense, many of the behaviours could be considered higher-impact (Nielsen et al., 2021b). There were also items describing activities taking place in a public way but that would have a more direct impact on nature (e.g., participating in organised clean-up events). The key difference between high-cost pro-nature and pro-environmental behaviours is that the former, except for two, specify a focus on nature/habitat conservation (whereas items describing pro-environmental behaviours specify "the environment" as their focus). High-cost pro-nature behaviours, similarly to high-cost pro-environmental behaviours, were reported at a very low frequency (only 2.6% of the sample reporting frequently engaging in each high-cost pro-nature behaviour, on average, and the majority reporting never having performed them).

7.4.2 Prevalence of Beliefs and Sustainable Behaviour

Table 7.2 summarises the sample's endorsement of items on nature belief measures. Similarly to the findings of *Chapter 6*, participants appeared to more highly endorse the biospheric value and intrinsic value belief items than connectedness to nature and empathy toward nature items. The instrumental value belief item was highly endorsed.

Table 7.2: Percentage Endorsement for Each Nature Belief Measure.

Belief/Measure	Likert scale and proportion of sample endorsing items
Biospheric values *Value Orientations Scale* (De Groot & Steg, 2008)	
Intrinsic value beliefs (item taken from Wickizer, 2016)	
Mind attribution to nature *Individual Differences in Anthropomorphism Questionnaire* (Waytz et al., 2010)	

Instrumental value beliefs (item taken from Wickizer, 2016)	
Connectedness to nature *Connectedness to Nature Scale* (Mayer & Frantz, 2004)	
Empathy toward nature *Dispositional Empathy toward Nature Scale* (Tam, 2013)	

For scales with a midpoint indicating a negligible level of agreement in either direction (on the *Connectedness to Nature* and *Dispositional Empathy toward Nature* scales, a score of 3 and 4, respectively, indicating “neither agree nor disagree”; on the intrinsic value belief item and instrumental value belief item, a score of 3 indicating “neither agree nor disagree”), a one-sample t-test was conducted comparing the sample’s mean score with the scale’s midpoint score:

1. On the *Connectedness to Nature Scale* (Mayer & Frantz, 2004), participants’ scores were significantly higher than the midpoint (M = 3.60, SD = 0.03), $t(447) = 17.22$, $p < .001$, d = 0.81), indicating that the sample expressed a significant level of agreement with the items overall.

2. On the *Dispositional Empathy Toward Nature Scale* (Tam, 2013), participants’ scores were significantly lower than the midpoint (M = 3.05, SD = 0.07), $t(447) = -13.89$, $p < .001$, d = 0.66), indicating that the sample expressed a significant level of disagreement with the items overall.

3. For the intrinsic value beliefs item, participants’ scores were significantly higher than the midpoint (M = 3.90, SD = 0.05), $t(447) = 17.41$, $p < .001$, d = 0.82), indicating that the sample expressed a significant level of agreement with the statement.

4. For the instrumental value beliefs item, participants’ scores were significantly higher than the midpoint (M = 4.28, SD = 0.05), $t(447) = 27.99$, $p < .001$, d = 1.32), indicating that the sample expressed a significant level of agreement with the statement.

Figure 7.4 shows the proportion of the sample reporting a frequency of sustainable behaviour above the midpoint on the *Pro-Environmental Behaviours Scale* (Whitmarsh et al., 2017), separately for resource-conservation, consumption, and high-cost pro-environmental behaviours. Similarly to the findings of *Chapter 6*, the low rates of performing high-cost behaviours supports their conceptualisation as relatively higher-cost than the other two categories of behaviour. *Appendix I* provides bar charts indicating the distribution of participant responses for each item on all measures of nature beliefs and sustainable behaviour.

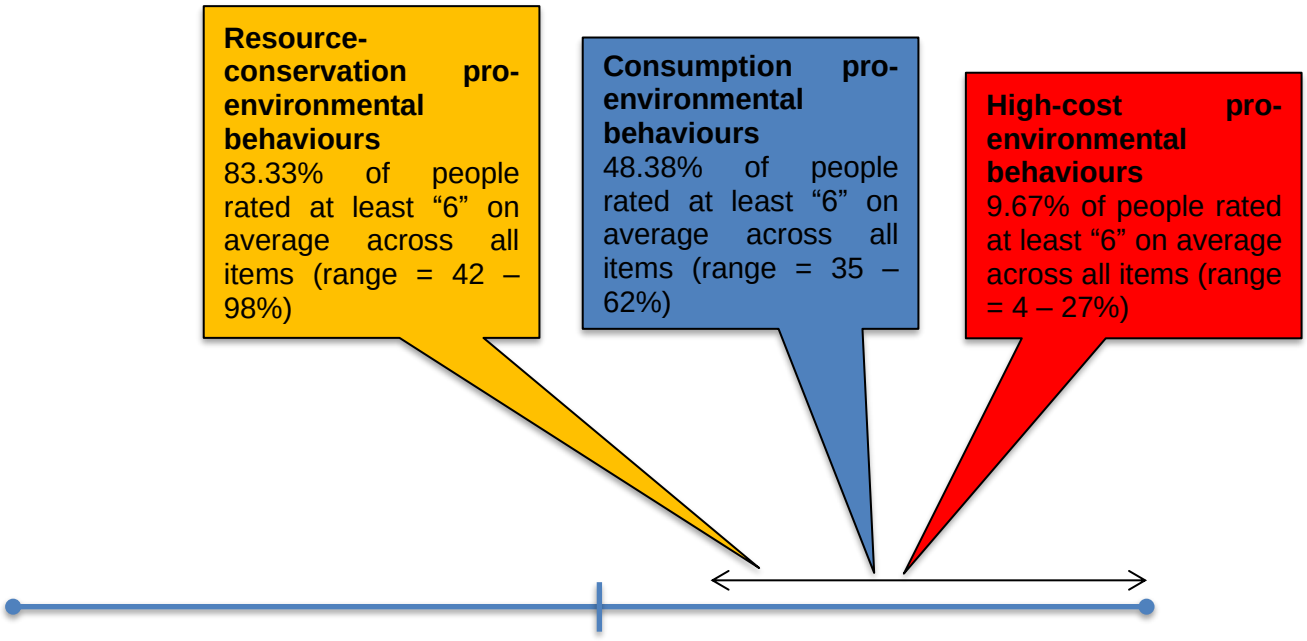


Figure 7.4: Percentage of participants selecting scores above the midpoint for each pro-environmental behaviour[11].

[11]All possible response options on the *Pro-Environmental Behaviours Scale* (Whitmarsh et al., 2017) were:

Not at all in the past year (1)	About once in the past year (2)	About 2 to 3 times in the past year (3)	About 4 to 6 times in the past year (4)	About once a month (5)	About 2 to 3 times per month (6)	About once a week (7)	About 2 to 3 times per week (8)	About 4 to 6 times per week (9)	At least once a day (10)

Figure 7.5 shows the proportion of the sample reporting a frequency of pro-nature behaviour above the midpoint on the *Pro-Nature Behaviours Scale* (Barbett et al., 2020), separately for personal, doing-for-wildlife, avoiding-for-wildlife, and high-cost pro-nature behaviours. The low rates of performing high-cost behaviours supports their conceptualisation as relatively higher-cost than the other three categories of behaviour. *Appendix I* provides bar charts indicating the distribution of participant responses for each item on all measures of nature beliefs and sustainable behaviour.

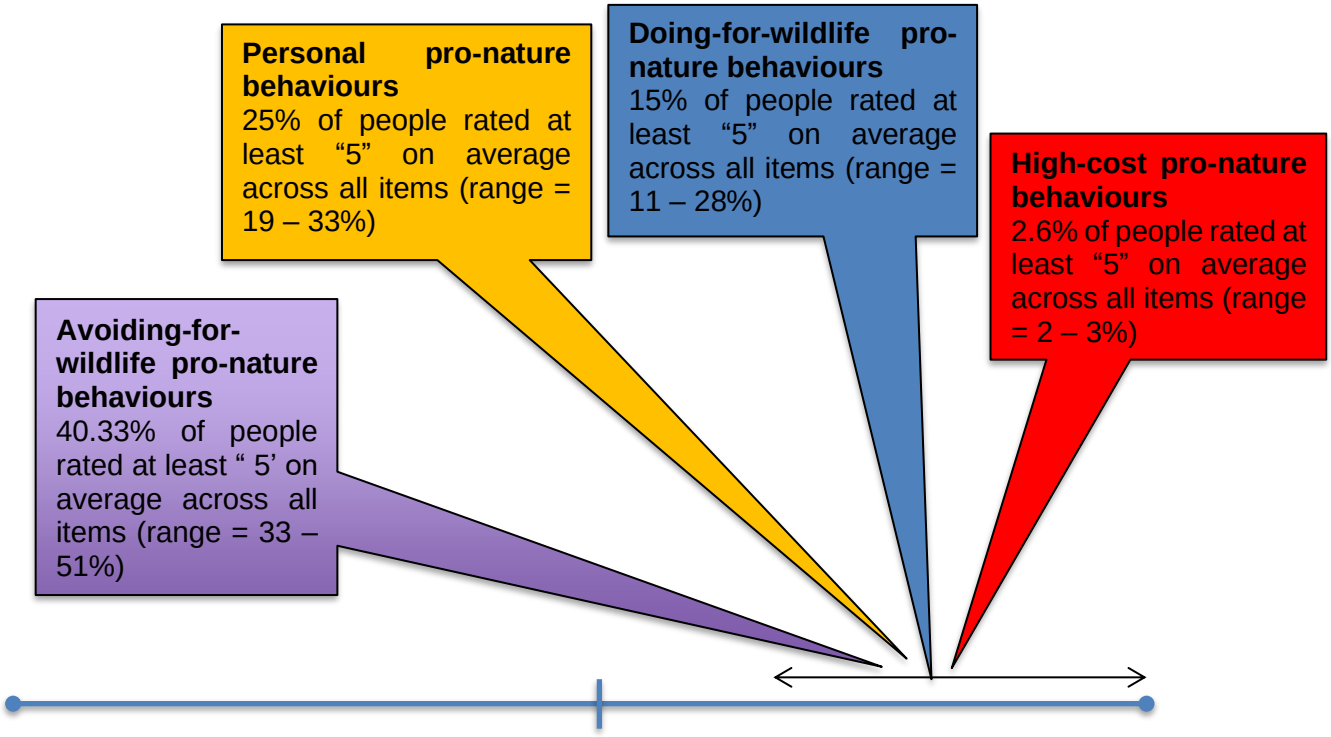


Figure 7.5: Percentage of participants selecting scores above the midpoint for each pro-nature behaviour[12].

[12]All possible response options on the *Pro-Nature Behaviours Scale* (Barbett et al., 2020) were:

Never (1)	Rarely (2)	Occasionally (3)	Sometimes (4)	Frequently (5)	Very Frequently (6)	Always (7)

7.4.3 Correlations and Group Comparisons

The distribution of age had a highly positive skew (with most participants' ages in the late teens/early twenties, and only a few participants older than 25). Empathy toward nature and connectedness to nature showed normal distributions, whereas biospheric values, intrinsic value beliefs, and instrumental value beliefs showed markedly negative skew. Consumption behaviours pro-environmental behaviours were normally distributed, resource-conservation pro-environmental behaviours showed marked negative skew, and high-cost pro-environmental behaviours showed marked positive skew. Personal, doing-for-wildlife, and high-cost pro-nature behaviours showed a markedly positive skew, and avoiding-for-wildlife pro-nature behaviours had a more normal distribution. Due to these deviations from a normal distribution, Spearman correlations were conducted on all nature beliefs, age, and pro-environmental/pro-nature behaviours (Table 7.3).

Replicating the findings of *Chapter 6*, Spearman correlations showed significant relationships between the nature beliefs that were also measured in *Chapter 6*: connectedness to nature, empathy toward nature, biospheric values, and intrinsic value beliefs. Instrumental value beliefs showed significant correlations with all these nature beliefs and the Value-Belief-Norm (VBN) model constructs (environmental worldview, awareness of consequences, ascription of responsibility, and personal norm) (Stern et al., 1999). Mind attribution to nature showed significant correlations with all nature beliefs and VBN model constructs, with the exception of awareness of consequences. Older participants showed lower mind attribution to nature. In contrast to the findings of *Chapter 6*, older participants reported lower biospheric values.

Mann-Whitney tests were conducted to compare men and women on each variable (Table 7.4). Similarly to the findings reported in *Chapter 6*, women had higher empathy toward nature and resource-conservation pro-environmental behaviours. Women also showed higher instrumental value beliefs, biospheric values, higher scores on the *New Ecological Paradigm* (environmental worldview), higher awareness of consequences, higher ascription of responsibility, and higher personal norm, and reported more frequent doing-for-wildlife pro-nature behaviours.

Table 7.3: Spearman Rank-Order Correlations (Cronbach's α Coefficients Along the Diagonal).

								Pro-environmental behaviours			*Pro-nature behaviours*			
	Age	Mind attribution to nature	Connnected-ness to nature	Empathy toward nature	Intrinsic value beliefs	Instrumental value beliefs	Biospheric values	Resource-conservation	Consumption	High-cost	High-cost	Personal	Doing-for-wildlife	Avoiding-for-wildlife
Age														
Mind attribution to nature	-0.14**	(.88)												
Connected-ness to nature	0.03	0.28***	(.89)											
Empathy toward nature	-0.02	0.34***	0.56***	(.93)										
Intrinsic value beliefs	0.06	0.19***	0.18***	0.22***	(-)									
Instrumental value beliefs	-0.03	0.11*	0.14**	0.17***	0.31***	(-)								
Biospheric values	-0.10*	0.22***	0.47***	0.43***	0.19***	0.13**	(.93)							
Resource-conservation PEBs	0.03	0.09	0.12*	0.06	0.13**	0.08	0.13**	(.56)						
Consumption PEBs	0.01	0.16***	0.32***	0.31***	0.16***	0.04	0.35***	0.41***	(.76)					
High-cost PEBs	0.06	0.18***	0.34***	0.27***	0.07	-0.07	0.22***	0.11*	0.57***	(.82)				
High-cost PNBs	0.07	0.13**	0.26***	0.23***	0.01	-0.13**	0.17***	0.00	0.37***	0.63***	(.89)			
Personal PNBs	0.04	0.17***	0.26***	0.31***	0.24***	0.15**	0.29***	0.17***	0.54***	0.61***	0.37***	(.85)		
Doing-for-wildlife PNBs	-0.06	0.19***	0.27***	0.31***	0.08	0.00	0.21***	0.09	0.31***	0.45***	0.44***	0.42***	(.86)	
Avoiding-for-wildlife PNBs	-0.02	0.16***	0.29***	0.23***	0.20***	0.17***	0.28***	0.15**	0.36***	0.32***	0.21***	0.42***	0.48***	(.82)

Note. n = 448. *p < .05. **p < .01. ***p < .001. PEBs = pro-environmental behaviours. PNBs = pro-nature behaviours.

Table 7.4: Mann Whitney U Tests comparing Men (M) and Women (W) on Subscale Scores.

Subscale	Median (M)	Median (W)	*U*
Mind attribution to nature	6.40	6.40	21445.00
Empathy toward nature	3.05	3.30	19744.00**
Connectedness to nature	3.42	3.42	23092.00
Biospheric values	4.38	5.00	19317.50***
Intrinsic value beliefs	4.00	4.00	23413.00
Instrumental value beliefs	4.50	5.00	21365.50*
Resource-conservation PEBs	8.17	8.50	20118.50**
Consumption PEBs	5.19	5.25	23617.00
High-cost PEBs	1.58	1.50	23664.50
High-cost PNBs	1.00	1.00	25454.50
Personal PNBs	2.67	2.67	22285.50
Doing-for-wildlife PNBs	1.60	2.00	20323.00**
Avoiding-for-wildlife PNBs	3.67	4.00	21609.50

Note. n = 448. *p < .05. **p < .01. ***p <.001. PEBs = pro-environmental behaviours. PNBs = pro-nature behaviours.

7.4.4 Hypothesis-Driven Regression Analyses

Standard OLS regressions were conducted with the eight predictors (sex, age, mind attribution to nature, connectedness to nature, empathy toward nature, biospheric values, intrinsic value beliefs, and instrumental value beliefs), separately for the three types of pro-environmental behaviour and four types of pro-nature behaviour. The assumption of homoscedasticity was not met for high-cost pro-environmental behaviours or any of the pro-nature behaviour variables (doing-for-wildlife, avoiding-for-wildlife, personal, and high-cost pro-nature behaviours), and heteroscedasticity-consistent standard errors were calculated for these[13]. The variance inflation factor was <2.5 for all variables, indicating no substantial multicollinearity (Johnston et al., 2018). Benjamini-Hochberg corrections were applied when determining the significance of each individual predictor to control for the influence of multiple hypothesis tests. See Tables 7.5 and 7.6 for the results of regression analysis for pro-environmental behaviours and pro-nature behaviours, respectively. The findings in relation to hypotheses *H1-H9* were as follows:

- *H1* was supported: mind attribution to nature did not predict any pro-environmental behaviours when included in regressions alongside other variables. Mind attribution to nature was also found not to predict any pro-nature behaviours.

- *H2* was supported: biospheric values predicted consumption pro-environmental behaviours. Biospheric values were found also to predict resource-conservation pro-environmental behaviours and two pro-nature behaviours: personal and avoiding-for-wildlife pro-nature behaviours.

- *H3* was supported: intrinsic value beliefs were not predictive of any pro-environmental behaviours.

- *H4* was supported: intrinsic value beliefs were predictive of avoiding-for-wildlife pro-nature behaviours. Intrinsic value beliefs were also predictive of personal pro-nature behaviours.

[13]Additional OLS regressions without heteroscedasticity-consistent standard errors were also performed for high-cost pro-environmental behaviours and doing-for-wildlife, avoiding-for-wildlife, personal, and high-cost pro-nature behaviours; no difference was found in the pattern of significant findings at the $p < .05$ level.

- *H5* was supported: instrumental value beliefs were negatively predictive of high-cost pro-environmental behaviours and high-cost pro-nature behaviours.

- *H6* was not supported: empathy toward nature did not predict high-cost pro-environmental behaviours. *H7* was supported, as empathy toward nature did predict high-cost pro-nature behaviours. Empathy was also predictive of doing-for-wildlife pro-nature behaviours.

- *H8* and *H9* were supported: connectedness to nature was predictive of high-cost pro-environmental behaviours and high-cost pro-nature behaviours, respectively. Connectedness to nature was also predictive of doing-for-wildlife and avoiding-for-wildlife pro-nature behaviours.

R^2 values indicate a “weak” effect size for the overall model of resource-conservation pro-environmental behaviours, and “moderate” effect sizes for the overall models of consumption and high-cost pro-environmental behaviours (Cohen, 1988). R^2 values indicate “weak” effect size for the overall models of high-cost and doing-for-wildlife pro-nature behaviours, and “moderate” effect sizes for the overall models of personal and avoiding-for-wildlife pro-nature behaviours (Cohen, 1988).

Table 7.5: Simultaneous Regressions of Nature Belief and Demographic Variables on the Three Types of Pro-Environmental Behaviours, Showing Standardised Beta Coefficients (and Standard Errors).

	Pro-environmental behaviours		
	Resource-conservation	Consumption	High-cost[a]
Women	0.22 (0.10)	-0.11 (0.09)	-0.10 (0.10)
Age	0.13* (0.05)	0.00 (0.05)	0.09 (0.04)
Mind attribution to nature	0.06 (0.05)	0.02 (0.05)	0.03 (0.05)
Connectedness to nature	0.01 (0.06)	0.14 (0.06)	0.29*** (0.05)
Empathy toward nature	-0.08 (0.06)	0.14 (0.06)	0.06 (0.05)
Biospheric values	0.17* (0.06)	0.22*** (0.05)	0.08 (0.05)
Intrinsic value beliefs	0.11 (0.05)	0.09 (0.05)	-0.01 (0.05)
Instrumental value beliefs	0.06 (0.05)	-0.06 (0.05)	-0.19* (0.06)
Observations	423	428	425
R^2	0.08	0.20	0.17
F statistic	4.64*** (df = 8; 414)	13.20*** (df = 8; 419)	10.62*** (df = 8; 416)

Note. Significance based on Benjamini-Hochberg-corrected *p*-values. *p<0.5; ***p<0.001.
[a]Analysis conducted with heteroscedasticity-consistent standard errors.

Table 7.6: Simultaneous Regressions of Nature Belief and Demographic Variables on the Four Types of Pro-Nature Behaviours, Showing Standardised Beta Coefficients (and Standard Errors).

	Pro-nature behaviours			
	Personal[a]	High-cost[a]	Doing-for-wildlife[a]	Avoiding-for-wildlife[a]
Women	-0.01	-0.17	0.17	0.08
	(0.09)	(0.10)	(0.10)	(0.09)
Age	0.03	0.06	0.04	0.05
	(0.04)	(0.05)	(0.05)	(0.04)
Mind attribution to nature	0.03	0.03	0.10	0.08
	(0.05)	(0.05)	(0.05)	(0.05)
Connectedness to nature	0.09	0.13*	0.16*	0.17*
	(0.06)	(0.05)	(0.06)	(0.06)
Empathy toward nature	0.13	0.15**	0.15*	0.02
	(0.06)	(0.05)	(0.06)	(0.06)
Biospheric values	0.19**	0.04	0.05	0.16*
	(0.05)	(0.06)	(0.05)	(0.06)
Intrinsic value beliefs	0.15**	-0.03	0.02	0.13*
	(0.04)	(0.05)	(0.05)	(0.05)
Instrumental value beliefs	0.08	-0.22**	-0.08	0.10
	(0.04)	(0.06)	(0.04)	(0.04)
Observations	426	423	424	422
R^2	0.19	0.12	0.14	0.18
Adjusted R^2	0.18	0.10	0.12	0.16
Residual standard error	0.83 (df = 417)	0.90 (df = 414)	0.88 (df = 415)	0.84 (df = 413)
F Statistic	13.88*** (df = 8; 417)	6.53*** (df = 8; 414)	9.14*** (df = 8; 415)	14.52*** (df = 8; 413)

Note. Significance based on Benjamini-Hochberg-corrected *p*-values. *p<0.5; **p<.01.
[a]Analyses conducted with heteroscedasticity-consistent standard errors.

7.4.4.1 Dominance Analysis. Dominance analyses were undertaken on all hypothesis-driven regressions to determine the individual contribution of each predictor to the model, expressed as R^2 (see Table 7.7). R^2 values show that instrumental value beliefs had the highest effect size for high-cost pro-nature behaviours (as a negative predictor of them). Empathy toward nature and connectedness to nature had the same effect size for high-cost pro-nature behaviours (as positive predictors). For high-cost pro-environmental behaviours, instrumental value beliefs had the lowest effect size (as a negative predictor) and connectedness to nature the highest effect size (as a positive predictor). Empathy toward nature had the highest effect size for doing-for-wildlife pro-nature behaviours. Where intrinsic value beliefs were significant, they had the lowest effect size compared with other predictors. The lowest effect size of all was age, explaining 1% of the variance in resource-conservation pro-environmental behaviours. The highest effect size of all was connectedness to nature, predicting 8% of the variance in high-cost pro-environmental behaviours. All effect sizes were “weak” (Cohen, 1988).

Table 7.7: R^2 Values of Significant Predictors, in Descending Order for Each Outcome.

Outcome: Resource-conservation pro-environmental behaviours	
Biospheric values	.02
Age	.01
Outcome: Consumption pro-environmental behaviours	
Biospheric values	.07
Outcome: High-cost pro-environmental behaviours	
Connectedness to nature	.08
Instrumental value beliefs	.03
Outcome: High-cost pro-nature behaviours	
Instrumental value beliefs	.04
Empathy toward nature	.03
Connectedness to nature	.03
Outcome: Personal pro-nature behaviours	
Biospheric values	.05
Intrinsic value beliefs	.03
Outcome: Doing-for-wildlife pro-nature behaviours	
Empathy toward nature	.04
Connectedness to nature	.04
Outcome: Avoiding-for-wildlife pro-nature behaviours	
Connectedness to nature	.05
Biospheric values	.04
Intrinsic value beliefs	.03

7.4.5 Exploratory Analyses

7.4.5.1 Mediation Analyses. Mediation analyses were conducted to determine whether each predictor (X) influenced its outcome (Y) via a mediating variable (M). Analyses explored whether connectedness to nature and empathy toward nature influence high-cost pro-environmental and pro-nature behaviours via guilt and anger, in line with Smith's (1993) theory of group affiliation's impact on guilt/anger, and subsequent behaviour (see Section 7.2.2.1). Eight mediation analyses were conducted in total, testing whether: connectedness to nature predicts high-cost pro-environmental behaviours via guilt/anger; connectedness to nature predicts high-cost pro-nature behaviours via guilt/anger; empathy toward nature predicts high-cost pro-environmental behaviours via guilt/anger; empathy toward nature predicts high-cost pro-environmental behaviours via guilt/anger (see Figures 7.6 and 7.7).

Table 7.8 shows the results from each of the four mediation models shown in Figure 7.6, providing bias-corrected and accelerated 95% confidence interval on path ab with 5,000 bootstrap samples (BCa 95% CI). With connectedness to nature as a predictor, only model (i) in Figure 7.6 was supported by the data, i.e., in which the influence of connectedness to nature on high-cost pro-environmental behaviours is mediated by eco-anger.

Table 7.8 shows the results from each of the four mediation models shown in Figure 7.7, providing bias-corrected and accelerated 95% confidence interval on path ab with 5,000 bootstrap samples (BCa 95% CI). With empathy toward nature as a predictor, only model (i) in Figure 7.7 was supported by the data, i.e., in which the influence of empathy toward nature on high-cost pro-environmental behaviours is mediated by eco-anger.

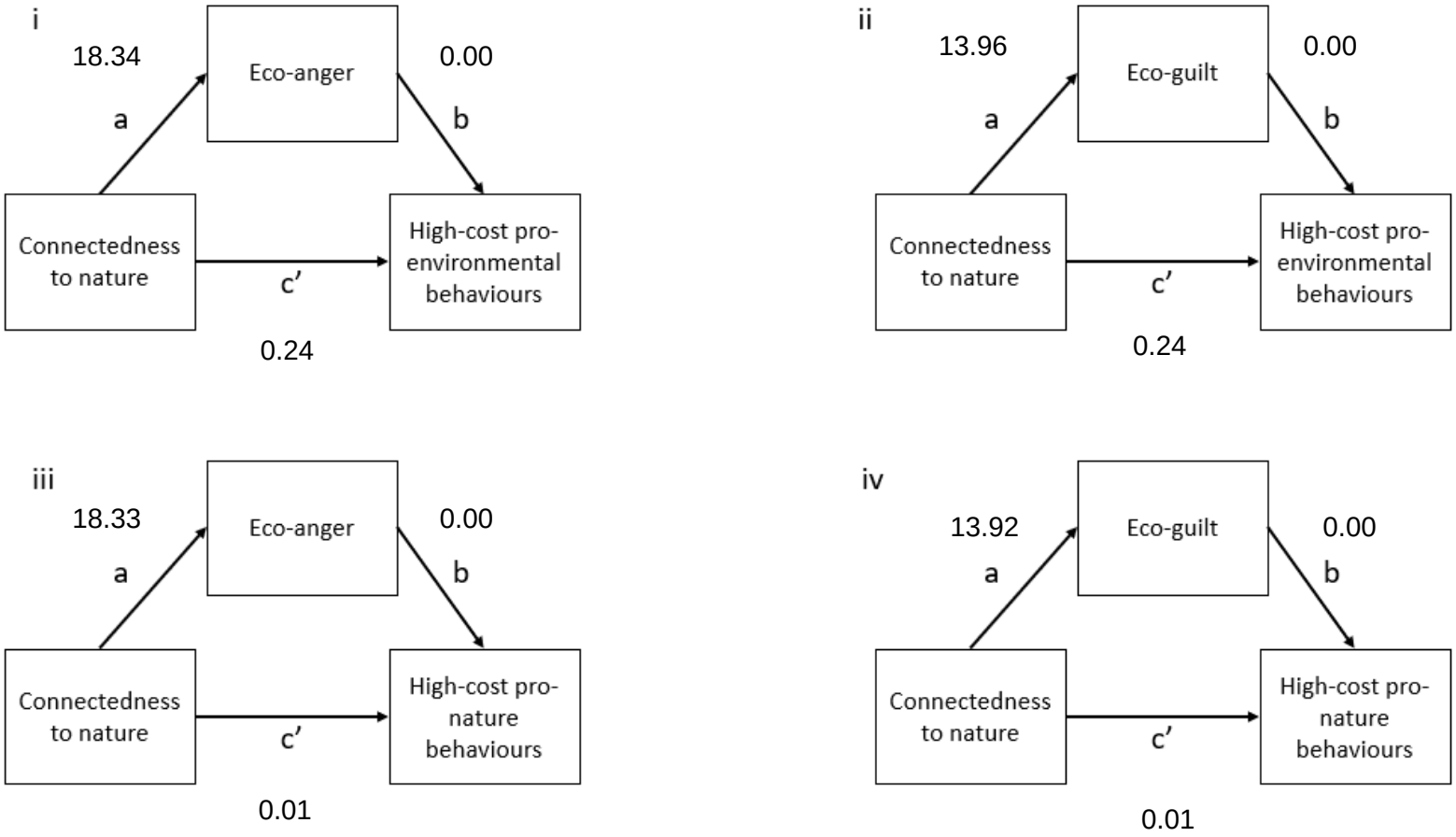


Figure 7.6: Mediation analyses with connectedness to nature as a predictor, two different mediators, and two different outcomes. Numbers represent beta coefficients (see Table 7.8).

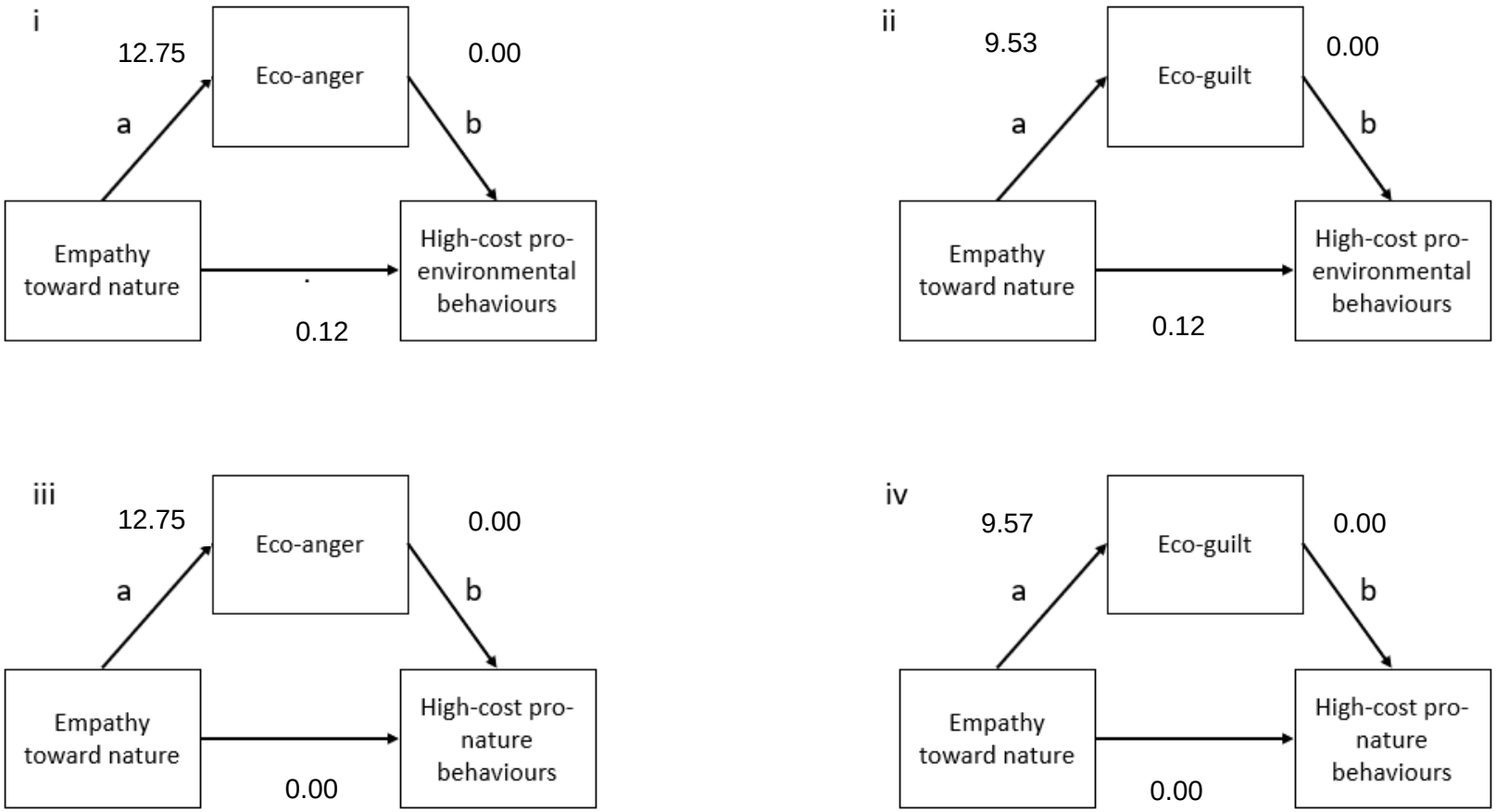


Figure 7.7: Mediation analyses with empathy toward nature as a predictor, two different mediators, and two different outcomes. Numbers represent beta coefficients (see Table 7.8).

Table 7.8: Results of Mediation Analyses for High-Cost Behaviours, With Two Nature Beliefs as Predictors and Two Emotions as Mediators.

	Beta coefficient				
Outcome (behaviour)	Path a	Path b	Path c	Path c'	BCa 95% CI
Predictor: Connectedness to nature					
Mediating emotion: Eco-anger					
High-cost PEBs	18.34***	0.00**	0.24***	0.18***	0.02 - 0.12**
High-cost PNBs	18.33***	0.00	0.01	0.01	-0.00 - 0.01
Mediating emotion: Eco-guilt					
High-cost PEBs	13.96***	0.00	0.24***	0.22***	-0.02 - 0.06
High-cost PNBs	13.92***	0.00	0.01	0.01	-0.00 - 0.01
Predictor: Empathy toward nature					
Mediating emotion: Eco-anger					
High-cost PEBs	12.75***	0.00*	0.12***	0.08*	0.01 - 0.09**
High-cost PNBs	12.75***	-0.00	0.00	0.00	-0.00 - 0.00
Mediating emotion: Eco-guilt					
High-cost PEBs	9.53***	0.00	0.12***	0.11***	-0.02 - 0.04
High-cost PNBs	9.57***	0.00	0.00	0.00	-0.00 - 0.00

Note. n = 448. Paths: a = Predictor to emotion; b = emotion (controlling for predictor) to behaviour; c = Predictor to behaviour; c' = Predictor to behaviour (controlling for emotion). BCa 95% CI = bootstrapped confidence interval of path ab. *p < .05. **p < .01. ***p < .001. PEBs = pro-environmental behaviours; PNBs = pro-nature behaviours.

7.4.5.2 An Extended Value-Belief-Norm Model.

7.4.5.2.1 Confirmatory Factor Analysis. A structural equation modelling (SEM) approach was taken to testing an extended Value-Belief-Norm (VBN) model (Stern et al., 1999) with an additional pathway in which connectedness to nature and empathy toward nature influence the development of a biospheric value orientation, as would be predicted if these variables are associated with a sense of group affiliation with nature. The remaining sequence reflects the original VBN model, in which biospheric values lead to broad beliefs about humans' impacts on the natural world (as measured by the *New Ecological Paradigm*; Dunlap et al., 2000), awareness of a specific consequences of humans' actions on non-human species, ascription of responsibility to oneself, and then a sense of personal obligation (personal norm) to act. Another pathway to be tested was a direct influence of connectedness to nature and empathy toward nature on personal norm, which would also be expected if these predictors operate via an increased sense of group affiliation with nature (see Figure 7.2). Correlations were conducted between these additional variables in the VBN model that had not been included in previous regressions, and the other nature beliefs (see Table 7.9).

Table 7.9: Correlations Between Each Nature Belief/Sustainable Behaviour and the Constructs in the Value-Belief-Norm Model (Stern et al. 1999).

	Environmental worldview	Awareness of consequences	Ascription of responsibility	Personal norm
Mind attribution to nature	0.22***	0.07	0.13**	0.27***
Connectedness to nature	0.25***	0.14**	0.19***	0.49***
Empathy toward nature	0.30***	0.19***	0.23***	0.51***
Intrinsic value beliefs	0.35***	0.33***	0.13**	0.28***
Instrumental value beliefs	0.48***	0.23***	0.11*	0.15**
Biospheric values	0.35***	0.28***	0.22***	0.51***
Resource-conservation PEBs	0.23***	0.22***	0.06	0.24***
Consumption PEBs	0.22***	0.16***	0.12*	0.47***
High-cost PEBs	-0.02	-0.01	0.08	0.29***
High-cost PNBS	-0.12*	-0.04	0.03	0.19***
Personal PNBs	0.27***	0.11*	0.07	0.37***
Doing-for-wildlife PNBs	0.09	0.05	0.05	0.22***
Avoiding-for-wildlife PNBs	0.31***	0.14**	0.12*	0.33***

Note. $n = 448$. *$p < .05$. **$p < .01$. ***$p < .001$. PEBs = pro-environmental behaviours. PNBs = pro-nature behaviours.

Following the guidance of Kline (2015), prior to conducting the full SEM, confirmatory factor analyses were conducted on all measures to be included as latent variables in the full SEM in order to confirm their factor structure. The three latent variables were *awareness of consequences*, *ascription of responsibility*, and *personal norm*, and items reflecting these constructs were bespoke to the current study to reflect human-caused impacts on the natural world. Structural equation modelling allows for the inclusion of latent variables as this allows their measurement error to be taken into account by measuring the variance that is not explained by observed variables (the individual questionnaire items in this case); it is therefore appropriate for variables whose measurement error has not been established in previous research to be included as latent variables (Kline, 2016).

Three separate confirmatory factor analyses were conducted on 80% of the dataset for *awareness of consequences*, *ascription of responsibility*, and *personal norm*, using the items selected during exploratory factor analyses conducted on these measures for 20% of the dataset[14].

- For *awareness of consequences*, these items are: 1, 2, 3, 7, and 9 (see *Appendix H*)
- For *ascription of responsibility*, these items are: 1, 3, 5, 8, and 10 (see *Appendix H*)
- For *personal norm*, these items are: 3, 4, 7, 8, and 10 (see *Appendix H*)

The models were run with each of the five items loading onto their single factors. The fit indices showed sub-optimal fit for personal norm items, and modification indices were run to determine what might be causing the misspecification. Modification indices indicated that the model for personal norm would be improved if four covariances were added between the error terms of items 3 and 4; items 3 and 7; items 3 and 8; and items 7 and 8. The wording of these items was

[14]Confirmatory factor analyses were also performed on the alternative items for awareness of consequences, ascription of responsibility, and personal norm, based on the other factor identified for ascription of responsibility (AR-Animals) during exploratory factor analyses (see *Footnote 8*). Fit indices were acceptable for awareness of consequences (AC; items 4, 5, 6, 8, 10) and ascription of responsibility (AR-Animals; items 2, 4, 6, 7, 9). Fit indices were sub-optimal for personal norm (PN; items 1, 2, 5, 6, 11); after improving the model by allowing the errors of two PN item pairs to covary (items 2 & 5, both with similar wording around “feeling guilty”; items 6 & 11, both with similar wording around a sense of obligation to act), fit indices for PN were acceptable. Cronbach’s α, AVE, and CR were acceptable for all factors, except for personal norm, which had an AVE of .46, slightly below recommended minimum of .5.

inspected, and it was deemed that their similar wording would account for covariance in their errors (i.e., variance not explained by the latent factor). Items 3 and 4 both started with “I feel a personal obligation to do whatever I can to...”. Items 3 and 7 shared the concept of “doing whatever one can”, as did items 7 and 8. Items 3 and 8 both included the phrase “personal obligation”. Similar wording is a common source of correlated residual errors and models can be adapted to represent this to improve model fit (Brown, 2015; Kline, 2015). The models to be tested are depicted in Figure 7.8.

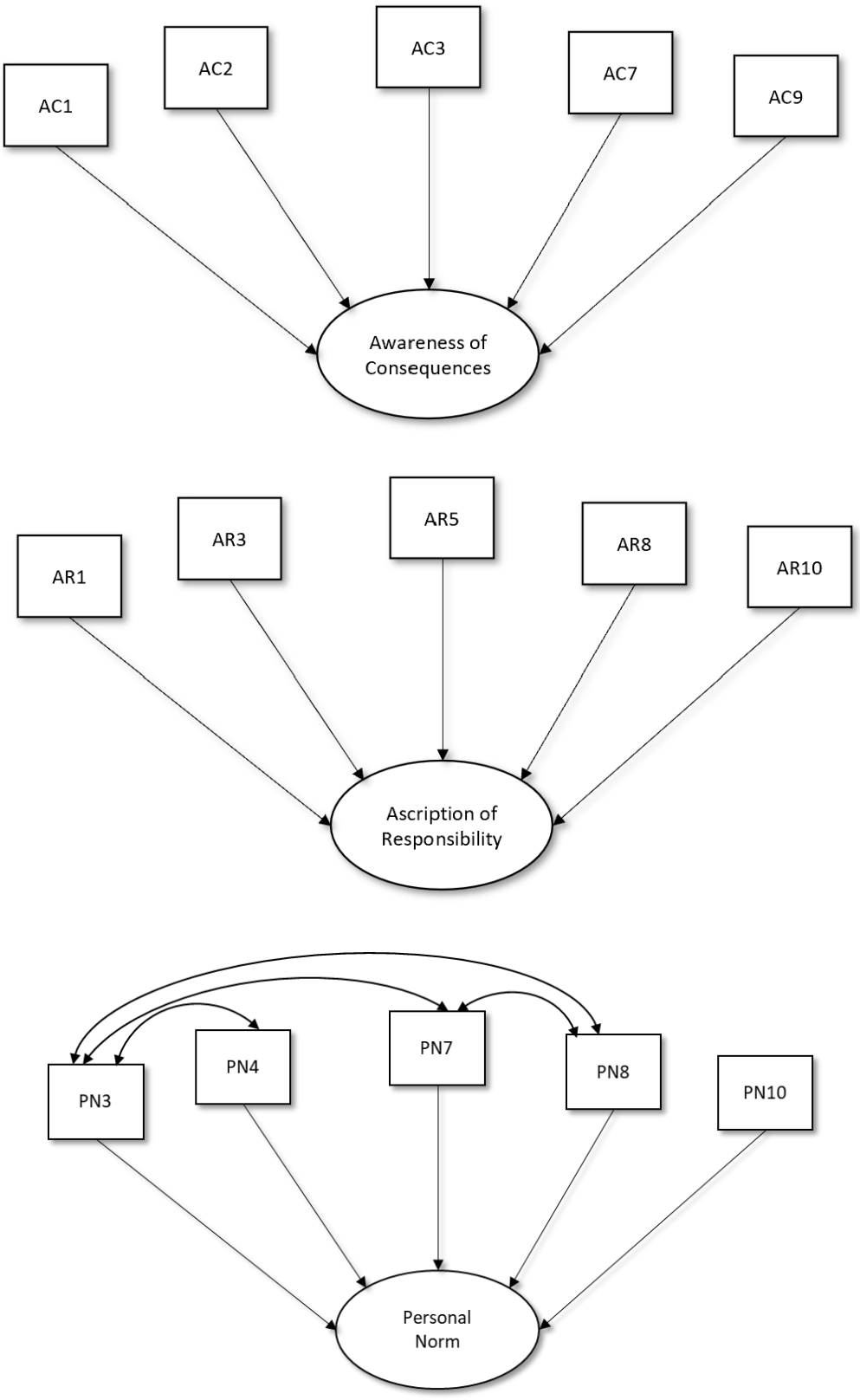


Figure 7.8: Three latent factors and their hypothesised relation to indicator variables (items on the questionnaires). double-headed arrows represent correlated error terms of indicator items. AC = awareness of consequences; AR = ascription of responsibility; PN = personal norm.

Items for all three scales all loaded > .6 onto their factors, in keeping with the minimum recommended loading for each item of .5 (Hair et al., 2018). To determine the overall fit of the model, the guidance of Hair et al. (2018) was followed. For a sample size > 250 and with < 12 manifest variables for each latent variable, *p* values are expected to be non-significant for the χ^2 test, a CFI or TLI of .96 or higher, and a RMSEA < .07 in the context of CFI = .96 or higher (Hair et al. [2019] advise against reporting RNI and SRMR in this scenario) (see *Section 7.3.11* for an explanation of these fit indices). All of the recommended values were met for each confirmatory factor analysis, indicating that each model was an acceptable fit to the data. Composite reliability (CR) scores were within acceptable limits (above 0.7 but not above 0.95; Hair et al., 2019), and the average variance extracted (AVE) was also acceptable for each factor (0.5 or higher; Hair et al., 2018). Table 7.10 shows all fit indices, CR, AVE, and Cronbach's α values for latent variables analysed with confirmatory factor analyses.

Table 7.10: Fit Indices for Latent Variables.

Index	Awareness of consequences	Ascription of responsibility	Personal norm[a]
χ^2 (df); *p* value	7.15 (5); *p* = .21	8.50 (5); *p* =.13	0.03 (1); *p* = .85
χ^2/df	1.43	1.70	0.04
CFI	1.00	1.00	1.00
TLI	1.00	1.00	1.00
RMSEA	0.03	0.04	0.00
AVE	0.63	0.55	0.64
CR	0.78	0.83	0.91
Cronbach's α	0.75	0.82	0.84

[a]After allowing for correlated residuals for items with similar wording.

7.4.5.2.2 Structural Equation Model. A full structural equation model was tested for the extended Value-Belief-Norm (VBN) model (Stern et al., 1999); the results are shown in Figure 7.9. The errors of the indicators of the personal norm latent variable were allowed to covary as per the confirmatory factor analysis of this measure (see Figure 7.8), and each latent variable (awareness of consequences, ascription of responsibility, and personal norm) was allowed to covary as they

referred to the same human actions/consequences in their wording (Kline, 2015). The two outcomes (high-cost pro-environmental and pro-nature behaviours) were also allowed to covary as the items share similar wording (Kline, 2015). The stand-alone manifest variables (i.e., those that were not entered in the model as indicators of latent variables) represent the mean score of measures; including a mixture of latent and manifest variables which was a means of limiting the number of parameters to be estimated. The stand-alone manifest variables all had established measurement error (e.g., as indicated by Cronbach's α) of an acceptable level (all > .7) (Cortina, 1993). It is usually deemed appropriate to include stand-alone manifest variables when measures have well-established psychometric properties and low measurement error (Kline, 2015). In total, there were three latent variables (awareness of consequences, ascription of responsibility, personal norm) and 21 manifest variables (connectedness to nature, empathy toward nature, biospheric values, environmental worldview, high-cost pro-environmental behaviours, high-cost pro-nature behaviours, and the 15 items entered into the model as indicators of the three latent variables [five per variable; see Figure 7.8]).

For a model to be identified, the error term for each endogenous variable must be given a scale of measurement (Kline, 2015). The RStudio package "*lavaan*" (Rosseel, 2012) was used to generate the structural equation model, and automatically provides a scale of measurement by fixing the path coefficient from each error term to its endogenous variable to 1. The model had degrees of freedom > 0 and was therefore over-identified, as is desirable for structural equation modelling (Kline, 2015) (see *Appendix J* for the standardised factor loadings of indicators onto each latent factor in the structural equation model).

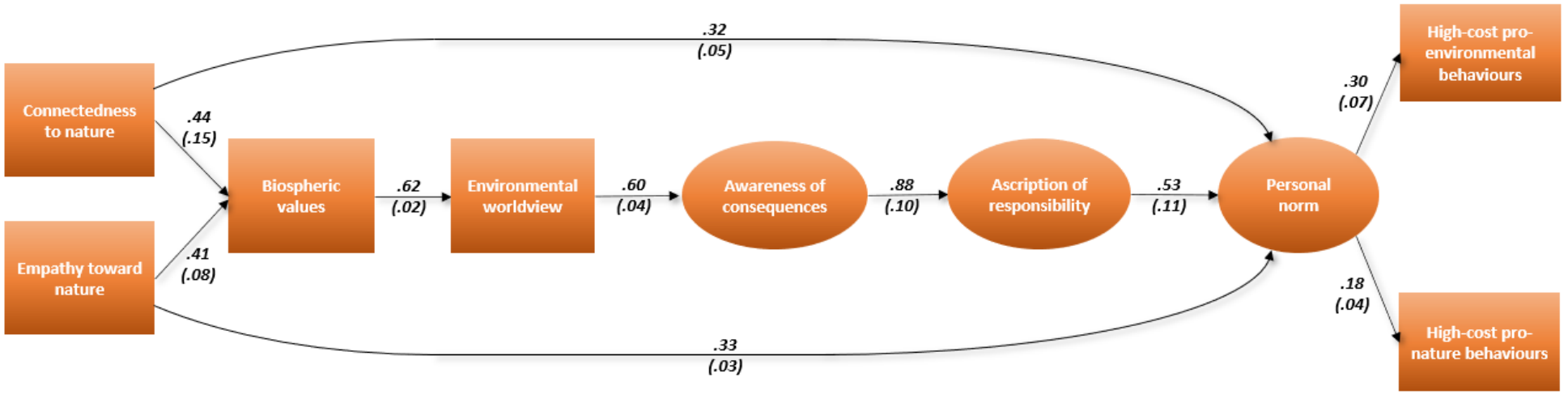


Figure 7.9: Results of the structural equation model for the extended VBN model (Stern et al., 1999). Numbers represent standardised beta coefficients (and standard errors). Square boxes represent manifest (observed) variables. Ovals represent latent (unobserved) variables, with the factor structure shown in Figure 7.8. All paths were significant at the $p < .001$ level. Awareness of consequences, ascription of responsibility, and personal norm items are those based on the AR-Environment factor within the ascription of responsibility measure (see Section 7.4.1).

In the SEM of the extended VBN model shown in Figure 7.9, connectedness to nature and empathy toward nature significantly predicted biospheric values and personal norm. Biospheric values significantly predicted broad environmental worldview (*New Ecological Paradigm*), and all other paths were also significant (from environmental worldview to awareness of consequences, from awareness of consequences to ascription of responsibility, from ascription of responsibility to personal norm, and from personal norm to high-cost pro-environmental behaviours and high-cost pro-nature behaviours).

The results are consistent with a model in which connectedness to nature and empathy toward nature have a distal influence on high-cost pro-environmental behaviours and pro-nature behaviours via the influence of biospheric values on the remaining sequence of variables. The results are also consistent with a model in which connectedness to nature and empathy toward nature influence high-cost pro-environmental behaviours and pro-nature behaviours more directly via their influence on a variable more proximally related to these behaviours: personal norm. The implications of these findings are discussed further in the discussion section of this chapter.

The standard VBN model (Stern et al., 1999) (i.e., an identical model to that shown in Figure 7.9, but without connectedness to nature and empathy toward nature) was also tested in a structural equation model. As with the previously described model, all regression paths between variables were significant[15].

Table 7.11 shows the fit indices from the extended VBN model as well as the standard VBN model, for comparison. To determine the overall fit of the model, the guidance of Hair et al. (2018) was followed. For a study with a sample size > 250 and between 12 and 30 manifest variables (including the indicators for the three latent variables), significant *p* values are expected for the χ^2 test, a CFI or TLI at least .94, RNI above .94, SRMR .08 or less, and RMSEA < .07 (see *Section*

[15]An extended VBN model was re-run including the items from the other factor identified for ascription of responsibility (AR-Animals) and items from awareness of consequences and personal norm factors with similar content (see *Footnote 11*), for comparison. Individual regression pathways showed that connectedness to nature and empathy toward nature were both significantly predictive of biospheric values and personal norm, in line with expectations; however, ascription of responsibility did not predict personal norm, which was not in keeping with the VBN model. The model had poorer fit than when the AR-Environment factor was used (no fit indices were within limits, except for the ratio of χ^2/df, which was just below 5 [4.99]). Removing connectedness to nature and empathy toward nature from the model (i.e., the original VBN model) (Stern et al., 1999) provided an even poorer fit to the data: no fit indices were acceptable, and an ANOVA showed the ratio of χ^2/df to be significantly worse for this model than when connectedness to nature and empathy toward nature were included.

7.3.11 for an explanation of these fit indices). All the recommended values were met for the fit indices in the extended VBN model, indicating that the model was an acceptable fit to the data. All of these indices were also met by the standard VBN model, except for SRMR and RMSEA, which were above the recommended levels of .08 or less and < .07, respectively. Every index shows a slightly better fit for the extended compared with the standard VBN model, indicating that the extended VBN model is at least as good an explanation of high-cost pro-environmental and pro-nature behaviours as the standard model (if not better). Although the ratio of χ^2/df (which should be below 5; Tabachnick & Fidell, 2007) was better for the extended compared with the standard model, an ANOVA to compare this ratio for the two models indicated that there was no significant difference between them on this indicator of model fit (p = .19).

Table 7.11: Fit Indices for the Extended and Standard Value-Belief-Norm Model.

Fit index	Extended VBN model	Standard VBN model
χ^2 (df); p value	528.13 (176); p < .001	487.15 (142) p < .001
χ^2/df	3.00	3.43
CFI	0.98	0.98
TLI	0.98	0.98
RNI	0.98	0.98
SRMR	0.08	0.08
RMSEA	0.07	0.08

7.4.5.3 Predictors of Actual Behaviour. Most participants asked to read the brief article on nature conservation at the end of the study (369 participants out of 560). Table 7.12 shows how the people who chose to read the article compare with those who chose not to, on each nature belief and self-reported sustainable behaviour. Five nature beliefs were significantly higher among those who chose to read the article: empathy toward nature, connectedness to nature, biospheric values, intrinsic value beliefs, and instrumental value beliefs. The following self-reported behaviours were higher among those who chose to read the article: consumption pro-environmental behaviours, high-cost pro-environmental behaviours, high-cost pro-nature behaviours, personal pro-nature behaviours, doing-for-wildlife pro-nature behaviours, and avoiding-for-wildlife pro-nature behaviours.

Table 7.13 shows the results of a binary logistic regression on whether or not people chose to read the article on nature conservation. Three variables were found to be significantly associated with choosing to read the article. Older respondents were significantly more likely to ask to read the article, as were people who scored higher on biospheric values and instrumental value beliefs.

Table 7.12: Mann Whitney U Tests Comparing Median Subscale Scores of Those Who Chose to/Not to Read the Article on Nature Conservation.

Subscale	Median (choosing to read the article)	Median (choosing not to read the article)	*U* (*p*)
Mind attribution to nature	6.80	6.40	23693.50
Empathy toward nature	3.50	3.10	25930.00***
Connectedness to nature	3.58	3.33	26564.50***
Biospheric values	5.13	4.30	27202.00***
Intrinsic value beliefs	4.00	4.00	26029.00***
Instrumental value beliefs	5.00	4.00	27183.00***
Resource-conservation PEBs	8.50	8.50	23416.00
Consumption PEBs	5.81	4.88	27602.00***
High-cost PEBs	2.00	1.33	26416.50***
High-cost PNBs	1.00	1.00	25032.00**
Personal PNBs	3.67	2.33	27316.00***
Doing-for-wildlife PNBs	2.20	1.60	24924.50**
Avoiding-for-wildlife PNBs	4.33	3.67	26585.50***

Note. n = 448. **p < .01. ***p <.001. PEBs = pro-environmental behaviours; PNBs = pro-nature behaviours.

Table 7.13: Binary Logistic Regression of Nature Beliefs and Demographic Variables on Choosing to Read the Article or Not, Showing Standardised Beta Coefficients (and Standard Errors).

	Chose to Read Article
Women	0.01
	(0.23)
Age	0.55***
	(0.14)
Mind attribution to nature	0.04
	(0.12)
Connectedness to Nature	0.18
	(0.15)
Empathy toward Nature	0.06
	(0.14)
Biospheric Values	0.42**
	(0.14)
Intrinsic Value Beliefs	0.13
	(0.12)
Instrumental Value Beliefs	0.32**
	(0.12)
Observations	439
Log Likelihood	-251.92
Akaike Inf. Crit.	521.84

Note. n = 448. **p<0.01; ***p<0.001.

7.5 Discussion

In this chapter I have provided the prevalence rates of nature beliefs and sustainable behaviour, and predictors of sustainable behaviour, in a survey of UK students. The prevalence of pro-environmental behaviours showed a similar pattern to what was found in an approximately representative general population UK sample (*Chapter 6*): resource-conservation pro-environmental behaviours were generally reported very frequently (e.g., recycling household waste), followed in frequency by consumption behaviours (e.g., buying produces with less packaging). High-cost behaviours (e.g., taking part in an environmental protest) were reportedly performed very infrequently by respondents.

This chapter introduced a new self-report questionnaire to measure pro-nature behaviours. Avoiding-for-wildlife pro-nature behaviours were the most frequently reported. The other three

classes of pro-nature behaviours appeared to be performed less frequently: doing-for-wildlife pro-nature behaviours, personal pro-nature behaviours, and high-cost pro-nature behaviours. Similarly to high-cost pro-environmental behaviours, high-cost pro-nature behaviours were especially infrequent, with the majority of participants reportedly "never" performing these behaviours.

In terms of belief prevalence, as reported in *Chapter 6*, biospheric values and intrinsic value beliefs were endorsed by a majority of participants, and there appeared to be less frequent endorsement of items reflecting connectedness to nature and empathy toward nature. Similarly to *Chapter 6*, participants showed a significant level of agreement with intrinsic value belief items and connectedness to nature items; unlike *Chapter 6*, participants showed a significant level of disagreement with empathy toward nature items.

A measure of mind attribution to nature was reported in this chapter: a majority of participants scored above the scale's midpoint, on average, across all items. Instrumental value beliefs were also measured for the first time in this chapter, and the sample showed a significant level of agreement with these items, on average. This contrasts with the findings of Wickizer (2016), whose United States sample largely disagreed with the same statement used in the present study. While it might be that there is a cultural basis for this difference between Wickizer's (2016) United States sample and the present study's UK sample, this discrepancy could also be due to age: Wickizer's [2016] sample had a mean age of 46.3, whereas the sample in the present study had a mean age of 20.

As most individuals agreed with the statements reflecting instrumental value beliefs and intrinsic value beliefs, it follows that some individuals agreed with both statements. This is of interest, as they are mutually incompatible positions: the intrinsic value beliefs item expresses the view that species are valuable regardless of their usefulness to humans; the instrumental value beliefs item is expressed in terms of species *only* being of value if they are useful to humans. This finding is, however, consistent with that of Hills (1993), where many of the same survey respondents agreed both with the view that humans should be dominant over animals and that humans and animals should be equal. It is also to some extent consistent with the co-existence of intrinsic and instrumental beliefs within the same individuals in the *Chapter 5* study.

Similarly to the findings presented in *Chapter 6*, women showed significantly higher levels of empathy toward nature (in line with previous findings: Tam, 2013) and significantly higher resource-conservation pro-environmental behaviours. In the present study, women also reported higher instrumental value beliefs, higher biospheric values (in line with previous work) (Sargisson et al., 2020), and higher doing-for-wildlife pro-nature behaviours. Older individuals in the present study showed lower mind attribution to nature (in line with previous research) (Tam, 2013; Tam, 2014).

Older participants showed significantly lower biospheric values in the present study, in contrast to previous research (Sargisson et al., 2020) and the higher biospheric values reported with higher age in *Chapter 6*; however, the range of ages in the present study was limited to the typical undergraduate student age, whereas the sample reported in *Chapter 6* had a much broader distribution of ages.

7.5.1 Hypothesis Testing

As expected, mind attribution to nature did not predict any pro-environmental behaviours beyond other variables in the model (*H1*). Mind attribution was also not predictive of any pro-nature behaviours. This is consistent with a model in which mind attribution to nature, while likely associated with sustainable behaviour, has an impact on pro-environmental behaviour via other variables (namely, empathy toward nature and connectedness to nature, as indicated in the systematic review of *Chapter 4*). Indeed, empathy and connectedness arguably rely on attributing mental capacities to nature. Empathy entails an emotional response to another being's experience, which presumes that the being in question is capable of having its own experience of the world. Connectedness is a sense of being part of the natural world; if this entails a sense of social belonging, then the natural world to which one belongs must perhaps be seen as a kind of social agent (i.e., with its own mind). It is also possible that intrinsic value mediates the influence of mind attribution to nature; Wickizer (2016) found evidence for sentience as an important component of intrinsic value's influence on attitudes, which would imply that mind attribution to nature and non-human species is an additional variable to include in future investigations of intrinsic value.

Biospheric values, as expected, predicted consumption pro-environmental behaviours (*H2*). It is also interesting that the only behaviours predicted by biospheric values were the more commonly reported forms of behaviour: resource-conservation and consumption pro-environmental behaviours, personal and avoiding-for-wildlife pro-nature behaviours. The fact that this study replicated the findings of *Chapter 6* in which biospheric values predicted consumption behaviours makes for a particularly compelling argument that this represents a true relationship between these constructs in the UK. The findings are supportive of the possibility that biospheric values commonly hold a social-adjustive function (Smith et al., 1956), as they appear to be consistently predictive of more socially-normative behaviours and not to be predictive of less normative behaviours.

This study replicated the finding from *Chapter 6* that intrinsic value beliefs are not predictive of any pro-environmental behaviours (*H3*). It was theorised that the conceptual overlap of intrinsic value beliefs with biospheric values – especially given that biospheric values are a broader concept including the environment, and not just non-human species - would preclude the predictive power of intrinsic value beliefs. This may be true, but it appears as though any conceptual overlap might not

preclude the ability of intrinsic value beliefs to predict pro-nature behaviours, as they were found to predict avoiding-for-wildlife pro-nature behaviours, as expected (*H4*) (as well as personal pro-nature behaviours) in the present study. Intrinsic value beliefs refer specifically to nature, whereas biospheric values refer to the environment more broadly; it is possible that, as intrinsic value beliefs are a more precise concept, they only predict behaviours with a similar level of precision (pro-nature behaviours) rather than broader pro-environmental behaviours.

A finding from *Chapter 6* that did not replicate was the relationship between empathy toward nature and high-cost pro-environmental behaviours, which was not significant in the present study (contrary to *H6*). By contrast, the association between connectedness to nature and a higher frequency of high-cost pro-environmental behaviours did replicate (as expected; *H8*). The principle of compatibility is relevant here, in which the degree to which attitudes predict behaviours depends on the degree to which they both correspond to the same target (Ajzen & Fishbein, 1977; Ajzen & Fishbein, 2000). Empathy toward nature refers to a narrower range of targets than connectedness to nature, which could explain these findings. Every item in the measure used to tap the concept of empathy toward nature (the *Dispositional Empathy toward Nature Scale*) (Tam 2013) refers to non-human species ("the suffering animals and plants"). By contrast, the measure of connectedness to nature (the *Connectedness to Nature Scale*) (Mayer & Frantz, 2004) refers to a broader set of targets: there is reference to "animals and plants" and "living organisms" but also to "the natural world", "nature", and the "web of life". The conceptual focus of empathy toward nature might explain why it was found to be predictive of a higher frequency of high-cost pro-nature behaviours (as expected; *H7*), which are at the same level of specificity as the items focus on nature conservation. Empathy toward nature also predicted doing-for-wildlife pro-nature behaviours, which refer to species and wildlife. The hypothesis that connectedness to nature would predict high-cost pro-nature behaviours was supported (*H9*); as it predicted both pro-environmental behaviours and pro-nature behaviours, this lends support to the idea that it has broader influence on behaviour as it is a more all-encompassing belief. Connectedness to nature also predicted doing-for-wildlife and avoiding-for-wildlife pro-nature behaviours.

The only relationship between instrumental value beliefs and pro-nature behaviours/pro-environmental behaviours in regression analyses was a negative one (as expected; *H5*). Specifically, instrumental value beliefs predicted a lower frequency of both high-cost behaviours (both pro-environmental and pro-nature). This suggests that a view of nature purely in terms of its instrumental value is detrimental to the kinds of high-cost behaviours that are required for society to mitigate the climate and ecological crises.

In *Chapter 5* it was theorised that instrumental value beliefs gatekeep access to the moral circle, preventing moral consideration toward non-human species; however, this does not explain why instrumental value beliefs would impede high-cost behaviours specifically. Understanding this finding could be aided by considering instrumental value beliefs alongside connectedness to nature and empathy toward nature, which show the opposite association with high-cost behaviour. Hills (1993) drew on the theory of Angyal (1941) to explain motivational bases of interactions with the natural world and proposed that these systems underlie different attitudes regarding nature. The first motivational basis for behaviour is an instrumental drive toward interaction with the world in a way that controls it to meet one's own needs (cf. instrumental value beliefs). Another drive is for identification with the world for the purpose of integrating with it; the constructs of connectedness with nature and empathy toward nature in the present study might sit within this second motivational system. Hills (1993) proposed that these motivational bases could be inconsistent with one another. Indeed, inspecting the findings presented by Hills (1993) reveals an intriguing pattern: farmers were high in instrumental value beliefs and low in empathy toward animals; members of animal rights groups showed the opposite pattern; and an urban sample showed moderate levels of each. It is possible that, when the two motivational bases described by Hills (1993) are in conflict (i.e., when identifying with the natural world would jeopardise humans' justification for using the natural world in a harmful way for their own purposes), individuals high in instrumental value beliefs are more prone to detaching psychologically from nature as a kind of disidentificaiton. This is like the idea discussed in *Chapter 5* in which instrumental value beliefs lead to a perception of conflict between the interests of other species and the interests of humans, and that humans morally disengage from other species in order to justify harming or exploiting them (Amiot & Bastian, 2015). Whereas connectedness to nature and empathy toward nature might strengthen a sense of identification with nature, instrumental value beliefs might motivate a drive to do the opposite in order to justify exploiting nature.

However, some of the findings in the present study suggest a more complex relationship between instrumental value beliefs and sustainable behaviour than simply causing psychological detachment or disidentification from the natural world. Although correlations showed instrumental value beliefs to be negatively associated with high-cost pro-nature behaviours, positive correlations existed between instrumental value beliefs and some sustainable behaviour (personal pro-nature behaviours and avoiding-for-wildlife pro-nature behaviours). One possible reason for the mixed pattern of associations between instrumental value beliefs and sustainable behaviour is that instrumental value beliefs can motivate a variety of different behaviours, some of which might involve protecting species and some of which might involve causing them harm; for example, seeing one kind of species as an asset might motivate harming other species that threaten the asset. As seen

in *Chapter 5*, viewing species as harmful to other species that humans deem valuable was justification for causing harm (such as culling badgers to protect livestock). It might be easier to predict sustainable behaviour from instrumental value beliefs if the end-goal or priority outcome motivating different behaviours were known, e.g., whether the aim is to protect human interests or to help species. Instrumental value beliefs also showed a positive correlation with nature beliefs in the present study (intrinsic value beliefs, mind attribution to nature, connectedness to nature, empathy toward nature, and biospheric values), which is not in keeping with the view that they lead people to detach psychologically from the natural world in any straightforward sense. Correlations also showed instrumental value beliefs to be positively associated with personal norm (a sense of obligation to reduce humanity's impact on other species).

Looking more closely at the wording of instrumental value beliefs in the present study ("Non-human species are only valuable if humans get to utilize them in some way") reveals two social groups: humans and non-humans. I have considered whether instrumental value beliefs might lead to *disidentification* from the natural world when its needs are in conflict with those of humans, but the other side of the coin is that these beliefs might also reflect stronger *identification* with humans. Instrumental value beliefs concern what is good for humans, and how nature can meet or be of detriment to humanity's needs. Considering instrumental value beliefs from a social identity perspective might explain the specificity of their influence on high-cost behaviours, which are mainly concerned not with behaviours that would reduce one's own environmental impact, but larger-scale organisational and societal changes that would protect the environment/nature in a way that could be seen as costly to humans. Mir, Noor, Habib, and Veeraswami (2015) conducted a survey of people local to a national park in India to understand their attitudes toward wildlife conservation initiatives. Conflict between humans and wildlife was cited as the main basis for opposition to conservation; this is an area where it is common for leopards and bears to attack livestock. Madden (2008) noted that cooperation with conservation initiatives is eroded when people feel as though the needs of wildlife are prioritised over their own needs. Mikołajczak et al. (2021) gathered English farmers' attitudes toward rewilding and organised results into themes. A prominent issue was whether rewilding is compatible with farmers' way of life, notably the economic interests of farmers and preserving the farming identity and traditions. Another theme was social justice: participants were more opposed to rewilding projects in which human interests would be negatively impacted as a result of protecting the interests of wildlife (e.g., beavers). A survey across northern America and Europe showed that attitudes toward wolves and their introduction were more negative among farmers, livestock owners, and countryside-dwellers; the authors suggested that this could be due to damage to economic interests (from wolves killing livestock) or perceived social conflict between rural residents and urban society, which has more pro-wolf attitudes (Williams, Ericsson, &

Heberlein, 2002). This implies that conflicts between different human social groups, and not just between humans and nature, is also relevant when considering attitudes to conservation initiatives.

Humans can self-categorise in numerous ways (Turner, Oakes, Haslam, & McGarty, 1994). The observation that instrumental value beliefs (relating to how nature exists to benefit humans) and beliefs that might reflect identifying with nature (connectedness to nature and empathy toward nature) are positively correlated could reflect a general predisposition toward higher-order self-categorisation as part of a broad collective, e.g., as a member of the human race or a member of the natural world. At first glance it might appear contradictory that these beliefs would be positively correlated but give rise to opposing effects on high-cost sustainable behaviour; however, this could result from a perceived conflict between the interests of humans and nature/other species when it comes to high-cost behaviours that might be perceived to lead to wide-ranging societal changes disadvantaging humans in some way. This pattern of associations reflects that found with regard to altruistic and biospheric values, which are positively correlated and have been found to predict sustainable behaviour in a similar way, but whose effects on behaviour dissociates when there is a conflict of goals (such as donating to environmental movements [biospheric values] versus humanitarian movements [altruistic values]) (De Groot & Steg, 2008).

7.5.1.1 Summary of Findings. In summary, the results of the present study indicated that mind attribution to nature does not independently contribute to sustainable behaviour beyond the influence of other variables. Biospheric values predicted only lower-cost/more frequently performed pro-environmental and pro-nature behaviours, and intrinsic value beliefs (which are more narrowly focused on nature conservation and non-human species) predict only lower-cost pro-nature behaviours (and not more general pro-environmental behaviours). High-cost pro-environmental and pro-nature behaviours were only positively predicted by connectedness to nature and empathy toward nature (the latter only predicting pro-nature behaviours, perhaps due to its narrower conceptual range). Instrumental value beliefs were negatively predictive of high-cost pro-environmental and pro-nature behaviours.

7.5.2 Exploring Predictors of High-Cost Behaviours

It is notable that empathy toward nature and connectedness to nature were both the only variables that were positively predictive of high-cost behaviour; this replicates the pattern found in *Chapter 6*, indicating that there is something unique about these nature beliefs that sets them apart from the others in this regard. I have argued that an important distinctive feature of connectedness to nature and empathy toward nature is that they encourage a sense of group affiliation with the natural world. Three implications of this are that these constructs could motivate high-cost action via (i) emotional responses to human-caused damage to the natural world (eco-emotions) (cf. Smith,

1993) and (ii) enhanced biospheric values (as reported by Martin & Czellar [2017]) and (iii) personal norm (as reported by Klain et al. [2017]), influencing high-cost behaviour via pathways articulated in the Value-Belief-Norm model (Stern et al., 1999).

7.5.2.1 Eco-Emotions. Participants were asked to rate their degree of anger and guilt at the knowledge that human actions are harming non-human species (eco-anger/eco-guilt). Four exploratory mediation analyses investigated whether each emotion could explain the influence of connectedness and empathy on high-cost pro-environmental behaviours and pro-nature behaviours. Only anger was found to be a significant mediator. Anger mediated the influence of connectedness to nature on high-cost pro-environmental behaviours and the influence of empathy toward nature on high-cost pro-environmental behaviours (and was not a mediator for pro-nature behaviours). Although the direct path between empathy toward nature and high-cost pro-environmental behaviours was found not to be significant in the regression analysis, a significant direct path between the predictor and the outcome is not a requirement for concluding that an indirect path exists (Montoya, 2022). These findings are consistent with what would be expected on the basis of Smith's (1993) theory, in which identifying as a member of a group experiencing maltreatment from another group would be expected to generate an angry response resulting from a sense of injustice. An angry response motivates action against the out-group (Smith, 1993); high-cost pro-environmental behaviours, as previously argued, might function to target the system that allows humans to continue harming the environment, and hence might be founded on a desire to take away benefits from humans that are considered illegitimate (Smith, 1993). It could be that high-cost pro-nature behaviours (where the focus is more narrowly on conservation work) do not hold the same meaning of structural change that will in some way harm the interests of powerful humans as a means of restoring justice.

Guilt, on the other hand, was not found to be a mediator for any analysis. Guilt is an emotion that would be expected to arise from identifying with a group that is behaving in a way not in keeping with certain standards of conduct (Smith, 1993), and can evoke sustainable behaviour motivated by a desire to repair (Rees, Klug, & Bamberg, 2015). Mediation analyses in the present study do not suggest that the association of empathy toward nature and connectedness to nature with high-cost pro-environmental behaviours or pro-nature behaviours can be explained by identifying with the human group and wishing to make amends arising from a sense of collective culpability (Turner et al., 1987). That is not to say that guilt is not a motivator: the systematic review of *Chapter 4* indicated that guilt can mediate the relation between anthropomorphism and sustainable behaviour, and material from interviewees reported in *Chapter 5* showed that people can experience moral concern about the actions of other humans. However, this does indicate that guilt might not be a strong motivator for more high-cost sustainable behaviour, whereas anger appears to be. It is also important

to stress that these mediation analyses are preliminary; there was no correction for Type I error as they were exploratory analyses, and therefore they are less likely to replicate.

7.5.2.2 Value-Belief-Norm Model. I have argued that identifying with the natural world, and therefore having a tendency to self-categorise in terms of "nature", would be expected to influence biospheric values and the development of a personal norm; one would expect valuing the environment to arise from a sense of identity with it, and for a sense of group affiliation with nature to encourage the development of a sense of personal obligation to protect it. These pathways have been empirically validated by previous research (Klain et al., 2017; Martin & Czellar, 2017), but the present study, to my knowledge, is the first to test whether the Value-Belief-Norm (VBN) model (Stern et al., 1999), within which biospheric values and personal norm sit, can explain the influence of connectedness to nature and empathy toward nature on high-cost sustainable behaviour via its theorised pathways.

The present study found that there was an acceptable overall model fit when connectedness to nature and empathy toward nature were included as additional variables. This extended model could be termed an "Identity-Value-Belief-Norm" model, where connectedness to nature and empathy toward nature reflect a tendency to identify with the natural world, which then influences the development of values, beliefs, and personal norms. Each individual pathway was also significant, and the findings were consistent with a model in which connectedness to nature and empathy toward nature influence high-cost pro-environmental behaviours and pro-nature behaviours through a more distal pathway (via their influence on biospheric values) as well as more proximally (via their influence on personal norm). The findings also indicate that this extended VBN model is at least as good an account for the data as the original VBN model that does not include connectedness to nature and empathy toward nature.

These findings challenge the view that the VBN model is not well-suited to understanding high-cost behaviours: Steg and Nordlund (2018) argued that this theory is better suited to explaining low-cost behaviours, whereas the theory of planned behaviour (Ajzen, 1991) can explain higher-cost behaviours due to its inclusion of a wider range of factors beyond environmental beliefs, which do not by themselves take contextual barriers to behaviour into account. Steg and Nordlund (2018) cited the particularly high-cost action of reducing car use; for some, this will be highly constrained by contextual factors such as transport infrastructure, and constructs in the theory of planned behaviour, such as perceived behavioural control, will reflect this. On the other hand, the theory of planned behaviour does not consider morality as a central explanation of behaviour and would arguably have limited usefulness for explaining behaviour where morality is quite a central feature, as in the case of humans causing harm to nature.

Further research is needed to clarify the point of costliness at which the VBN model no longer predicts behaviours, which could help clarify which behaviours require environmental adaptations to reduce their costliness (e.g., better transport links to replace reliance on cars) and which behaviours could be addressed via changes in psychological drivers such as nature beliefs. It is important to note that the model tested in this study is one out of a variety of possible models that might be supported by theory, and the nature of structural equation modelling is that a multitude of models might be consistent with the data. Another caveat is that structural equation modelling can capitalise on chance findings in the dataset that are due to random error and are not due to true underlying relationships in the population (Kline, 2015); as such, these results are subject to replication.

7.5.3 Exploring Predictors of Actual Behaviour

In the present study, participants were given the option at the end of the survey to read a short article on nature conservation, which was estimated to take three minutes. This was intended as a measure of actual sustainable behaviour as opposed to self-reported sustainable behaviour. Most participants (66%) asked to read the article. This fact, along with the relative ease of reading a short article, arguably indicates that this is a more low-cost sustainable behaviour. Analyses showed a mixed pattern of associations with self-report measures of behaviour: choosing to read the article was predicted by higher scores on the more low-cost measures of pro-nature behaviours (doing-for-wildlife, avoiding-for-wildlife, and personal pro-nature behaviours) but was not associated in this way with scores on the resource-conservation pro-environmental behaviours. Choosing to read the article was positively predicted by both biospheric values and instrumental value beliefs, and this pattern of predictions was not found for any of the self-reported behaviours (where these two nature beliefs were not jointly predictive of any category of self-reported behaviours, and instrumental value beliefs only showed negative predictive power).

It seems, from the above findings, that the choice to read the article is perhaps best understood not as a sustainable behaviour but would be better characterised as a learning or information-seeking behaviour. Petty and Cacioppo's elaboration likelihood model (1986) could be useful here: this model proposes that people are motivated to engage in a more effortful process of consuming information (the "central" information processing route) when they have the *motivation* to do so (e.g., wishing to reduce cognitive dissonance) (Festinger, 1957), the *ability* to do so (e.g., have enough time and energy to engage with the topic), and enough *opportunity* (as would be provided, for example, by having few distractions). As the offer to read the article took place at the end of a study in which participants had already read some information pertaining to nature conservation, their interest in the topic might have been piqued and, for those who knew relatively little about this area before taking part, this could have set up cognitive dissonance (Festinger, 1957) between what

they had learned and what they thought they knew about the topic. As a result, this could explain why some had more *motivation* to engage in effortful processing of relevant information (reading the article). The fact that a majority chose to read the article could reflect the fact that a majority knew little about the topic beforehand.

While the choice to read a nature conservation article is free from the memory bias from which self-report measures suffer, it is not free from social desirability bias; the choice to read the article was made within a research context and could well have been motivated by a desire to be perceived in a positive light by the researchers. Indeed, researchers have found that perceived social pressures motivate people to spend time learning information about energy (Griffin et al., 2005). This is consistent with the notion that biospheric values, which may have a social-adjustive function, were predictive of choosing to read the article. The choice to read the article could have been a way of learning about nature from the position of wishing to better utilise it for human benefit (which would explain why instrumental value beliefs were predictive of choosing to read the article).

7.5.4 Conclusion

The present study undertook hypothesis-driven analyses of the associations tested in *Chapter 6*, and some findings replicated: biospheric values predicted consumption pro-environmental behaviours, connectedness to nature predicted high-cost pro-environmental behaviours, and intrinsic value beliefs did not predict any pro-environmental behaviours. Novel hypotheses were tested with regard to pro-nature behaviours: connectedness to nature and empathy toward nature were found to predict high-cost pro-nature behaviours. Additional nature beliefs were also examined in the current study: mind attribution to nature was not found to predict any pro-environmental or pro-nature behaviours; instrumental value beliefs were found to be negatively predictive of high-cost pro-environmental and pro-nature behaviours.

I have proposed that the findings with regard to connectedness to nature and empathy toward nature uniquely predicting high-cost behaviours could be understood from the perspective of Self-Categorisation Theory (Turner et al., 1987), and have provided two strands of (preliminary) evidence to support this view: (i) eco-anger (and not eco-guilt) appeared to mediate the relationship between connectedness/empathy and high-cost pro-environmental behaviours (consistent with humans identifying with nature as a social group and experiencing an angry response to human-caused damage) (Smith, 1993); (ii) an extended VBN model (Stern et al., 1999) with connectedness and empathy added as an “identity” variable at the beginning of the sequence appeared to be an equal fit to the data (if not a better fit) than the original VBN model. I have also considered instrumental value beliefs from a self-categorisation perspective. Finally, this study explored which nature beliefs and demographics were predictive of choosing to read an article on nature conservation; the findings

were mixed, and I have considered what they suggest in terms of how nature beliefs influence information-seeking/learning behaviour in relation to conservation. *Chapter 8* will synthesise the findings across this study and those in the preceding chapters and consider implications for theory as well as practical suggestions relating to sustainable messaging and building a more sustainable society.

Chapter 8 General Discussion

8.1 Chapter Overview

In this thesis I have presented novel findings about nature beliefs and how they predict different kinds of sustainable behaviour. In this final chapter I will first summarise the findings in relation to each research question before integrating key insights across the different studies and attempting to account for discrepancies. Many kinds of sustainable behaviour have been considered in the thesis, and I will first explore what we can conclude about specific classes of behaviour: pro-environmental behaviours versus pro-nature behaviours; high-cost behaviours versus lower-cost behaviours. There will also be a discussion of different motivational bases for beliefs, including self-defining functions and social-adjustive functions, and findings will be integrated with theory (primarily Self-Categorisation Theory) (Turner et al., 1987). I will consider the implications of the findings, through the lens of theory, for promoting sustainable behaviour and consider implications for future research.

8.2 Answers to Research Questions

In *Chapter 2* I presented the research questions forming the basis of this thesis.

1. What can we conclude from the highest quality international research about the association between anthropomorphism and sustainable behaviour?

The systematic review presented in *Chapter 4* concluded that there is consistent, high-quality evidence for anthropomorphism – mind attribution to nature in particular – being associated with sustainable behaviour. There is good experimental evidence that connectedness to nature and guilt mediate the association between anthropomorphism/mind attribution to nature and sustainable behaviour. There is good correlational evidence that empathy toward nature mediates the association between anthropomorphism/mind attribution to nature and sustainable behaviour.

2. What other nature beliefs, besides anthropomorphism, are associated with sustainable behaviour?

The grounded theory presented in *Chapter 4* indicated that intrinsic value beliefs about individual species are associated with moral consideration for those species and instrumental value beliefs appear to detract from moral consideration. Generalised intrinsic value beliefs are associated with moral concern when coupled with an awareness of harm being caused by humans to other species.

3. Are measures of nature beliefs and sustainable behaviour valid and reliable for the UK context?

In *Chapters 6* and *7*, evidence was reported that measures validated primarily in non-UK countries had acceptable construct validity and internal reliability in UK samples.

4. What is the prevalence of nature beliefs and different kinds of sustainable behaviour in the UK public?

Chapters 6 and *7* indicated that certain nature beliefs receive endorsement from the majority in the UK (biospheric values, intrinsic value beliefs, instrumental value beliefs, and connectedness to nature). Empathy toward nature items received, on average, equivocal endorsement (*Chapter 6*) or significant levels of disagreement (*Chapter 7*). Instrumental value beliefs received significant agreement from participants (*Chapter 7*). Mind attribution to nature was endorsed by a majority of participants, on average, across all items (*Chapter 7*).

Across *Chapters 6* and *7*, a large majority of participants performed resource-conservation pro-environmental behaviours at least 2-3 times in the past month (on average across all items), around half the sample performed consumption behaviours and a small minority (< 10%) performed high-cost pro-environmental behaviours at this frequency. In *Chapter 7*, avoiding-for-wildlife pro-nature behaviours were performed frequently by almost half the sample (on average across all items), personal and doing-for-wildlife pro-nature behaviours were performed frequently by a minority (25% and 15%, respectively) and high-cost pro-nature behaviours were performed frequently by a very small minority (2.6%).

5. What is the unique contribution of each nature belief to a range of sustainable behaviour in the UK?

I draw firmer conclusions from *Chapters 6* and *7* than the other chapters, as these final chapters reported analyses from large-scale data from UK-based samples. A finding in both chapters is that the only positive predictors of high-cost behaviours (both pro-environmental and pro-nature) were connectedness to nature and empathy toward nature (with connectedness showing more consistent evidence across both studies than empathy). Connectedness to nature and empathy toward nature also predicted personal and doing-for-wildlife pro-nature behaviours, and connectedness also predicted avoiding-for-wildlife pro-nature behaviours.

Chapter 7 showed that intrinsic value beliefs predicted personal pro-nature behaviours, as did biospheric values. Biospheric values predicted personal pro-nature behaviours and avoiding-for-wildlife pro-nature behaviours. Biospheric values consistently predicted consumption pro-

environmental behaviours in both chapters, and there was less consistent evidence for their prediction of resource-conservation pro-environmental behaviours. Instrumental value beliefs predicted a lower frequency of high-cost pro-environmental and pro-nature behaviours (*Chapter 7*). Table 8.1 summarises the findings of the main analyses presented in *Chapters 6* and *7*.

Table 8.1. Summary of the Findings for Nature Beliefs in the Main Analyses of *Chapters 6* and *7*.

Predictor	Outcome	Chapter 6	Chapter 7
Biospheric values	↑ consumption PEBs	Significant	Significant
	↑ resource conservation PEBs	Non-significant	Significant
	↑ high-cost PEBs	Non-significant	Non-significant
	↑ high-cost PNBs		Non-significant
	↑ doing-for-wildlife PNBs		Non-significant
	↑ personal PNBs		Significant
	↑ avoiding-for-wildlife PNBs		Significant
Empathy toward people	↑ consumption PEBs	Significant	
	↑ resource conservation PEBs	Significant	
	↑ high-cost PEBs	Non-significant	
	↑ high-cost PNBs		
	↑ doing-for-wildlife PNBs		
	↑ personal PNBs		
	↑ avoiding-for-wildlife PNBs		
Empathy toward nature	↑ consumption PEBs	Non-significant	Non-significant
	↑ resource conservation PEBs	Non-significant	Non-significant
	↑ high-cost PEBs	Significant	Non-significant
	↑ high-cost PNBs		Significant
	↑ doing-for-wildlife PNBs		Significant
	↑ personal PNBs		Non-significant
	↑ avoiding-for-wildlife PNBs		Non-significant

Predictor	Outcome	Chapter 6	Chapter 7
Connectedness to nature	↑ consumption PEBs	Significant	Non-significant
	↑ resource conservation PEBs	Non-significant	Non-significant
	↑ high-cost PEBs	Significant	Significant
	↑ high-cost PNBs		Significant
	↑ doing-for-wildlife PNBs		Significant
	↑ personal PNBs		Non-significant
	↑ avoiding-for-wildlife PNBs		Significant
Intrinsic value beliefs	↑ consumption PEBs	Non-significant	Non-significant
	↑ resource conservation PEBs	Non-significant	Non-significant
	↑ high-cost PEBs	Non-significant	Non-significant
	↑ high-cost PNBs		Non-significant
	↑ doing-for-wildlife PNBs		Non-significant
	↑ personal PNBs		Significant
	↑ avoiding-for-wildlife PNBs		Non-significant
Instrumental value beliefs	↑ consumption PEBs		Non-significant
	↑ resource conservation PEBs		Non-significant
	↑ high-cost PEBs		Significant
	↑ high-cost PNBs		Significant
	↑ doing-for-wildlife PNBs		Non-significant
	↑ personal PNBs		Non-significant
	↑ avoiding-for-wildlife PNBs		Non-significant

Note. Greyed-out cells: relationship not tested. Relationships that were not found to be significant in either study are omitted. ↑ = positive association; ↓ = negative association. PEBs = pro-environmental behaviours. PNBs = pro-nature behaviours.

6. What theoretical frameworks best account for the impact of nature beliefs on sustainable behaviour in the UK?

The results presented in *Chapter 4* are similar to the Value-Belief-Norm (VBN) model (Stern et al., 1999), which proposes that valuing nature leads to an awareness of the harm caused to nature

by humans. On this basis, it appears that the VBN model could be a useful framework for understanding pro-nature behaviours.

Chapter 7 explored additional relationships between variables to explore whether the association between connectedness/empathy and high-cost sustainable behaviours could reflect identity. Self-Categorisation Theory (Turner et al., 1987), and the implications of Smith's (1993) extension of this theory to account for emotional responses to perceived harm caused to one's in-group, formed the basis of exploratory analyses. First, anger (but not guilt) was found to be a significant mediator of the relationship between connectedness/empathy and high-cost pro-environmental behaviours (but not high-cost pro-nature behaviours). Second, evidence was provided that an extended VBN model with connectedness and empathy included as identity-based variables (the "Identity-Value-Belief-Norm" model) can explain high-cost pro-environmental and pro-nature behaviour, and might be a better account for relationships between variables in the dataset than the original VBN model. The following sections will expound on the theoretical implications of these findings, and their practical implications.

8.3 Classes of Behaviour

In the following sections I discuss the findings reported across all studies presented in the thesis (*Chapters 4 – 7*). First I consider what can be concluded in terms of predictors of pro-environmental and pro-nature behaviours; then, I discuss what we can conclude in terms of predictors of higher- versus lower-cost behaviours.

8.3.1 Pro-Environmental Behaviours and Pro-Nature Behaviours

In this thesis, pro-environmental behaviours are those geared toward protecting the environment, such as through reducing carbon emissions, whereas pro-nature behaviours are concerned more specifically with nature, non-human species, and their habitats. Richardson et al. (2020) underlined the lack of research on pro-nature behaviours, which are behaviours that focus on species conservation. The systematic review of *Chapter 4* supported this, finding that the majority of studies looked at general pro-environmental behaviours rather than pro-nature behaviours.

Across both quantitative chapters (*Chapters 6* and *7*), connectedness to nature predicted both pro-environmental behaviours and pro-nature behaviours. The argument I have advanced is that the breadth of a nature belief influences the breadth of behaviours that it accounts for. Whereas connectedness to nature conveys a sense of connectedness to nature as a broad concept (Mayer & Frantz, 2004), empathy toward nature refers more specifically to "the suffering animals and plants" (Tam, 2013); this might explain why empathy toward nature's association with pro-environmental behaviours did not replicate across these two chapters, and it only predicted pro-nature behaviours

in *Chapter 7* (i.e., due to different levels of compatibility between the measures) (Ajzen & Fishbein, 2000). Although analyses involving pro-nature behaviours were conducted in a way that limited the false-discovery rate, only *Chapter 7* reported pro-nature behaviours, and therefore these results are subject to replication.

It is important to consider the overlap and discrepancies between the findings of the grounded theory study (*Chapter 5*) and the quantitative studies (*Chapters 6* and *7*). The grounded theory presented intrinsic value beliefs as an important predictor of moral concern for non-human species, and this is consistent with some of the findings of *Chapter 7*, in which intrinsic value beliefs predicted avoiding-for-wildlife and personal pro-nature behaviours. The grounded theory proposed intrinsic value beliefs to be foundational for moral concern but insufficient for more sustained engagement in pro-nature behaviours; *Chapter 7*, similarly, found intrinsic value beliefs not to predict high-cost pro-nature behaviours. *Chapter 6* did not find intrinsic value beliefs to predict any pro-environmental behaviours, and this result was replicated in *Chapter 7*; these results suggest that intrinsic value beliefs may not be reliably associated with pro-environmental behaviours. Again, the specificity of these beliefs to non-human species is a likely reason that they are specifically associated with pro-nature behaviours, and not with behaviours targeting the environment more generally (pro-environmental behaviours). Biospheric values, by contrast, are conceptually similar to intrinsic value beliefs (Dietz et al., 2005) but refer to the environment more broadly, which might explain why they were predictive of both pro-nature behaviours and pro-environmental behaviours in *Chapter 7* (which also replicated the findings of *Chapter 6* that they were predictive of consumption pro-environmental behaviours).

The fact that instrumental value beliefs (*Chapter 7*) were negatively predictive of both pro-environmental behaviours and pro-nature behaviours is perhaps unexpected, as these beliefs relate specifically to non-human species rather than the environment more broadly. As these beliefs were only measured in one study, the results would need to replicate before we could rely on them. It is possible that these beliefs are truly predictive of a broad range of behaviours: I have argued that instrumental value beliefs reflect a strong identification with humans as a social category, leading to an opposition to any high-cost pro-environmental behaviours or pro-nature behaviours that would in any way be costly to human interests; this possibility is further discussed in *Section 8.5.*

Although the grounded theory (*Chapter 5*) presented instrumental value beliefs as leading to moral disengagement from individual species, interviews did not identify factors that would lead to disengagement from pro-nature behaviours, only those that would be positively associated with pro-nature behaviours. This stands in contrast to the findings presented in *Chapter 7* with respect to instrumental value beliefs, which found them to be negatively predictive of high-cost pro-nature

behaviours. It is possible that the discrepancy here is due to an omission of the grounded theory study; on reflection, I would like to have asked participants who were not engaging in high-cost actions what the reasons for this might have been.

Mind attribution to nature was also measured in *Chapter 7* for the first time and was not uniquely predictive of any pro-environmental behaviours or pro-nature behaviours. This is consistent with the findings of the systematic review (*Chapter 4*), in which mind attribution to nature influences sustainable behaviour via empathy toward nature and connectedness to nature. It is also consistent with the findings of the grounded theory (*Chapter 5*), in which mind attribution to nature did not emerge as an explanatory concept.

8.3.2 High/Low-Cost Behaviours

High-cost behaviours tend not to be predicted by values and beliefs alone due to structural barriers (Diekmann & Preisendörfer, 2003). It is notable, then, that connectedness to nature predicted high-cost behaviours across *Chapters 6* and *7*. High-cost pro-nature behaviours were also predicted by connectedness to nature in *Chapter 7*. Empathy toward nature was a less consistent predictor of high-cost pro-environmental behaviours, as this result was only found in *Chapter 6* and not replicated in *Chapter 7*. *Chapter 7* found empathy toward nature to predict high-cost pro-nature behaviours. The grounded theory of *Chapter 5* did not find connectedness to nature or empathy toward nature to be significant explanations for pro-nature behaviours, which appears to conflict with the quantitative findings. How can we account for this disparity? Qualitative and quantitative studies can be understood as complementary approaches, each with its own set of strengths and limitations (Slonim-Nevo & Nevo, 2009). A strength of quantitative data collection is that associations can be detected between beliefs and behaviours where participants might not be aware of these relationships. This is especially relevant for connectedness to nature and empathy toward nature: it has been argued that environmental identity (i.e., one's self-concept in relation to the natural world; not to be confused with "environmental self-identity", i.e., how environmentally-friendly one perceives oneself to be) (Wang et al., 2021) is implicit and not consciously accessed unless efforts are made to explore it (Doherty et al., 2022). It might be, therefore, that interviewees in *Chapter 5* were not aware of the influence of connectedness to nature and empathy toward nature on their pro-nature behaviours or would not have used the kind of language that is to be found in the measures used in the quantitative studies.

High-cost behaviours were negatively predicted by instrumental value beliefs in *Chapter 7*. However, this is by no means the final word on this topic; only one study in the thesis measured instrumental value beliefs quantitatively, and thus the results are subject to replication. Furthermore, patterns of correlations between instrumental value beliefs differed for high-cost behaviours and

other behaviours, in which it appeared to be positively associated with some lower-cost behaviours (and many nature beliefs). One complicating factor for interpreting these findings is that some individuals agreed with mutually incompatible statements, i.e., both that “Non-human species are only valuable if humans get to utilize them in some way” *and* “Non-human species have inherent value, above and beyond their utility to humans”. This can be understood perhaps as comfortable cognitive dissonance, i.e., where these beliefs might not be central to someone’s identity and therefore their contradictory nature can be tolerated (see Hills, 1993).

Another complicating factor in understanding the association between instrumental value beliefs and sustainable behaviour is that people might hold different instrumental value beliefs about different species, influencing their behaviour in a way that could not be straightforwardly predicted by the general measure of instrumental value beliefs used in the study of *Chapter 7*. Indeed, Hills (1993) presented evidence that these things can dissociate, as farmers seemed to have different kinds of instrumental value beliefs about different kinds of species. Sometimes, instrumental value beliefs about species might promote pro-conservation attitudes, when conservation of one species entails harming a predator or invasive species (e.g., supporting the culling of badgers to protect livestock as discussed by one participant in *Chapter 5*). It is likely that instrumental value beliefs are better suited as a measure of beliefs about particular species for particular contexts, rather than as a general measure which cannot capture these nuances.

8.4 Classes of Nature Belief

8.4.1 Belief Functions

Self-defining and social-adjustive beliefs differ in how they relate to identity and group membership (to be further explored in *Section 8.5*). Social-adjustive beliefs are beliefs held for the purpose of following social norms of the in-group in order to maintain ongoing membership of the group (Smith et al., 1956), and are not necessarily central to one’s identity. There is evidence that biospheric values have a social-adjustive function (Bouman et al., 2020); in keeping with this (*Chapter 6* and *7*), biospheric values and intrinsic value beliefs are very common beliefs in the UK, and predict more common (i.e., socially normative) sustainable behaviour (*Chapter 7*); they do not predict high-cost pro-nature or pro-environmental behaviours, which are not socially normative.

Self-defining beliefs are central to one’s identity (Zunick et al., 2017). It was argued in *Chapter 5* that the internalised moral standard theorised to underlie sustained sustainable behaviour is a belief about moral behaviour that has become central to one’s identity; this might be what leads to the personal sense of moral obligation which constitutes the personal norm of the Value-Belief-Norm (VBN) model (Stern et al., 1999). In contrast with social-adjustive beliefs, self-defining beliefs centred

around nature might make it harder to ignore dissonance arising from the knowledge that one is in some way complicit in harming nature.

I have proposed that connectedness to nature and empathy toward nature both, at their core, entail identifying with the natural world, and hence could be considered identity-based beliefs. It is possible that connectedness and empathy underlie self-defining beliefs about nature; for example, in *Chapter 5*, one participant remarked on her long-standing empathy for animals and alluded to this attitude toward animals being central to her sense of self, as well as a decisive factor in the kind of social group she had chosen:

"We're friends because we're the soppy buggers when it comes to animals, we'll be out, I don't care if it's pitch black throwing it down. If I'm a little bit concerned about the horse, I'm going to go check on the horse. I'm, a lot of my friends are all that way as well. Um, we're animal lovers." (Participant 20).

I have theorised that both empathy toward nature and connectedness to nature lead to the development of (self-defining) personal norms. Self-defining beliefs can lead to declarative and visible actions (Zunick et al., 2017), which is in keeping with the finding that personal norms led to high-cost pro-environmental behaviours and pro-nature behaviours within the VBN model (Stern et al., 1999) tested in *Chapter 7*; the high-cost behaviours included in this model often entail a public component (e.g., writing to a politician about an environmental issue or doing something with neighbours to address an environmental issue [high-cost pro-environmental behaviours]). If high-cost behaviours are founded on a self-defining belief (personal moral norm) and not a social-adjustive belief, it follows that they are not performed simply in order to conform to social norms; consistent with this, high-cost pro-environmental behaviours and pro-nature behaviours were performed very infrequently across both *Chapters 6* and *7*, and hence would not likely be seen as socially normative.

It could be that beliefs that are less commonly held in one's social group are particularly likely to become self-defining: if one recognises that one's views about a topic (e.g., animal rights) are quite extreme compared with others' views on the topic, this view might come to form part of "self-other differentiation", considered to be a key part of identity development (Koepke & Denissen, 2012). If others notice one's views as being different to the typical views within a social group, this might also become a feature of how one is treated and discussed by others, strengthening the sense of that belief being central to one's identity.

8.4.2 Trait Versus State

In the systematic review of *Chapter 4* I summarised evidence that inducing a state of feeling connected to nature can lead to more sustainable behaviour (Tam et al., 2013). Studies have also experimentally induced feelings of empathy, which leads to a sense of personal obligation to help nature (Berenguer, 2007). In both of these studies, activating these beliefs was achieved through highlighting certain traits that might be considered humanlike (anthropomorphism/mind attribution to nature). While these sorts of experiments suggest how messaging might be framed in a way that enhances engagement or sustainable behaviour momentarily, these are unlikely to give rise to longer-term changes in connectedness and empathy.

While it is possible to induce a temporary mindset of mind attribution to nature, connectedness to nature, and empathy toward nature, these appear also to be dispositional traits, i.e., a persistent tendency to perceive and respond to nature in a particular way across situations (Tam, 2013; Whelan, Hingston, & Thomson, 2019; Zylstra et al., 2014). Exposure to nature in childhood is thought to be particularly important for the development of these traits (Chawla, 2015; Hughes et al., 2018; Shuttlewood et al., 2016). This provides further theoretical support for the inclusion of these variables at the beginning of the VBN model (Stern et al., 1999), where they can, over time, influence the development of other beliefs. Longitudinal research would be needed to ascertain whether, over time, dispositional anthropomorphism/mind attribution to nature can be developed, whether connectedness to nature and empathy toward nature as traits, rather than temporary states, can be developed, and to confirm the causal influence of anthropomorphism/mind attribution on connectedness and empathy.

8.5 Social Identity and Group Membership

Self-categorising as a member of various collectives has broad implications for the field of environmental psychology and can explain a range of recent findings. Eco-anxiety (chronic anxiety about environmental disaster) (Clayton, Manning, Krygsman, & Speiser, 2017) appears to be higher among those with higher connectedness to nature (Whitmarsh et al., 2022). This is unsurprising from a self-categorisation perspective; Smith (1993) considered anxiety to be an expected response for those who identify with group that is experiencing mistreatment. This thesis contributes numerous findings that show the relevance of a social identity and social-categorisation paradigm for understanding sustainable behaviour (Turner et al., 1987).

Two factors interplay to determine whether someone categorises themselves as an individual or as part of a collective in any given context: the relative *accessibility* of a social category, and the *fit* of that category to what is perceived in the moment (Oakes, 1987). *Accessibility* refers to a

combination of situational factors that would highlight an aspect of a person's social identity and the person's predisposition to access that identity (based on how frequently they have made use of that self-categorisation in the past) (Reimer, Schmid, Hewstone, & Al Ramiah, 2020). *Fit* refers to two things: the degree to which a person sees more similarity between themselves and in-group members than between themselves and out-group members (comparative fit); the degree to which the in-group and the out-group are perceived to be prototypical (normative fit) (Reimer et al., 2020). Accessibility and fit interact to determine the salience of a distinction between the in-group and the out-group, which in turn determines the propensity to self-categorise as a member of any given collective at a particular time (Reimer et al., 2020).

Self-Categorisation Theory (Turner et al., 1987) can be invoked to explain how individuals relate to members of a perceived in-group as well as a perceived out-group. Turner et al. (1994) proposed that the activation of a social category in any given moment can lead an individual to *depersonalise*, in which they perceive themselves primarily as an approximately representative of a particular in-group. As discussed in *Chapter 5*, this can explain the strong emotional reactions to others' perceived immoral treatment of other species and the natural world, as though one were morally compromised by the actions of others in one's social group (e.g., British people, Westerners, humans). This theory is also consistent with the importance of pets, which participants in *Chapter 5* described as influential in extending moral consideration to non-human species and described as members of the family (indicating that they are psychologically encompassed within a group that includes other humans). This implies that those with such early exposure to pets, and perhaps other features of nature and non-human species, might experience repeated self-categorisation that envelops nature-based entities, increasing the accessibility of such a social categorisation in future contexts (Oakes, 1987).

"And it was very much how I was brought up that if you have animals, they are part of the family." (Participant 20).

High-quality evidence was reviewed in *Chapter 4*, which found anthropomorphism and mind attribution to nature to be predictive of sustainable behaviour and related variables, such as behavioural intention. Experimental evidence was found for the role of connectedness to nature in mediating this association, and cross-sectional evidence supported empathy toward nature as mediating the association. These results raise the possibility that seeing animals as having humanlike characteristics allows us to identify with them (i.e., to perceive ourselves as part of nature), which may lead to more sustainable behaviour.

Prior research is consistent with a self-categorisation account of connectedness and empathy and their influence on sustainable behaviour. There is already substantial evidence that empathy toward people is influenced by self-categorisation; perceiving other humans as part of one's in-group leads to more empathy toward them (and intentions to engage in pro-social behaviour) than perceiving other humans as part of an out-group (Stürmer, Snyder, Kropp, & Siem, 2006; Tarrant, Dazeley, & Cottom, 2009). The reverse also appears to be true: Davis et al. (1996) found that encouraging perspective-taking (a facet of empathy) of another person led to more inclusion of the other in one's self-concept. Humans' emotional responses to nature might be influenced by similar processes: having a pet in childhood increases empathy toward animals, and there is evidence that empathy toward animals mediates between pet attachment and meat avoidance (Rothgerber & Mican, 2014). Amiot and Bastian (2015) reviewed the evidence for a generalising effect in which pet ownership leads to less negative attitudes toward non-pet animals in childhood (Bowd, 1984), and how pets might become "ambassadors" for other animals in this regard (Serpell, 2000). The findings are less consistent for the role of pet ownership in the development of empathy toward people: Daly and Morton (2003) did not find children with pets to have higher empathy toward people than children without pets. This is consistent with the notion that pet ownership leads specifically to greater self-categorisation with non-human species.

The systematic review of *Chapter 4* presented experimental evidence that guilt can mediate the influence of anthropomorphising pigs on choosing not to eat their meat. As previously discussed, Smith's (1993) extension of Self-Categorisation Theory proposed that guilt would be an individual's response toward an out-group when the in-group's behaviour in relation to the out-group falls short of moral conduct. In these studies (Wang & Basso, 2019) there was no distinction made between personal guilt and guilt felt on behalf of one's in-group; further research would be needed to clarify the extent to which guilt-driven sustainable behaviour relates to one or the other. Nonetheless, the results presented in *Chapter 5* do suggest that guilt on behalf of humans as a perceived in-group is a motivator for moral concern toward non-human species.

Chapters 5 and *7* presented evidence that anger plays a role in sustainable action. In *Chapter 5*, participants described their guilt and anger at human behaviour that harms nature. In *Chapter 7*, the mediating effects on guilt and anger were explored with respect to high-cost behaviour. Whereas guilt did not mediate between connectedness to nature/empathy toward nature and high-cost behaviour, anger did. This is in line with Smith's (1993) theory that more self-sacrificing (i.e., high-cost) behaviours result from feeling a part of a maligned group (e.g., nature), which results in an angry response and action against the out-group (e.g., humans that are causing harm). Indeed, I have argued that the high-cost behaviours in this study, such as protesting, could be perceived as targeting human society broadly and geared toward social change. It is of note that, in *Chapter 6*,

empathy toward people did not predict high-cost pro-environmental behaviours, whereas empathy toward nature did, suggesting that it is an identification with nature in particular that might be crucial for these high-cost actions.

Further work is needed to clarify how guilt, anger, and other emotions operate with respect to self-categorisation. While the findings I have presented in this thesis are consistent with the theory of Smith (1993), they were exploratory analyses and require replication. Tam (2019) reported two studies that found anger and guilt about human impacts on the environment to be separately associated with high-cost, public-sphere behaviours, although only guilt was found to mediate between mind attribution to nature and these behaviours. It is possible that attributing a mind to nature brings nature and non-human species within the bounds of moral consideration, thus facilitating the experience of guilt at the knowledge of harm to these targets, but this is not the same as creating a more substantive inclusion of nature within the self-concept as is entailed in connectedness to nature, which might be more likely to influence sustainable behaviour via anger as opposed to guilt (consistent with the findings of *Chapter 7*).

Research has indicated that guilt and anger are associated with pro-environmental behaviour intention for different reasons; Harth, Leach, and Kessler (2013) found that guilt predicted intention to repair damage caused by humans and anger predicted intention to punish humans for harms they had caused. The authors presented evidence that inducing a perception that "we Germans" are causing environmental harm led to sustainable behaviour intentions via guilt and anger, which suggests that identifying with humans might be a self-categorising mechanism that is also important in sustainable behaviour. Further work might clarify this by measuring different kinds of group categorisation simultaneously (e.g., as a human being/as part of nature) to see which has a stronger and more reliable effect on high-cost behaviours, and via which emotional mediators.

The Social Identity Model of Pro-Environmental Action (Fritsche, Barth, Jugert, Masson, & Reese, 2018) proposes that collective emotions are important drivers of collective environmental action, and the authors have noted empirical findings that support their model (e.g., a meta-analysis showing that participating in collective environmental action depends on perceiving one's in-group to be mistreated by an out-group, and consequent feelings of anger) (Van Zomeren, Postmes, & Spears, 2008). These authors exclude connectedness to nature from their definition of social identity, framing it as "personal connectedness". I argue that connectedness to nature could entail perceiving oneself as part of a kind of social group and experiencing emotions that are experienced at the level of one's collective identity (such as anger on behalf of nature); however, there may be points of difference between a nature-based identity and a social identity that involves other humans, as interaction with nature would likely not entail human group processes in the same way, such as

social comparisons and developing social norms. Schulte, Bamberg, Rees, and Rollin (2020) have also postulated a role for social identity in motivating collective sustainable behaviour; their meta-analyses showed that identifying with opinion-groups (e.g., environmental activists) is strongly correlated with collective sustainable behaviour, and a better predictor of collective than private-sphere behaviour. Again, the concept of identifying with nature does not feature in this work, and it would be helpful to explore the validity and the utility of conceptualising connectedness to nature in this way.

Repeated self-categorisation in which one's collective identity includes features of the natural world could explain the development of a variety of beliefs. Most obviously, connectedness to nature, in which there is an overlap between one's sense of self and the natural world (Mayer & Frantz, 2004), could develop in this way. It is also plausible that experiencing empathy toward nature encourages inclusion of natural entities in the self-concept (as suggested by the study of Davis et al., 1996), as it requires appreciating similar capacities for suffering. As previously discussed, connectedness to nature and empathy toward nature are dispositional tendencies but can also be activated as momentary states. Whereas the former might refer to the increased accessibility to a nature-based self-categorisation in any given moment based on repeated historical experiences of self-categorising in this manner, the latter might refer to the situational factors that highlight an aspect of a person's social identity, and the comparative and normative fit of a group representing "nature" that an individual might encounter (Reimer et al., 2020). Those who have a higher disposition in terms of connectedness to nature and empathy toward nature might therefore be more prone to state activation of these self-categorisations.

More research is required to understand which kinds of identity are particularly influential for sustainable behaviour: Vesely et al. (2021) reported in a series of meta-analyses that connectedness to nature (environmental identity) is moderately-to-strongly associated with environmentalism, and that environmental self-identity (how pro-environmental one perceives oneself to be) is strongly associated with environmentalism. Other forms of identity (place identity and identifying with groups unrelated to environmental topics) were more weakly associated with environmentalism (Vesley et al., 2021). However, these authors did not differentiate between behavioural costliness, and it might be that different kinds of self-categorisation have varying effects in different kinds of sustainable behaviour.

It would be remiss not to acknowledge that social identity and self-categorisation can also derail efforts to promote behaviour change. Emotions like anger and guilt are likely to interact with group categorisation in complicated ways to predict sustainable behaviour; the anger expressed by participants toward species in *Chapter 5* (e.g., badgers that spread tuberculosis, and wasps)

indicates that perceiving particular species as “other” might be used to justify harm. Identity can create resistance to behaviours that benefit from being adopted en masse. For example, Covid-19 prompted a rise in anti-vaccine sentiment, and an anti-vaccine social identity has become common, at least in the United States (Motta, Callaghan, Sylvester, & Lunz-Trujillo, 2021). Identity can also impede sustainable behaviour. For example, identifying with human groups who are in some way opposed to environmentalism or pro-nature causes could be detrimental to sustainable action. Climate change denial appears to be identity-based; in the United States, those with a Republican and/or conservative political identity resist solutions to climate change (Campbell & Kay, 2014). In *Chapter 7* it was proposed that instrumental value beliefs reflect a tendency to self-categorise as “human”, and that their association with a lower frequency of high-cost behaviours is founded on a motivation not to jeopardise the interests of humans by prioritising the interests of the out-group: nature and non-human species. According to Brown and Turner (1981), depersonalisation is a process in which those who are highly-identified with an in-group (such as humans) found their beliefs and behaviours on the norms and needs of the in-group. Future work would be needed to explore this.

8.6 Implications of Findings for Promoting Sustainable Behaviour and for Future Research

8.6.1 Messaging Strategies

Understanding which nature beliefs are predictive of different kinds of sustainable behaviour has implications for how messages should be framed in order to promote nature beliefs that might lead to more sustainable actions. Furthermore, understanding the prevalence of nature beliefs in the UK allows us to consider the kinds of framing that might be useful in messaging strategies or campaigns with a broad, population-level reach, as well as those targeting local communities, or individuals with specific characteristics and dispositions.

I have considered how matching message content to pre-existing dispositions might enhance message persuasiveness and prevent backfiring; for example, Tam (2015a) found that an anthropomorphised depiction of nature either increases or decreases message persuasiveness and intention to use a green product, depending on pre-existing levels of attachment anxiety. Care should be taken even with matched messaging: the review of Teeny, Siev, Briñol, and Petty (2021) reported that matching can backfire particularly when the quality of the argument contained in a source of information is weak (e.g., when attempting to generate positive attitudes toward an exercise class, either extolling its physiological and psychological benefits with statistical evidence [strong argument] or with the endorsement of an undergraduate from a relatively weak institution [weak argument]) (Dimmock, Jackson, Clear, & Law, 2013). These findings are consistent with the Elaboration Likelihood Model (Petty & Cacioppo, 1986), in which a more personally-relevant

message will result in more effortful, elaborate processing of the message, which might be a disadvantage when the argument contained in the message is weak or unconvincing. In the case of anthropomorphism, those who are more predisposed to seeing nature as similar to humans might therefore be more persuaded by pro-environmental messaging containing strong arguments (e.g., scientific data) whereas this group might be even less persuaded by a weak pro-environmental message than a group with a lower tendency to anthropomorphise.

I have also considered how some nature beliefs (and pro-environmental/pro-nature behaviours) might have a primarily social-adjustive function, and others a primarily self-defining function. It has been proposed that matching the content of a message to the function underlying a particular belief should enhance the persuasiveness of the message (a functional-matching effect) (DeBono, 1987); indeed, presenting information in a social-adjustive light has been found to increase perceptions of message quality and persuasiveness particularly for those whose attitudes have social-adjustive functions (Lavine & Snyder, 1996). In the following sections, these factors will be considered for three kinds of messaging scenarios: general public messaging; messaging for local communities; disposition-specific messaging.

8.6.1.1 General Public Messaging. Findings presented in this thesis suggest that intrinsic value beliefs and biospheric values are only predictive of lower-cost sustainable behaviour (biospheric values consistently predict consumption pro-environmental behaviours; intrinsic value beliefs and biospheric values predict personal and avoiding-for-wildlife pro-nature behaviours). Researchers have found value-resonance effects, in which values expressed in messages match the values of message recipients; for example, Schemer, Wirth, and Matthes (2012) found that only the voting preferences of people high in authoritarian values were shaped by message framing that appealed to this value system. As biospheric values and intrinsic value beliefs were found to be highly prevalent in the UK (*Chapters 6* and *7*), it might be that framing information about nature from a position that underscores its inherent value and right to exist (intrinsic value) as well as framing policy from a position of what is good for the environment and not just good for humans (biospheric values) could be an effective approach to shaping public sustainable behaviour. A meta-analysis showed behavioural intervention strategies such as public messaging only had the desired effect on behaviour 2-3% of the time, on average (Nisa, Bélanger, Schumpe, & Faller, 2019). Nonetheless, as argued in *Chapter 1*, by changing attitudes, beliefs, and values in a way that will promote public-sphere actions, this can change wider societal structures, removing barriers to individual action.

I have argued that intrinsic value beliefs and biospheric values could have a primarily social-adjustive function for most people, i.e., a means of maintaining psychological proximity to one's in-group. As previously discussed, information that is presented in a way that matches the social-

adjustive functions of beliefs can be particularly persuasive: Lavine and Snyder (1996) found that informing participants of their peers' intention to vote in upcoming elections was particularly persuasive to people deemed to hold attitudes with a higher social-adjustive function (high self-monitors). Bouman et al. (2020) found that those who perceive their group to have higher biospheric values report more pro-environmental behaviours, and that this effect is enhanced for those who identify more strongly with their group. It would be useful to investigate ways of informing the public that *others* commonly hold these beliefs about the environment and the natural world, and that holding such views is a desirable social quality; this could, for instance, be part of a government's assertion of national identity or civic values. Informing the public of the normativity of intrinsic value beliefs would be useful to investigate (e.g., replicating the methodology that Bouman et al. [2020] used with biospheric values), as it might be expected that these beliefs would be particularly helpful for promoting pro-nature behaviours given their specificity. The results presented in this thesis suggest that this might enhance behaviours that are themselves socially-normative (i.e., that might have a social-adjustive function), rather than more high-cost behaviours that are less commonly reported by the public.

Despite the normativity of instrumental value beliefs in a UK student sample (*Chapter 7*), the evidence presented in this thesis suggests that they do not promote lower-cost behaviours and might actively detract from high-cost actions. Experimental data would be required to fully test this possibility, but the evidence from this thesis would suggest it is unwise to frame information about nature purely from an instrumental value perspective if the goal is for humans to move toward more high-cost actions to protect nature. As mentioned in *Chapter 1*, instrumental value is the principal frame used for public messaging of nature in the UK (e.g., in terms of "ecosystem services"), and the results of this thesis suggest that this might be counterproductive.

An alternative way of framing nature is not as a separate entity that we can utilise, but as something that we are part of (i.e., our connectedness to nature). From a Self-Categorisation Theory perspective (Turner et al., 1987), this might encourage a higher-order self-categorisation that goes beyond "humans" and encompasses non-human life in the in-group. The systematic review of *Chapter 4* presented high-quality evidence that encouraging an anthropomorphic perspective of nature can prime at least a temporary mindset of connectedness to nature, leading to increases in sustainable behaviour. Given that connectedness to nature and empathy toward nature were among the less prevalent beliefs in the general population UK sample (*Chapter 6*), it would be important to test the helpfulness of this kind of informational framing for individuals with differing levels of these dispositions. It might be expected that these traits behave as moderators, in which those who have a more empathic disposition toward nature and have a dispositional tendency to feel connected to nature would be more responsive to framing nature as something to which we all belong. It would

be useful to test whether those with a less empathic disposition toward nature and feel less of a persistent connectedness to nature in their day to day lives can be primed in this way, and whether framing information in such a way could be counterproductive for such individuals.

8.6.1.2 Messaging for Communities. While general public messaging might allow for priming nature beliefs that are already prevalent among the population or shaping behaviour by activating beliefs (and behaviours) with a social-adjustive function, local initiatives are in a position to frame more specific information about particular aspects of nature or species that they wish to protect. For example, the Dyfi Osprey Project (n.d.) in Wales is a conservation project that protects and seeks to increase the number of ospreys and accepts donations and volunteers to help with the cause. On the project's website, the ospreys are named after Welsh rivers and lakes (e.g., Idirs, Clarach, and Nova), and information about these birds (their decline and near-extinction) is framed in terms of historical persecution by humans and ongoing threats, such as egg poachers. Here we can see information framing that would likely encourage people to view these birds as individuals, perhaps with humanlike qualities (anthropomorphism), and that might be expected to stimulate guilt and/or anger at their mistreatment by humans. The results presented in this thesis suggest that these frames would likely be helpful for encouraging community engagement with such initiatives, although care should be taken to anthropomorphise species in a way that presents humanlike attributes that will be perceived as plausible by the intended audience (as argued in *Chapter 4*). Initiatives such as the Dyfi Osprey Project might also benefit from specific framing of particular species' intrinsic value and associated concepts, e.g., their right to exist and their right to life (Phillips et al., 2020), which were theorised as a species' gateway into the moral circle in *Chapter 5*. Some participants in *Chapter 5* noted that early experiences with creatures, particularly pets, led to a more generalised appreciation of species' intrinsic value; creatures such as ospreys might benefit from framing that presents them in a pet-like manner, such as highlighting how they belong to a particular community.

As I have argued in *Section 8.3.2*, although generalised instrumental value beliefs might be unhelpful for high-cost sustainable behaviour (*Chapter 7*), in circumstances where another species (such as an invasive species) forms part of the threat to a protected species, instrumental value-framing of information about the invasive species (e.g., the harm it causes to a valued species) might encourage local support toward its management; in *Chapter 5*, instrumental value beliefs were used to justify management of invasive or pest species. It is possible that highlighting the instrumental value of a protected species is also beneficial, e.g., how it contributes to "ecosystem services", but this framing could, in the longer-term, lead to its categorisation as primarily of instrumental value and justify abuse and exploitation of that species if its interests were to be perceived in conflict with those of humans. The appropriateness of framing nature for its instrumental value is hotly debated among conservationists, and the debate often pits an instrumental value approach against an intrinsic value

approach (Tallis & Lubchenco, 2014). Tallis and Lubchenco (2014) have called for a variegated set of values employed for specific purposes and have argued that, whereas intrinsic value framing will be helpful at times, powerful and influential actors (like companies) might need an instrumental value frame to understand how species might be beneficial, e.g., from an economic point of view; this would presumably help larger-scale conservation efforts than what could be achieved by individuals.

Conflict between groups should be considered in conservation efforts. I have argued that, when protecting a species creates a perceived conflict to human interests, those who are highly identified with humans as a social group (and therefore might be more invested in instrumental value beliefs highlighting species' usefulness to humans) might be less supportive of such large-scale projects; this is suggested by the study of Williams et al. (2002), where people whose livelihoods would be affected by large-scale conservation efforts are most opposed to these measures. Any local conservation initiatives should therefore bear in mind how nature or particular species might be seen as an out-group with which to compete for resources and political power, and how this might jeopardise support for such projects. Perceived social conflict between different human groups should also be borne in mind, and the visible representatives of such organisations should arguably be presented as having features that are prototypical of the people whose support and buy-in might be needed (Turner et al., 1987).

It might be that focusing messaging strategies on those communities who already have access to nature, either based on geographic location (e.g., rurality) or interest (e.g., gardeners, ramblers, or pet-owners; Crompton & Kasser, 2009) would be a cost-effective use of resources; as will be discussed in *Section 8.6.2*, developing a sense of connectedness with nature likely depends on opportunities for contact with the natural world in order to self-categorise in a different way. From a practical point of view, such messaging initiatives could display information in a place-based way (such as posters in shops and town halls) or online (e.g., on special interest social media forums).

8.6.1.3 Disposition-Specific Messaging. This thesis has presented evidence that connectedness to nature and empathy toward nature are predictive of high-cost sustainable behaviour (*Chapters 6* and *7*). Mind attribution to nature appears to explain sustainable behaviour via connectedness to nature and empathy toward nature, with particularly good (experimental) evidence that framing information about nature in an anthropomorphic way can influence sustainable behaviour via at least temporary increases in connectedness to nature (*Chapter 4*). However, as discussed in *Chapter 4*, care should be taken when framing information anthropomorphically. There is high-quality, experimental evidence that certain dispositional traits might reduce the effectiveness of particular message framing: as noted in the systematic review of *Chapter 4*, Tam (2015a) found that low levels of attachment anxiety and low desire for control can be counterproductive for message

persuasiveness and intention to perform sustainable behaviour when messages frame nature from an anthropomorphised perspective.

People high in connectedness to nature and empathy toward nature, I have argued, are likely to have self-defining beliefs, e.g., higher personal norms about the moral treatment of nature. Whereas beliefs with a social-adjustive function might make messaging more persuasive when it has a social-comparative frame (Lavine & Snyder, 1996), a self-comparative frame might be more appropriate for self-defining beliefs, in which the discrepancy between one's behaviour and one's cherished beliefs is highlighted (cf. the hypocrisy induction, which has been used, for example, in water conservation) (Dickerson, Thibodeau, Aronson, & Miller, 1992). It is remarkable that this process occurred during an interview with a participant who reported sustained engagement in pro-nature behaviours (*Chapter 5*), leading to a self-reported commitment to change behaviour to be more in line with his own belief system. Hills (1993) found that beliefs about the equality of humans and nature and about the dominance that humans should exert over nature were often reported by the same individuals; they proposed that these motivations were not central to such individuals, and as such the discrepancy between them could be more easily tolerated. It is possible that such discrepancies are less easily tolerated when beliefs are more self-defining.

Also of interest are people's dispositional tendencies regarding processing information (need for cognition; Cacioppo & Petty, 1982) and approaching emotionally-laden situations (need for affect) (Maio & Esses, 2001) (see Haddock & Maio [2019] for an overview). Individuals high in need for cognition think more carefully about information when forming attitudes and have been found to base attitudes on an evaluation of the attributes of an attitude object more than those with a low need for cognition (Haugtvedt, Petty, & Cacioppo, 1992). Individuals high in need for affect are more drawn to emotional situations, such as emotional films, as opposed to less emotional situations (Maio & Esses, 2001), their attitudes are more guided by affective information than people low in need for affect (Huskinson & Haddock 2004), and recognition of information for these individuals (suggestive of deeper information-processing) is higher when the information is affect-based, whereas this effect is not found when the information is cognition-based (Haddock, Maio, Arnold, & Huskinson, 2008). Most of the nature beliefs investigated in this thesis are purely cognitive in nature, whereas connectedness to nature and empathy toward nature have both cognitive and affective components (Zylstra et al., 2014). It would be useful to determine whether those who are high in these dispositional beliefs also demonstrate higher need for affect, and therefore whether matching information to these dispositional characteristics (e.g., presenting more emotional information in nature-based messaging for those high in connectedness to nature and empathy toward nature) might be particularly engaging or persuasive.

8.6.2 Developing Beneficial Traits

It is potentially of great significance that dispositional beliefs could motivate sustained and high-cost behaviour. Psychological traits can be developed and might support high-cost sustainable behaviour of the kind that targets systemic aspects of human ecological and environmental impacts. Effect sizes of nature beliefs were small (in *Chapter 7*, the largest R^2 value was for connectedness to nature as a predictor of high-cost pro-environmental behaviours: 8%); nonetheless, changing social norms only requires a relatively small proportion of individuals engaging in high-cost behaviours, with estimates that as few as 3% of the public visibly engaging in non-normative behaviour could lead to social contagion effects (Andrighetto & Vriens, 2022; Iacopini, Petri, Baronchelli, & Barrat, 2021).

The traits of note in this thesis are connectedness to nature and empathy toward nature. A tendency to anthropomorphise/perceive mental capacities in nature may also be important: according to cross-sectional and experimental data from *Chapter 4*, these may influence sustainable behaviour via connectedness and empathy. The findings presented in this thesis suggest a helpful starting point for exploration when looking to develop certain dispositions toward the natural world. Participants in *Chapter 5* reported pet ownership and previous experience with species to be associated with seeing other species as part of one's family. This is consistent with previous work showing that pet ownership is associated with concern for species preservation and less support for strategies that put human needs above those of wildlife (Shuttlewood et al., 2016). Adolescents who provide more care for their family dog have been found to engage in more pro-environmental behaviours (Torkar, Fabijan, & Bogner, 2020). Chawla (2015) summarised research findings in which concern for non-human species is enhanced by exposure to and exploration of nature in childhood.

There are numerous avenues to explore when attempting to incorporate an understanding of our place within nature into education. Gruenewald (2003) argued that a place-based pedagogy is appropriate for ensuring educational institutions lead to citizens that enhance the well-being of the ecological settings they inhabit. A related concept is that of planetary health, which is an emerging discipline that views human health and that of the planet as interwoven and considers safe environmental limits that allow humans to flourish; it is the health of humans as well as natural systems on which humans depend (Whitmee et al., 2015). Such an approach to education potentially represents a break from more traditional ideas of health that currently exists within medical education. Zylstra et al. (2014) argued that a scientifically-validated approach is needed that moves our attitudes, perceptions, and behaviour into alignment with statements found in measures such as the *Connectedness to Nature Scale* (Mayer & Frantz, 2004), in which we begin to experience ourselves as part of the natural world. This kind of education, according to Zylstra et al. (2014),

should be trans-disciplinary, integrating these ideas across a variety of existing topics, and should have a large experiential component. The findings in this thesis indicate that education should also emphasise other species' similarity to humans, particularly their mental capacities, to encourage empathy toward species and a sense of connectedness to nature. It is known that connectedness to nature can be developed through education programmes (Ernst & Theimer, 2011; Lankenau, 2018; Liefländer, Fröhlich, Bogner, & Schultz, 2013), but there is little data on the effectiveness of such interventions long-term.

Developing dispositions such as connectedness to nature and empathy toward nature would benefit from research to better understand the normal development of these traits. For example, empathy toward people, as well as prosocial behaviours, is known to undergo different developmental stages that rely on a range of factors, such as cognitive development and parenting styles (Silke, Brady, Boylan, & Dolan, 2018). An interesting feature of empathic development is that some of the social capabilities on which it relies (e.g., emotional recognition) appear to undergo a dip during mid-puberty (e.g., Peters & Kemner, 2017); these are the sorts of developmental events that it would be helpful to track for nature-based relating, such as empathy toward nature.

Insights from Self-Categorisation Theory (Turner et al., 1987) could help to guide initiatives for developing new sorts of identities that encompass the natural world. Building someone's predisposition to perceive themselves as part of nature might entail building opportunities, starting in childhood, to repeatedly categorise oneself in this way; this would increase the *accessibility* of a social category in any given situation (Reimer et al., 2020). While education is one way of offering these opportunities, as found in *Chapter 5*, a sense of identity can be reinforced in social settings that may take place outside educational contexts; participants spoke of a view of themselves as pro-nature which was enhanced by socialising with like-minded others, such as via social media. New opportunities for re-conceptualising and broadening one's identity might arise with changes in circumstances; there is evidence that the Covid-19 pandemic led people to spend more time in nature (Robinson et al., 2021). It is possible that enforced distancing from others led to a need for connection that could be more easily satisfied by natural entities, such as those found in public parks. Indeed, some participants in *Chapter 5* noted that accessing nature during Covid-19 felt emotionally restorative.

Little is known about *why* access to nature might enhance connectedness to nature, what activities in nature might be most beneficial, and what qualities and duration of exposure to nature might be most helpful. What is known is that certain demographics have less access to natural spaces. For instance, there are racial disparities in access to high-quality green spaces (Rigolon, Browning, McAnirlin, & Yoon, 2001), and people with mental health problems experience lower

intrinsic motivation to engage with natural spaces (Tester-Jones et al., 2020). Building nature-based identities is an endeavour that will therefore require an approach that addresses existing social inequities and other barriers to access.

The findings of *Chapter 7* imply that believing in the instrumental value of nature could be counter-productive to the development of more high-cost sustainable behaviour, and I have argued that this could be due to a tendency to identify strongly with a "human" self-categorisation leading to perceptions of conflict with the needs of nature or non-human species. Part of the problem with education that separates humans from the rest of nature might be that it also encourages a view of nature and non-human species as being purely "for" humans. Moving away from such an understanding of nature in education could help stimulate new ways of interacting with the natural world that are not exploitative, that are respectful, and that do not reduce it to its economic value or other benefits for humans. Governments could also ease national transition toward a more inclusive self-categorisation that includes nature. Crompton and Kasser (2009) argued that government policy is a form of social modelling; the authors suggested that adopting different indicators of national prosperity moving beyond self-focused materialism, which would convey different governmental values and priorities to policymakers and the public. Crompton and Kasser (2009) highlighted existing measures of the nation's psychological wellbeing, such as the New Economics Foundation's Happy Planet Index (NEF; 2006), which includes environmental health. Incorporating the environment within a measure of wellbeing would be one way of encouraging more overlap between the public's understanding of the "self" and of "nature".

Turner et al. (1987) posited a hierarchy of identities, in which personal and social identities are distinct. A third category is as a human being, which is considered the most inclusive level (Turner et al., 1987). This is similar to Singer's (2011) proposal that the history of human morality has been an ever-expanding circle, encompassing kin, then other human groups. Expanding our self-concept to include all sentient beings or even all life might be the next stage in this process; this would not need to be at the cost of other forms of self-categorising but would be like adding an annexe to the self-concept. However, this does raise a question: when people identify with nature, with *what* are they identifying? According to Self-Categorisation Theory (Turner et al., 1987), collective identities form in part when one perceives oneself to have more similarities with one group over another. This implies that people who are predisposed to self-categorising as part of "nature" see something of themselves in the natural world, whilst also seeing discontinuity between themselves and other potential self-categorisations at any given moment. What are the prototypical aspects of "nature" with which people might identify that would not be perceived as strongly in the group "humans"? Nature is often portrayed as a place to "get away from it all", i.e., the complexities of human life; for some, nature might represent a person's values that are overlooked or violated in

the present-day UK cultural and socio-political context. Non-human species were seen by some in the grounded theory of *Chapter 5* as representing a kind of psychological safety; one participant described non-human species as follows:

"They won't tell on you, they won't betray you, right, so you can feel like when you share a lot of information with them, and they, like, you know they are listening, and they show some kind of response to me, it's like hard to describe, but you know that they're like, deep down maybe they care for you." (Participant 3).

Another clue as to key features of a nature-based identity comes from how the measure of empathy (the *Dispositional Empathy Toward Nature Scale*) (Tam, 2013) toward nature is worded, which refers to "suffering animals and plants". Connectedness to nature in our current ecological context also implies an awareness of how nature suffers as humans destabilise climate and ecological systems (connectedness to nature is a predictor of eco-anxiety) (Whitmarsh et al., 2022). Is suffering or the experience of victimisation at the hands of humans perceived by some to be a prototypical feature of nature and non-human species? Can connectedness to nature and empathy toward nature be motivated by a desire to seek commonality or refuge in the natural world? Do identity-based nature beliefs such as connectedness and empathy lead to, or result from, political worldviews, such as those that prize fairness, equality, and social justice? Are these beliefs associated with broader values that transcend natural targets, such as Schwartz's (1992) transcendent values? Finding answers to these questions should help clarify *why* identity-based nature beliefs might influence high-cost sustainable behaviour.

8.7 Limitations

8.7.1 Measures

Pro-environmental and pro-nature behaviours were clustered together in *Chapters 6* and *7* based on costliness and other features; however, there will inevitably be variation at the individual level in the function of behaviours and their costliness. For example, living in a more urban setting might make it easier to travel to an Extinction Rebellion protest, whereas those in more remote regions would have additional barriers to accessing such events. Eating a meat-free diet might be less effortful for someone who does not like meat and the social costs less for someone who is surrounded by others who do not eat meat; someone for whom meat is a big feature of their daily diet, or whose social group conforms to strong meat-eating norms, would find eating a meat-free diet more effortful and socially costly. A nomothetic approach was taken in the quantitative studies of this thesis, providing a general picture of population-level associations between variables; however, a weakness of this approach is that these individual-level variations in the meanings of different types

of sustainable behaviour could not be taken into consideration. In future it might be helpful to integrate an appraisal of individual behavioural costliness into survey measures, such as asking participants how difficult they would find it to undertake each behaviour and creating bespoke scores of costliness, which might give a more fine-tuned account of what predicts behaviours that differ in perceived costliness. It might also be possible to differentiate between different kinds of behavioural cost, such as financial, effort, as well as social costs and to examine, for example, whether social-adjustive beliefs are particularly predictive of behaviours that are less socially costly.

Resource-conservation pro-environmental behaviours showed low internal consistency across *Chapters 6* and *7* (Cronbach's α = .58 and .56, respectively). While this might be due in part to having quite a small number of items (Cortina, 1993), other behavioural measures also had a small number of items but higher internal consistency. It is possible that low internal consistency for the items reflecting resource-conservation pro-environmental behaviours were actually heterogeneous and did not measure one unitary construct. Nunnally (1967) suggested that an alpha value above .5 is adequate for the early stages of research; however, for future studies it would be beneficial to reconsider the use of this subscale for measuring resource-conservation behaviours, or even to consider whether resource-conservation is indeed a meaningful class of pro-environmental behaviours. This relates to the point made in the previous paragraph about the need for research to illuminate the meaning or the intended consequences of different kinds of sustainable behaviour.

The measures of sustainable behaviour used in this thesis covered a range of lower-cost and high-cost actions and measured actual behaviour in addition to self-reported behaviour in *Chapter 7*. However, a range of very high-cost behaviours were not included, such as choosing to live car-free. Also, although some higher-impact behaviours were included (such as avoiding eating meat), many were not included e.g., choosing to have one fewer child (Wynes & Nicholas, 2017). The sorts of high-impact behaviours described by Wynes and Nicholas (2017) could be considered one-off actions; it would not make sense to ask, for instance, how frequently over the past year one has chosen to have one fewer child. Nonetheless, it would be useful for future research to determine the degree to which beliefs about nature are influential in determining big life decisions that have sizeable impacts on one's carbon footprint.

Sustainable behaviour is determined by a range of factors, both psychological and contextual. For example, differences have been found in levels of sustainable behaviour between rural and urban individuals (Anderson & Krettenauer, 2021). Contextual factors are also associated with different nature beliefs; some studies have found those living in more farm or rural contexts to have less concern for animal rights (Mariti, Pirrone, Albertini, Gazzano, & Diverio, 2018). Collecting data to understand factors like rurality, geography, and financial factors, would have allowed for a richer

understanding of psychological and contextual factors and how they compare in their ability to predict lower- and higher-cost behaviour.

Although Kellert's (1985) typology of attitudes was deemed a helpful starting point for understanding the influence of psychological variables on sustainable behaviour (as reviewed in *Chapter 2*), these attitudes were not measured in this thesis. This was in part a decision to reduce participant burden by limiting the number of questionnaires included in the quantitative studies reported in *Chapters 6* and *7*. The decision was also made on the basis that this thesis looked at broader psychological constructs (beliefs), whereas attitudes refer to a narrower range of entities or situations (Stern, Dietz, & Guagnano, 1995). Serpell (2004) proposed that Kellert's typology of attitudes could be expressed as to orthogonal dimensions of affect and utility. This thesis has included both dimensions, with affect represented by connectedness to nature and empathy toward nature, and utility represented by instrumental value beliefs and intrinsic value beliefs. What was not well represented among the beliefs measured in the quantitative chapters was the negative instrumental value of nature (in which nature might be a threat to humans, or harmful in some way), or nature as an affectively negative experience. There are no constructs to my knowledge that refer to a general belief or experience of affective disconnectedness from nature, or a belief about nature's general harmfulness; it might be that research into people's perceptions of species in particular contexts might be better suited to a more specific assessment of attitudes, and that Kellert's (1985) typology would be very suitable for such investigations.

Zylstra et al. (2014) noted shortcomings to the *Connectedness to Nature Scale* (Mayer & Frantz, 2004), including its coverage of cognitive aspects of connectedness without full consideration of the affective and experiential aspect. Including measures of connectedness and empathy that include separate cognitive and affective subscales would allow future researchers to undertake more detailed analyses of their association with sustainable behaviour, including need for affect or need for cognition as moderators (Haddock & Maio, 2019). Empathy measures that have cognitive and affective subcomponents include *The Environmental Empathy Scale* (Musitu-Ferrer, Esteban-Ibañez, León-Moreno, & García, 2019) and *The Emotional and Cognitive Scale of the Human-Nature Relationship* (Mundaca, Lazzaro-Salazar, Pujol-Cols, & Muñoz-Quezada, 2021). A connectedness to nature measure with more clear coverage of cognitive and affective aspects is the *Nature Relatedness Scale* (Nisbet, Zelenski, & Murphy, 2009).

It was concluded in *Chapter 7* that the measure of actual behaviour that was used does not measure sustainable behaviour, but instead measures learning behaviour or information-seeking behaviour. This behaviour was chosen to reduce participant burden (participants were asked whether they wanted to read a brief article). Lange and Dewitte (2019) published guidance on

different kinds of self-report and observed behaviour measures, and the research questions most appropriate to them. Self-report measures assessing a broad range of behaviours, and ideally multiple measures (as was the case for the study reported in *Chapter 7*) are deemed most appropriate when the objective is to understand individual differences in sustainable behaviour (Lange & Dewitte, 2019). Impact-orientated measures are recommended by Lange and Dewitte (2019), i.e., those that ask about specific behaviours that would likely have a particular kind of impact on nature or the environment, rather than intent-orientated measures where the focus is on actions that are intended to have an impact on nature or the environment, but that may or may not do so (e.g., whether a person has undertaken action out of concern for the environment). As noted previously, however, a limitation of not measuring the intent of particular behaviours limits understanding of how different beliefs influence sustainable action. For example, instrumental value beliefs negatively predicted high-cost sustainable behaviour in *Chapter 7*, whereas connectedness to nature was positively predictive; the impact-orientated measure I used was agnostic as to the intention behind these high-cost actions (e.g., to stand up for the environment, to repair damage caused by humans, or to take retributive action against humans that are causing harm). Some traditional pro-environmental behaviours appeared to have underlying pro-nature motivations for some; for example, participants in the grounded theory study of *Chapter 5* sometimes reported behaviours more typically thought of as pro-environmental, such as avoiding littering, where this was intended to be limit their impact on non-human species (i.e., a pro-nature intention).

"I would never go out and litter I would never and to damage things for the hell of it. I don't like, you know, when people release balloons and release lanterns and stuff like that, I would never do that." (Participant 19)

While Lange and Dewitte (2019) recommended the *General Environmental Behaviour Scale* (Kaiser, 1998) as a measure with strong psychometric properties (e.g., Arnold, Kibbe, Hartig, & Kaiser, 2018), I decided not to use this measure due to its length. Lange and Dewitte (2019) also suggested informant-reports as a means of validating findings; however, the statistical techniques required for the studies of *Chapters 6* and *7* furthermore required large sample sizes, and it would have been financially and practically prohibitive to sample data from participants and informants.

It was deemed beyond the scope of this thesis to consider the role of social norms in detail, although they are relevant to social-adjustive beliefs (Smith, 1956). Although social norms were identified as a potentially relevant factor in the grounded theory of *Chapter 5* (in which external social triggers were found to be important for sporadic sustainable behaviour), a decision was made to focus on personal moral norms. The quantitative studies that were undertaken in part to empirically confirm the grounded theory of *Chapter 5* had to balance including enough measures to survey a

broad range of beliefs whilst minimising participant burden. There were also cost considerations for collecting a large number of responses for a long survey. Excluding social norms also allowed for retaining parsimony, as the Value-Belief-Norm model (Stern et al., 1999) does not include social norms. Research has also indicated that personal moral norms have a more direct impact on sustainable behaviour, whereas social norms have a more indirect impact (Fornara et al., 2020), and so the former was deemed a potentially more influential variable to include in analyses.

8.7.2 Study Design

The cross-sectional design of the quantitative studies presented in this thesis allowed for the prevalence of nature beliefs and sustainable behaviour to be assessed at a single point in time, and to test for the (statistical) predictiveness of nature beliefs and demographic variables. True causality could not be inferred from this cross-sectional design, and regressions undertaken on questionnaires in cross-sectional data are also prone to simultaneity bias as predictor variables and outcome variables, in reality, often influence each other simultaneously (Mishra, Mokhtarian, Clewlow, & Widaman, 2019). Testing the accuracy of an extension to the Value-Belief-Norm model (Stern et al., 1999) explored in *Chapter 7* would require a longitudinal design to follow up participants and observe how variables at each time point predict variables at later time points. This would, ideally, involve recruiting children and following-up throughout adolescence and into adulthood; of course, this would very resource-intensive. In some cases, an experimental methodology would be useful for establishing causality; for instance, manipulating individuals to identify with humans versus nature could test some of the ideas put forward in this thesis about the influence of self-categorising on sustainable behaviour. This methodology would be limited, however, to understanding the influence of temporary, state-like changes.

8.7.3 Sampling

The systematic review of *Chapter 4* was conducted to limit systematic bias in the kinds of papers that were included (e.g., by carefully selecting a range of terms that would fully tap the concepts under consideration). Although “grey” literature was not excluded (i.e., work that can be found outside of traditional publishing, such as doctoral dissertations), since conducting the systematic review I have come to be aware of some benefits of including grey literature. The inclusion of grey literature can limit the influence of publication bias, as unpublished (“grey”) research is more likely to include non-significant findings. Future reviews on this topic would benefit from making use of such approaches for including unpublished literature.

In the grounded theory study presented in *Chapter 5*, many of the interviews were conducted remotely, which allowed for the inclusion of participants from different nations. This was particularly

conducive to theoretical sampling (Charmaz, 2006), in which participants with specific characteristics were sampled in order to systematically test aspects of the developing theory. However, there were difficulties recruiting individuals for the “animal workers” group, and responses on farmers’ social media groups indicated negative emotional reactions to the study; those individuals who did opt to take part may not therefore have been representative of this segment of the population and could have influenced the developing theory. Many media reports focus on the role of livestock farming in climate change (e.g., Harvey, 2020) and the IPCC (2019) has advised on the benefits of adapting plant-based diets. This political context could make certain groups suspicious of research with an environmental focus that asks for their views.

Participant groups in *Chapter 5* differed in their age and gender distribution, with the undergraduates being markedly younger than the other two groups and the pro-nature group comprising mainly men whereas the other two groups had a more balanced gender composition. Gender and age are known to be associated with pro-environmentalism (Gifford & Nilsson, 2014), and different group characteristics might therefore have led to some differences in the interview content between groups. Age, for example, might explain why social influence from others was predominantly discussed in the undergraduate group, given the rise of youth-focused environmental movements such as “school strike for climate” (Rachwani, 2021). The context of living with other students might also enhance the need to conform with one’s peer group.

I attempted to lessen the bias associated with conducting some interviews pre-Covid-19 and others that took place during the pandemic by explicitly asking about the impact of Covid-19 on how participants related to nature. The fact that some participants were interviewed in person and others remotely might also have given rise to different responses. The card-sort task involved participants reflecting on the similarity of different species to humans and to consider the different kinds of similarity with which to categorise. It is possible that the card-sort task primed participants to think about the topic and to answer the questions in a certain way, i.e., in terms of their similarity to humans. Similarity to humans was not identified as a concept in the theory, which implies that the influence from the card sort was not too great. I removed the card-sort task from the interview process after the first seven participants primarily as many of the responses to the card sort task had become repetitive; however, the card-sort task was not used with every participant group, and therefore important information about how different participants consider species similarity to humans might have been missed.

It could be argued that Covid-19 might reduce the comparability of the findings presented in *Chapter 6* with those presented in *Chapter 7*, as data for the former were collected before the pandemic. Indeed, research indicates that people spent more time in nature due to the pandemic

(Robinson et al., 2021). However, climate change concern did not appear to diminish in the UK during the period of April 2019 and June 2000 (Evensen et al., 2021) or between October/November 2020 and May 2022 (Whitmarsh et al., 2022), suggesting that this period might not have led to any substantive, lasting changes in people's views about the environment.

8.7.4 Terminology

The terminology used in this thesis reflects terms used in the literature. In order to identify as many papers as possible for the systematic review of *Chapter 4* it was important to use terms such as anthropomorphism in searches; nonetheless, such a concept is anthropocentric, as it frames the characteristics of non-human species as "humanlike". The term non-human species is also not without its problems, as it casts species as "other", potentially contributing to the culture of separating humans psychologically from the rest of nature. Other terms have gained traction in the literature, including the "more-than-human" world (O'Connor & Kenter, 2019), although this arguably also keeps a psychological divide between humans and nature. Similarly, terms such as "connectedness to nature" perhaps keep a psychological divide between humans and nature, whereas "connectedness with nature" might better represent humans' inclusion in nature (Zylstra et al., 2014). Indeed, other languages might already convey the concept in this way; for example, a term that can be used in Welsh – "*cysylltedd â natur*" – literally translates as "connectedness with nature".

During the undertaking of this thesis, it has become clearer that the meaning of "intrinsic value" and "instrumental value" have been hotly debated. O'Connor and Kenter (2019) noted that a variety of definitions exist, and that there is a lack of agreement as to whether these values can be abstract (e.g., referring to the biosphere as a whole) or must refer to specific targets. Quantitative research on intrinsic and instrumental value beliefs is in its infancy, as much of the work on these concepts remains at the level of philosophical discussion. This was most evident in the fact that I could only find single-item measures for these constructs, whereas other constructs in the quantitative studies in *Chapters 6* and *7* were multi-item and, at times, had more than one sub-component. Future quantitative work to establish the predictiveness of intrinsic and instrumental value beliefs should bear these problems in mind and might benefit first from developing multi-item measures to establish whether these beliefs can be reliably and validly measured. Given the complexity of relationships reported in *Chapter 7* between instrumental value beliefs and other beliefs and behaviours, and the fact that these beliefs appear to vary according to species (Hills, 1993), it seems particularly likely that this sort of belief is better suited for examining predictors of sustainable behaviour in more specific contexts with specific targets (e.g., the conservation of a particular animal).

Another term that is gaining in popularity in the literature is the “relational value” of nature (e.g., Chan, Gould, & Pascual, 2018; O’Connor & Kenter, 2019), referring to the value perceived in one’s relationship with nature. There is no consensus as to how these values are to be measured; connectedness to nature is the most common way of measuring beliefs about the relational value of nature (e.g., dos Santos & Gould, 2018), and care toward nature (cf. empathy) is also believed to be reflective of relational value (Kleespies & Dierkes, 2020). Relational value remains a very broad concept with fuzzy boundaries (O’Connor & Kenter, 2019), perhaps better suited as a practical reminder for humans to ensure that the usual concepts of intrinsic and instrumental value include the value of the relationships we have with nature, rather than as a separate theoretical concept (Chan et al., 2018). Relational value was deemed too undefined a concept to consider in detail in this thesis, although it is notable that the only two predictors of high-cost behaviour fall within the definition of relational value.

8.8 Conclusion

This thesis has undertaken a wide-ranging, mixed-methods investigation of broad beliefs about nature and non-human species, their prevalence in the UK, and their contribution to different kinds of pro-environmental and pro-nature behaviours. Messaging strategies that frame information from the perspective of prevalent nature beliefs should be considered, and current messaging approaches that focus on nature’s instrumental value could inadvertently discourage more high-cost sustainable behaviour. Nature beliefs that intersect with identity appear to be predictive of high-cost behaviours, and this thesis has conducted a preliminary exploration of pathways that might explain the link between identifying with nature and performing high-cost behaviours to protect nature and the environment from human impacts. There is strong evidence from this thesis, and prior research, that connectedness to nature is a highly beneficial disposition from the standpoint of promoting sustainable behaviour and developing an appreciation in the public of our place within nature. I have proposed what insights from Self-Categorisation Theory (Turner & Reynolds, 1987) have to offer in terms of how an identity with nature might be promoted in a variety of settings and have suggested possible directions for future research in this area.

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Appendices

Appendix A: List of Studies Excluded at Full-Text

Paper	Reason for exclusion
Beatson et al. (2009)	Experimental study in which the researchers induced participants to think about personal mortality and human creatureliness. This study was not included as it looked at the effect of seeing humans as having qualities similar to creatures, as opposed to investigating perceptions of species as having humanlike qualities.
Brown & McLean (2015, Studies 1 & 2)	Study 1 excluded for not measuring any of the variables of interest to the review; Study 2 excluded following quality appraisal.
Butterfield et al. (2012, Studies 1 & 2)	Studies were excluded following quality appraisal.
Hawkins & Williams (2016)	Data and analyses deemed to be the same as those of another included study (Hawkins et al. 2020).
Kamil et al. (2019)	Quasi-experimental study in which all participants saw the same (anthropomorphised) educational video about the Komodo dragon and then received factual information about this species and differences in attitudes pre- and post-intervention were reported. This study was excluded as it was not a truly experimental study allowing for conclusions to be drawn about the effects of anthropomorphism in isolation (there was no comparison group that saw a non-anthropomorphised video), and also did not provide correlational data.
Laksmidewi & Soelasih (2019, Studies 1 & 2)	Study 1 was excluded following quality appraisal. Study 2 depicts a shopping bag in anthropomorphised/non-anthropomorphised form; as the researchers did not anthropomorphise nature, this study was not included in this review.
Menor-Campos et al. (2018)	The researchers assessed belief in animal mind among primary school children and its association with personal variables (such as age), but not with attitudes toward any species or any sustainable behaviours or psychological variables.
Tam (2014, Study 3)	Study was excluded following quality appraisal.

Tam et al. (2013, Study 2)	Study was excluded as there was no measure of sustainable attitudes or measures of primary interest to the study.
Wang & Basso (2019; Studies 1a & 1b)	1a: All participants were induced to perceive animals in an anthropomorphic way, and there was no control group that was not induced in this way. Participants were then randomized either to hear about the meat- or the egg-based dishes on a restaurant's menu. As all participants underwent an anthropomorphising manipulation, the differences between the groups could not be attributed to the manipulation, and this study was therefore not included; 1b: participants were randomly allocated to read anthropomorphised or non-anthropomorphised depictions of pigs and looked at group differences intention to go to eat at the restaurant; however, this did not ask directly about intention to eat (at restaurants serving) meat, but rather asked about intention to eat at a restaurant offering similar services to the one that was depicted (which happened to serve meat). This was deemed not to be a study that could answer the question of whether the manipulation would lead to different intention to eat meat / frequent meat-eating restaurants *per se*.
Wang et al. (2020, Studies 1, 2, & 3)	Studies were excluded following quality appraisal.

Appendix B: Items excluded from the NHLBI's "Quality Assessment Too for Observational Cohort and Cross-Sectional Studies"

The following items were excluded from this tool for the purposes of the present review, as they are more relevant to clinical studies where 1. high dropout and unequal dropout between groups is a common source of bias; 2. the hypotheses are causal; 3. blinding of participants and researchers can reduce bias in participants' responses and in how researchers analyse outcomes:

1. Was the participation rate of eligible persons at least 50%?

2. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?

3. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?

4. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?

5. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?

6. Was the exposure(s) assessed more than once over time?

7. Were the outcome assessors blinded to the exposure status of participants?

8. Was loss to follow-up after baseline 20% or less?

9. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?

Appendix C: Items excluded from the NHLBI's "Quality Assessment of Controlled Intervention Studies" Tool

The following items were excluded from the quality appraisal tool as they were either already included in the tool for correlational studies (item 11) or deemed more relevant to clinical experimental studies, where blinding may be more important, e.g., to reduce bias in researchers' assessments of outcomes, dropout as well as differential dropout between groups is a common source of bias, and lack of adherence to the intervention is a common source of bias:

3. Was the treatment allocation concealed (so that assignments could not be predicted)?

4. Were study participants and providers blinded to treatment group assignment?

5. Were the people assessing the outcomes blinded to the participants' group assignments?

7. Was the overall drop-out rate from the study at endpoint 20% or lower of the number allocated to treatment?

8. Was the differential drop-out rate (between treatment groups) at endpoint 15 percentage points or lower?

9. Was there high adherence to the intervention protocols for each treatment group?

10. Were other interventions avoided or similar in the groups (e.g., similar background treatments)?

11. Were outcomes assessed using valid and reliable measures, implemented consistently across all study participants?

12. Did the authors report that the sample size was sufficiently large to be able to detect a difference in the main outcome between groups with at least 80% power?

13. Were outcomes reported or subgroups analyzed prespecified (i.e., identified before analyses were conducted)?

14. Were all randomized participants analyzed in the group to which they were originally assigned, i.e., did they use an intention-to-treat analysis?

Appendix D: Information Sheets, Consent Forms, and Demographic Information Forms

1. Chapter 5 Study

Understanding Environmental Attitudes and Behaviours

Study Information

Thank you for considering taking part in this study. This is a study looking at people's environmental attitudes and behaviours, including how people feel about nature and the environment. We are only looking to collect data from adults (18+ years of age). In this study, you will be given cards with the names of different species on them. The researcher (Marc Williams) will ask you questions relating to how you feel about these different species. The session will be audio recorded in order for the interview to be transcribed for analysis. The audio recording will be kept on a computer at Cardiff University and password-protected. The study should take no longer than 1 hour of your time.

Contact details

Researcher: Marc Williams (williamsm93@cardiff.ac.uk)

Supervisors: Professor Lorraine Whitmarsh (***REDACTED***)

Professor Diarmait Mac Giolla Chríost (***REDACTED***)

School of Psychology Research Ethics Committee:-

Secretary to the Research Ethics Committee School of Psychology

Tower Building

70 Park Place, Cardiff, CF10 3AT

Email: psychethics@cardiff.ac.uk

Privacy Notice: The information provided on the consent form will be held in compliance with GDPR regulations. Cardiff University is the data controller and (***REDACTED***) is the data protection officer (***REDACTED***). This information is being collected by Marc Williams. This information will be held securely and separately from the research information you provide. Only the researcher will have access to this form and it will be destroyed after 7 years. The lawful basis for processing this information is public interest.

Consent Form

Understanding Environmental Attitudes and Behaviours

I understand that my participation in this project will involve talking with the researcher about how I feel about different species. I understand the session will be audio-recorded and will require approximately one hour of my time.

I understand that participation in this study is entirely voluntary and that I can withdraw from the study at any time up until the point of submitting the final questionnaire, without giving a reason.

I understand that the research information provided by me will be held totally anonymously, so that it is impossible to trace this information back to me individually. I understand that this information will be held for 7 years, and it may be published. I understand that I am free to ask any questions at any time. I am free to withdraw or discuss my concerns with the researcher, Marc Williams (williamsm93@cardiff.ac.uk), or the supervisors, Prof. Lorraine Whitmarsh (***REDACTED***) and Prof. Diarmait Mac Giolla Chríost (***REDACTED***). I understand that at the end of the study I will be provided with additional information and feedback about the purpose of the study.

I understand that I must be 18 years or above, and resident in the UK, to take part in this study. I consent to participate in the study conducted by Marc Williams, School of Psychology, Cardiff University, under the supervision of Profs. Lorraine Whitmarsh and Diarmait Mac Giolla Chríost.

Please tick one box:-

□ Yes, I consent to participate

□ No, I do not consent to participate

Signature:

Date:

Privacy Notice: The information provided on the consent form will be held in compliance with GDPR regulations. Cardiff University is the data controller and (***REDACTED***) is the data protection officer (***REDACTED***). This information is being collected by Marc Williams. This information will be held securely and separately from the research information you provide. Only the researcher will have access to this form and it will be destroyed after 7 years. The lawful basis for processing this information is public interest.

Demographics

Please provide your age:

What is your gender:

- Man (including trans man)
- Woman (including trans woman)
- Non-binary
- Other
- Prefer not to say

2. Chapter 6 Study

Understanding Environmental Attitudes and Behaviours

Study information

Thank you for considering taking part in this study. This is a study looking at people's environmental attitudes and behaviours, including how people feel about nature and the environment, people's thoughts about conservation measures, how people feel about and respond to other people, as well as levels of loneliness. In total there are 10 questionnaires to complete, which should normally take approximately 17 minutes to complete. We are only looking to collect data from adults (18+ years of age) and people residing in the UK.

Privacy Notice: The information provided on the consent form will be held in compliance with GDPR regulations. Cardiff University is the data controller and (***REDACTED***) is the data protection officer (***REDACTED***). This information is being collected by Marc Williams. This information will be held securely and separately from the research information you provide. Only the researcher will have access to this form and it will be destroyed after 7 years. The lawful basis for processing this information is public interest.

Consent form

I understand that my participation in this project will involve completing 10 questionnaires which ask about environmental attitudes, values, and behaviours, ways of thinking, and experiences of loneliness, which will require approximately 17 minutes of my time. I understand that participation in this study is entirely voluntary and that I can withdraw from the study at any time up until the point of submitting the final questionnaire, without giving a reason.
I understand that the research information provided by me will be held totally anonymously, so that it is impossible to trace this information back to me individually. I understand that this information will be held for 7 years, and it may be published. I understand that I am free to ask any questions at any time. I am free to withdraw or discuss my concerns with the researcher, Marc Williams (williamsm93@cardiff.ac.uk), or the supervisor, Prof. Lorraine Whitmarsh (***REDACTED***). I understand that at the end of the study I will be provided with additional information and feedback about the purpose of the study.
I understand that I must be 18 years or above, and resident in the UK, to take part in this study. I

consent to participate in the study conducted by Marc Williams, School of Psychology, Cardiff University, under the the supervision of Profs. Lorraine Whitmarsh and Diarmait Mac Giolla Chríost.

Please tick one box:-

- ○ Yes, I consent to participate
- ○ No, I do not consent to participate

Demographics

Please provide your age:

What is your gender:

- Man (including trans man)
- Woman (including trans woman)
- Other
- Prefer not to say

Please provide your age by draggling the slider, below:-

	0	120
Age		

3. Chapter 7 Study

Understanding Pro-Environmental and Pro-Nature Behaviour

Thank you for considering taking part in this study. This is a study looking at people's attitudes, beliefs, and values toward nature and non-human species, and their thoughts and feelings about human activities that could be harming nature and non-human species. "Non-human species" refers to the animals, plants, and other living things on Earth other than humans.

The study is also looking at people's behaviours toward nature and the environment, how they feel about climate change, and how they manage their emotions. In total there are 13 questionnaires to complete, which should normally take approximately 20 minutes. We are only looking to collect data from adults (18+ years of age).

Privacy Notice: The information provided on the consent form will be held in compliance with GDPR regulations. Cardiff University is the data controller and (***REDACTED***) is the data protection officer (***REDACTED***). This information is being collected by Marc Williams. This information will be held securely and separately from the research information you provide. Only the researcher will have access to this form and it will be destroyed after 7 years. The lawful basis for processing this information is and public interest.

I understand that my participation in this project will involve completing 13 questionnaires which ask about environmental attitudes, beliefs, and values toward nature and non-human species and thoughts and feelings about human activities that could be harming nature and non-human species. I understand that questions will also ask about behaviours toward nature and the environment, how I feel about climate change and how I manage my emotions. I understand that participation in this study is entirely voluntary and that I can withdraw from the study at any time up until the point of submitting the final questionnaire, without giving a reason.
I understand that the research information provided by me will be held totally anonymously, so that it is impossible to trace this information back to me individually. I understand that this information will be held for 7 years, and it may be published. I understand that I am free to ask any questions at any time. I am free to withdraw or discuss my concerns with the researcher, Marc Williams (williamsm93@cardiff.ac.uk), or the main supervisor, Prof. Geoff Haddock (***REDACTED***). I understand that at the end of the study I will be provided with additional information and feedback about the purpose of the study.
I understand that I must be 18 years or above to take part in this study. I consent to participate in

the study conducted by Marc Williams, School of Psychology, Cardiff University, under the supervision of Profs. Geoff Haddock, Lorraine Whitmarsh, and Diarmait Mac Giolla Chríost.

○ Yes, I consent to participate

○ No, I do not consent to participate

Privacy Notice: The information provided on the consent form will be held in compliance with GDPR regulations. Cardiff University is the data controller and (***REDACTED***) is the data protection officer (***REDACTED***).

This information is being collected by Marc Williams. This information will be held securely and separately from the research information you provide.

Only the researcher will have access to this form and it will be destroyed after 7 years. The lawful basis for processing this information is public interest.

Demographics

Please provide your age:

What is your gender:

- Man (including trans man)
- Woman (including trans woman)
- Non-binary
- Other
- Prefer not to say

Please provide your age by draggling the slider, below:-

0 120

Age	

Are you an undergraduate or Master's student?

○ Undergraduate

- ○ Master's
- ○ Other

Gender What is your gender?

- ○ Man (including trans man)
- ○ Woman (including trans woman)
- ○ Non-binary
- ○ Other
- ○ Prefer not to say

Ethnicity What is your ethnic group?

- ○ Asian or Asian British (Includes any Asian background, for example, Bangladeshi, Chinese, Indian, Pakistani)
- ○ Black, African, Black British or Caribbean (Includes any Black background)
- ○ Mixed or multiple ethnic groups (Includes any Mixed background)
- ○ White (Includes any White background)
- ○ Another ethnic group (Includes any other ethnic group, for example, Arab)
- ○ I would prefer to describe in my own words

Prefer not to say

If What is your ethnic group? = Asian or Asian British (Includes any Asian background, for example, Bangladeshi, Chinese, Indian, Pakistani)

Which one best describes your Asian or Asian British background?

- ○ Bangladeshi
- ○ Chinese
- ○ Indian
- ○ Pakistani
- ○ Another Asian background
- ○ Prefer not to say

Display This Question:

If What is your ethnic group? = Black, African, Black British or Caribbean (Includes any Black background)

Which one best describes your Black, African, Black British or Caribbean background?

- ○ African
- ○ Caribbean
- ○ Another Black background
- ○ Prefer not to say

Display This Question:

If What is your ethnic group? = Mixed or multiple ethnic groups (Includes any Mixed background)

Which one best describes your Mixed or Multiple ethnic groups background?

- ○ Asian and White
- ○ Black African and White
- ○ Black Caribbean and White
- ○ Another Mixed background
- ○ Prefer not to say

Display This Question:

If What is your ethnic group? = White (Includes any White background)

Which one best describes your White background?

- ○ British, Welsh, English, Northern Irish, Scottish
- ○ Irish
- ○ Irish Traveller or Gypsy
- ○ Another White background
- ○ Prefer not to say

Display This Question:

If What is your ethnic group? = Another ethnic group (Includes any other ethnic group, for example, Arab)

Which one best describes your background?

- ○ Arab
- ○ Another ethnic background
- ○ Prefer not to say

Display This Question:

If What is your ethnic group? = I would prefer to describe in my own words

Describe I would describe my ethnic group as follows:-

_____

What is your country of residence outside of university term-time?

▼ Afghanistan (1) ... Zimbabwe (195)

Appendix E: Names of Species Shown to Participants During the Card Sort Task

Bacterium	Venus flytrap	Mushroom
Ant	Daffodil	Spider
Butterfly	Ivy	Tree
Bee	Lobster	Jellyfish
Chimpanzee	Monkey	Worm

Squirrel	Meerkat	Dog
Pig	Dolphin	Whale
Parrot	Crow	Frog
Seagull	Pheasant	Salamander

Snake Lizard Goldfish

Salmon Amoeba

Appendix F: Example of Open, Axial, and Selective Coding of an Interview Transcript (*Chapter 5*)

Table 1. Excerpt from grounded theory interview transcript, and corresponding codes.

Excerpt from transcript	Open codes	Axial codes	Selective code
"So that is more than a governmental responsibility, it is a personal responsibility as well, so thinking about small changes we can do and thinking about uh about how we can be healthy, how we can you know reduce the amount of waste we produce, we have actually downsized…. Now we just have one small fridge and a freezer, so we just buy this stuff that we can definitely consume, we don't want to waste anything at all, so use it or otherwise we can …keep in the fridge and use the other day…likewise with packaging and stuff, as much as possible we try to recycle, so it doesn't go into landfill or whatever…so as much as possible trying to recycle, not to waste, segregate packaging cartons whatever that you get, put it in separate places…yeah yeah so…it bothers me, and technically, I want to leave the planet in a shape where it's probably better than what I got, so for the next generation it should probably be significantly better, if not at least be in a shape that you had it…I can definitely recall in (Asian country) *where I grew up, you used to see so many sparrows, so many of them in the city, the villages, whatever, they used to see migratory birds coming in, wintertime, and that was pretty wonderful comparisons, it was quite warm…squirrels, there was so many of them in our area, and*	Personal responsibility Making small changes Reducing waste Making sustained changes Minimising waste Finding new solutions Avoiding landfill Recycling Being bothered Sense of personal mission Thinking of future generations Recalling previous experience Prior experience of species Positive experience of nature Prior experience of species	<u>Sustained behaviour</u> Condition: internalised moral standards <u>Experiencing moral concern</u> Condition: awareness that	**Moral concern**

that is gone nowadays, we have a concrete jungle, uh, and all that we see are pigeons they are everywhere, they are treated like a pest by people, who shoo them away and whatever, but I can see the uh changes that have happened, and here in (UK city) *as well, you can see the foxes, right, foxes are literally gone, there are very few of them, and I remember seeing a picture of a fox…at the garbage dump, so their habitat has been taken over by humans…it's built up …so another tragic case of fox getting run over so pretty bad, pretty bad situation, number of species that are extinct, that are likely to becomes extinct. We used to have the uh turtles, in* (Asian country) *and used to be part of the culture but we go to the beach we see the turtles there, they usually come in for nesting, but these days there's so little, you really need to search and search just to find the turtles there…"*	Concern about species decline Concern about treatment of species Aware of changes in nature Concern about species decline Previous experience of nature Aware of humans affecting habitats Painful memories human impacts Concern about species extinction Cultural aspects of nature Concern about decline of species	humans are causing harm to nature	

Appendix G: Examples of Memos (Written After Interviewing *Participant 17*)

4th November, 2020

There's the idea of the moral default again, only killing when "needed" otherwise there's no point. Is this based on empathic response or something more rule-based? Maybe perspective-taking isn't enough/isn't important. He said that tigers' feelings don't influence how he sees them, he wants to preserve them because they're nice to look at. And doesn't see any role for himself in acting – he's only concerned about others' harmful actions. Whereas other participant goes out of her way to sponsor leopards – what's the difference? She talks about her responsibility for doing this...moral responsibility?

The moral baseline is the basic view of oneself that must not be threatened and actually reminds me of something lots of other participants have said but I hadn't thought about much til now: I leave species alone, live and let live...I don't harm unless it's required e.g., meat for eating. Is this how identity comes in – a kind of moral identity? Falling short of values is a threat to self-esteem (think of that participant who talked about engaging in pro-nature behaviour because it's a self-esteem boost...). And possibly others' esteem... Rosenberg's theory of self-esteem: shortfall between how you would ideally be and how you see yourself (/how others see you...?) Making the right choice. The moral default allows for a balancing of self-esteem: I am ok as long as I'm not harming anything.

5th November, 2020

Looked through previous interviews...now I think morality does fit more than empathy. Some participants are describing a norm, which is "feeling a 'moral obligation to perform or refrain from specific actions'" (Schwartz & Howard, 1981). This norm was very similar between people: leave species alone. Reminds me of foundational norm of Jonathan Haidt's work (harm/care) - we shouldn't harm anything unless it's justified. The only difference between abattoir workers and the pro-nature people was the question of what was justified, hinging on whether animals were seen as there for us to use as tools or similar to us in terms of their rights. Some people go beyond this though and think it's their responsibility to actively do something, not just to avoid causing harm.

Appendix H: Results of Exploratory Factor Analyses

1. Pro-Environmental Behaviours Scale (Whitmarsh et al., 2017) (Chapter 6 data)

Kaiser's criterion suggested two factors, the scree plot suggested three, and a parallel factor analysis suggested four. The EFA was run with all suggested factor solutions. The four-factor solution required removal of five items and explained .45 of the variance; however, it yielded one factor with two items that were not interpretable as a factor and this solution was therefore rejected. The two-factor solution required the removal of one cross-loaded item, which led to another item to drop below .32 loading, but then after this item was removed, all items loaded onto a factor with no cross-loadings; this model accounted for .37 of the variance. The three-factor solution was chosen. This required the removal of two items (item 12 loaded insufficiently onto any factor, and 16 still cross-loaded significantly once 12 was removed), yielding a stable factor solution accounting for .40 of the variance. These three factors were deemed interpretable and were labelled resource-conservation behaviours, consumption behaviours, and high-cost behaviours (see Table 1). These factors are in keeping with the findings of Whitmarsh et al. (2017).

Table 1: Factor Loadings of Items in the Pro-Environmental Behaviours Scale.

	Pro-environmental behaviour		
Item	Resource-conservation	Consumption	High-cost
1. Turned off lights when not in use	*0.44*	0.04	-.13
2. Avoided littering (throwing rubbish on the street)	*0.45*	-0.01	-.07
3. Recycled household waste (e.g. glass)	*0.45*	0.03	.04
4. Turned off the tap when brushing teeth	*0.36*	0.17	.00
5. Avoided wasting food (e.g. by using leftovers)	*0.62*	0.08	.03
6. Taken short showers (less than 3 minutes long) or infrequent baths	*0.46*	0.09	.17
7. Bought products with less packaging	0.31	*0.51*	-.01
8. Eaten organic, locally-grown or in season food	0.15	*0.51*	-.01
9. Bought environmentally-friendly products	0.13	*0.69*	-.04
10. Encouraged other people to save energy	0.18	*0.44*	.06
11. Avoided buying new things (e.g. clothes, luxury items)	0.09	*0.45*	.01

12. Fitted energy-saving lightbulbs at home	0.17	0.19	.13
13. Avoided eating meat	0.07	*0.53*	-.04
14. Found out more about environmental issues (e.g. learning more about climate change)	-0.02	*0.76*	-.04
15. Signed a petition about an environmental issue	-0.19	*0.58*	.18
16. Donated money to an environmental campaign group	-0.09	*0.38*	*.47*
17. Done something together with neighbours, people at work or friends to address an environmental issue	-0.03	0.24	*.56*
18. Offered support (e.g. by voting) for political action to protect the environment	-0.11	0.31	*.46*
19. Got involved in conservation work to protect natural environments (e.g. national parks, coastline)	-0.03	0.12	*.66*
20. Set up a recycling scheme at work, college or elsewhere	0.08	-0.03	*.71*
21. Written to a politician about an environmental issue	-0.04	-0.05	*.85*
22. Took part in a protest about an environmental issue	0.04	-0.1	*.91*
Eigenvalues[a]	1.64	3.17	3.22
% of variance[a]	8	16	16
Cronbach's α[a]	.58	.81	.84

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Grey rows are items that were removed from the measure. Items are colour-coded to show which ones were retained in analyses involving each factor: orange items = resource-conservation behaviours; blue items = consumption behaviours; red items = high-cost behaviours.

[a]After removing items.

2. Interpersonal Reactivity Index (Davis, 1980) (Chapter 6 data)

The scree plot suggested a three-factor solution, Kaiser's criterion suggested a four-factor solution, and a parallel factor analysis suggested a five-factor solution. Three separate EFAs were conducted for the three-factor solutions. The five-factor solution yielded a factor matrix with 11 cross-loaded items. After items were deleted to reach a stable factor structure, the factors were not interpretable. The four-factor solution yielded a factor matrix that necessitated deleting six cross-loading items and one item that did not load at all, and the items did not load according to what would be expected, e.g., items from the empathic concern scale appeared across multiple factors. The three-factor solution was retained: items were removed one by one (six items removed in total: two non-loading, four cross-loading) and the EFA was re-run, until a stable pattern of loadings was reached. Item inspection and referring to the items corresponding to the subdomains in the original *Interpersonal Reactivity Index* (IRI) led to the labelling of the three factors as Empathy (11 items; a combination of items from EC and PT subscales in the original IRI), Fantasy (five items), and Personal Distress (six items) (see Table 1). This factor solution accounted for .43 of the variance.

Table 1: Factor Loadings of Items in the Interpersonal Reactivity Index.

Item	Empathy	Personal distress	Fantasy
1. I daydream and fantasise, with some regularity, about things that might happen to me	-.08	.19	*.45*
2. I often have tender, concerned feelings for people less fortunate than me	*.60*	.06	.16
3. I sometimes find it difficult to see things from the "other person's" point of view	*.57*	-.23	.01
4. Sometimes I don't feel sorry for other people when they are having problems	*.72*	.00	-.16
5. I really get involved with the feelings of the characters in a novel	.18	.04	*.57*
6. In emergency situations, I feel apprehensive and ill-at-ease	.07	*.64*	.02
7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it	.24	.09	.18
8. I try to look at everybody's side of a disagreement before I make a decision	*.34*	-.29	.21
9. When I see someone being taken advantage of, I feel kind of protective toward them	*.47*	-.03	.21
10. I sometimes feel helpless when I am in the middle of a very emotional situation	.01	*.54*	.14
11. I sometimes try to understand my friends better by imagining how things look from their perspective	*.50*	-.08	*.32*

12. Becoming extremely involved in a good book or movie is somewhat rare for me	.18	-.01	.19
13. When I see someone get hurt, I tend to remain calm	*.36*	*.48*	-.07
14. Other people's misfortunes do not usually disturb me a great deal	*.80*	.13	-.10
15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments	*.42*	-.15	-.06
16. After seeing a play or movie, I have felt as though I were one of the characters	-.11	.06	*.75*
17. Being in a tense emotional situation scares me	-.01	*.61*	.12
18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them	*.62*	-.04	-.07
19. I am usually pretty effective in dealing with emergencies	.03	*.70*	-.15
20. I am often quite touched by things that I see happen	*.54*	.07	.27[b]
21. I believe that there are two sides to every question and try to look at them both	*.39*	-.27	.21
22. I would describe myself as a pretty soft-hearted person	*.46*	.21	.18
23. When I watch a good movie, I can very easily put myself in the place of a leading character	.02	.01	*.82*
24. I tend to lose control during emergencies	-.05	*.74*	.08
25. When I'm upset at someone, I usually try to "put myself in their shoes" for a while	*.40*	-.14	*.32*
26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me	.06	.05	*.74*
27. When I see someone who badly needs help in an emergency, I go to pieces	-.06	*.62*	.12
28. Before criticising somebody, I try to imagine how I would feel if I were in their place	*.48*	-.13	.24
Eigenvalues[a]	3.61	2.95	2.80
% of variance[a]	16	13	13
Cronbach's α[a]	.84	.82	.82

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Grey rows are items that were removed from the measure. Red items ("Empathy" factor) were used in analyses.

[a]After removing items.

[b]Item cross-loaded once other items were removed.

3. Dispositional Empathy Toward Nature Scale (Tam 2013) (Chapter 6 data)

Kaiser's criterion and a scree plot suggested a one factor solution, and a parallel factor analysis suggested there were three factors. The EFA was run with both factor solutions. The one-factor solution was chosen as it was deemed the cleaner solution as it rendered a factor in which all items loaded > 0.32 and explained .70 of the variance in the factor (see Table 1). Although the three-factor solution explained more of the variance (0.82), two of the factors only included two items. The one factor solution was also more interpretable and theoretically consistent with the *Dispositional Empathy Toward Nature Scale* as a measure of empathy as a unified construct (Tam, 2013), and the three-factor solution was less interpretable.

Table 1: Factor Loadings of Items in the Dispositional Empathy Toward Nature Scale..

Item	Empathy toward nature
1. I imagine how I would feel if I were the suffering animals and plants	*.85*
2. I get involved with the feelings of the suffering animals and plants	*.89*
3. I feel as though I were one of the suffering animals and plants	*.89*
4. I can very easily put myself in the place of the suffering animals and plants	*.90*
5. I try to understand how the suffering animals and plants feel by imagining how things look from their perspective	*.88*
6. I visualise in my mind clearly and vividly how the suffering animals and plants feel in their situation	*.90*
7. I have tender, concerned feelings for the suffering animals and plants	*.73*
8. I feel what the suffering animals and plants are feeling	*.84*
9. I feel the pain the suffering animals and plants are experiencing	*.83*
10. I feel sympathetic toward the suffering animals and plants	*.60*
Eigenvalue	6.96
% of variance	70
Cronbach's α	.96

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Red items were used in analyses.

4. Connectedness to Nature Scale (Mayer & Frantz, 2004) (Chapter 6 data)

Kaiser's criterion and a scree plot suggested a one factor solution and a parallel factor analysis suggested there were three factors. The three-factor solution explained .49 of the variance but one factor had only two items loading onto it. Another factor had four items loading onto it, but two of these were substantially cross-loaded with another factor. The three-factor solution was not theoretically interpretable. The one-factor solution was chosen as it was deemed a cleaner solution: all items loaded significantly onto the factor (> 0.32), except for items 12 and 14 (see Table 1). These were removed, and the factor analysis re-run. All retained factors loaded substantially onto the factor (> 0.32) with no substantial cross-loadings. This factor explained a proportion of .45 of the variance. This solution was also consistent with the findings of Mayer and Frantz (2004) and the theory of connectedness to nature as a unitary construct.

Table 1: Factor Loadings of Items in the Connectedness to Nature Scale.

Item	Connectedness to nature
1. I often feel a sense of oneness with the natural world around me	*.75*
2. I think of the natural world as a community to which I belong	*.84*
3. I recognize and appreciate the intelligence of other living organisms	*.55*
4. I often feel disconnected from nature	*.54*
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living	*.59*
6. I often feel a kinship with animals and plants	*.68*
7. I feel as though I belong to the Earth as equally as it belongs to me	*.74*
8. I have a deep understanding of how my actions affect the natural world	*.62*
9. I often feel part of the web of life	*.77*
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'	*.62*
11. Like a tree can be part of a forest, I feel embedded within the broader natural world	*.83*
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature	-.14
13. 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	*.34*
14. My personal welfare is independent of the welfare of the natural world	.10
Eigenvalue[a]	5.38
% of variance[a]	.45
Cronbach's α[a]	.90

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Grey rows are items that were removed from the measure. Red items used in analyses.

[a]After removing items.

5. Intrinsic Value Beliefs Scale (Chapter 6 data)

The following items were chosen to represent intrinsic value beliefs: item 7 from the *New Ecological Paradigm Scale* (Dunlap et al., 2000) ("Plants and animals have as much right as humans to exist"); items 6 and 11 in the *Environmental Attitudes Questionnaire* (adapted from Rauwald & Moore, 2002) (respectively: "All life in nature has a right to exist"; "A dog trained for a task, like a hunting dog (or a dog to protect the house), is generally a better dog than one owned just as a pet"). Item 11 reflects instrumental value, and was reverse-scored before inclusion in the EFA. These items were chosen as instrumental and intrinsic value are considered conceptual opposites (O'Neill, 2001[16]), so were seen as potentially two ends of a continuum (one factor). Kaiser's criterion, a scree plot, and a parallel factor analysis all suggested one factor. An EFA was run with the 1-factor solution. All items loaded at > .32 but one had a communality below .2 (the instrumental value item). This item was removed, and the remaining 2 items yielded a stable structure explaining .51 of the variance (see Table 1). The two items reflected the concept of other species' "right to exist".

Table 1: Factor Loadings of Items Reflecting Intrinsic and Instrumental Value Beliefs.

Item	Intrinsic value beliefs
1. Plants and animals have as much right as humans to exist	*.71*
2. All life in nature has a right to exist	*.71*
3. A dog trained for a task, like a hunting dog (or a dog to protect the house), is generally a better dog than one owned just as a pet	*.36*
Eigenvalue[a]	1.02
% of variance[a]	.51
Cronbach's α[a]	.59

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. The item in grey was removed from the measure. Red items were used in analyses.

[a]After removing one item.

[16]O'Neill, J. (2001). Meta-ethics. In D. Jamieson (Ed.), *A companion to environmental philosophy* (pp. 163-176). Blackwell Publishers Ltd.

6. Value Orientations Scale (De Groot & Steg, 2008) (Chapter 6 data)

The scree plot and parallel factor analysis methods suggested a three-factor solution and applying Kaiser's criterion suggested a two-factor solution. Two separate EFAs were conducted for the factor solutions. The two-factor solution yielded a stable structure, with a total variance of .55 explained. The first factor (variance .38) corresponded to the altruistic and biospheric items, and the second (variance .17) corresponded to the egoistic items. The two factors did not correlate highly with each other (-.09). The three factor solution yielded a stable structure, with a total variance of .65 explained. Correlations between items and their assigned factors were, on average, higher in the three-factor solution than the two-factor solution, and the former was also theoretically consistent with the 3 proposed underlying factors in the measure. As such, the three-factor solution was chosen (see Table 1).

Table 1: Factor Loadings of Items in the Value Orientations Scale.

Item	Egoistic	Altruistic	Biospheric
1. Social power: control over others, dominance	*.70*	-.11	-.04
2. Wealth: material possessions, money	*.50*	.04	-.17
3. Authority: the right to lead or command	*.91*	-.03	.04
4. Influential: having an impact on people and events	*.66*	.20	.01
5. Equality: equal opportunity for all	-.01	*.77*	-.08
6. A world at peace: free of war and conflict	-.04	*.70*	.06
7. Social justice: correcting injustice, care for the weak	.00	*.90*	.00
8. Helpful: working for the welfare of others	.02	*.66*	.18
9. Preventing pollution: protecting natural resources	.00	.09	*.82*
10. Respecting the earth: harmony with other species	-.02	-.02	*.96*
11. Unity with nature: fitting into nature	.03	-.06	*.90*
12. Protecting the environment: preserving nature	-.01	.05	*.88*
Eigenvalues	3.32	2.49	2.01
% of variance	.28	.48	.65
Cronbach's α	.78	.86	.94

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Red items ("Biospheric" factor) were used in analyses.

7. New Ecological Paradigm (Dunlap et al., 2000) (Chapter 6 data)

A parallel factor analysis suggested five factors whereas the scree plot and Kaiser's criterion both suggested one. An EFA was run with both solutions. For the five-factor solution, three of the factors had two or fewer items each and were not interpretable. The one-factor solution was chosen. All items loaded sufficiently but three had communality values < .20. These three items were removed (items 1, 6, and 9). This yielded a stable structure of items explaining .35 of the variance (see Table 1).

Table 1: Factor Loadings of Items in the New Ecological Paradigm.

Item	Environmental worldview
1. We are approaching the limit of the number of people the earth can support	*.43*
2. Humans have the right to modify the natural environment to suit their needs	*.52*
3. When humans interfere with nature it often produces disastrous consequences	*.64*
4. Human ingenuity will ensure that we do NOT make the earth unlivable	*.50*
5. Humans are severely abusing the environment	*.68*
6. The earth has plenty of natural resources if we just learn how to develop them	*.37*
7. Plants and animals have as much right as humans to exist	*.46*
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations	*.69*
9. Despite our special abilities humans are still subject to the laws of nature	*.33*
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated	*.73*
11. The earth is like a spaceship with very limited room and resources	*.53*
12. Humans were meant to rule over the rest of nature	*.47*
13. The balance of nature is very delicate and easily upset	*.55*
14. Humans will eventually learn enough about how nature works to be able to control it	*.48*
15. If things continue on their present course, we will soon experience a major ecological catastrophe	*.76*
Eigenvalue[a]	4.23
% of variance[a]	.35
Cronbach's α[a]	.86

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Grey rows are items that were removed from the measure. Red items were used in analyses.

[a]After removing items.

8 Pro-Nature Behaviours Scale (Barbett et al., 2020) (Chapter 7 data)

A parallel factor analysis suggested 3 factors, as did Kaiser's criterion, whereas the scree plot indicated 4 factors. The 3-factor solution required deleting 4 items, whereas 2 items needed to be deleted from the 4-factor solution. Both had the same three factors (high-cost, doing-for-wildlife, and personal behaviours), and the 4-factor solution had an additional factor consisting of avoiding-for-wildlife behaviours (the items for which were all deleted in the 3-factor solution due to cross-loadings). The 4-factor solution was retained as the 4 factors made conceptual sense and retained more of the items (see Table 1).

Table 1: Factor Loadings of Items in the Pro-Nature Behaviours Scale.

	Pro-nature behaviour			
Item	High-cost	Doing-for-wildlife	Personal	Avoiding-for-wildlife
1. I attend local council/local authority meetings about nature conservation issues	*.82*	.02	.09	-.05
2. When I see litter, I pick it up	*.42*	-.15	-.18	*.56*
3. I get in touch with local authorities on nature conservation issues	*.81*	.16	.07	-.02
4. I vote for nature or wildlife conservation-friendly legislation in local or national referendums/votes/etc.	.14	-.05	*.93*	-.01
5. I vote for parties/candidates with strong pro-nature conservation policies in elections	-.03	.03	*.84*	.06
6. I plant pollinator-friendly plants	.04	*.85*	.08	-.05
7. I plant plants with different flowering seasons	-.04	*.88*	.00	-.02
8. I plant native plants	.03	*.92*	-.05	.03
9. I maintain plants with berries/fruits	.21	*.68*	-.13	.11
10. I volunteer with a conservation organisation in habitat management work	*.81*	.02	.10	-.06
11. I volunteer with a conservation organisation in another area not mentioned above (e.g., fundraising, education, etc.)	*.83*	.03	.00	-.01
12. I participate in organised clean-up events	*.60*	-.02	-.01	.15
13. I sign petitions supporting nature conservation efforts	.16	.00	*.54*	.13
14. I leave an undisturbed/unmaintained area for wildlife	-.12	.29	.29	*.38*

15. I avoid cutting/trimming hedges during bird breeding season (March–July)	-.18	.12	.25	*.60*
16. I avoid using insecticides	-.19	.08	.27	*.64*
17. I add log piles or other materials that can be used as a home/shelter by wildlife	.15	*.33*	-.03	*.41*
18. I provide food for wild animals, such as birds	.06	.25[b]	-.04	*.44*[c]
Eigenvalues[a]	1.95	3.19	2.17	3.36
% of variance[a]	12	20	14	21
Cronbach's α[a]	.89	.86	.85	.82

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Grey rows are items that were removed from the measure. Items are colour-coded to show which ones were retained in analyses involving each factor: red items = high-cost behaviours; blue items = doing-for-wildlife behaviours; orange items = personal behaviours; purple items = avoiding-for-wildlife behaviours.

[a]After removing items.

[b]Item's factor loading exceeded .32 after removing items 2 and 17.

[c]Item's factor loading dropped below .32 after removing items 2 and 17.

9. Individual Differences in Anthropomorphism Questionnaire (Waytz et al., 2010) (Chapter 7 data)

The scree plot and parallel factor analysis methods suggested a three-factor solution and applying Kaiser's criterion suggested a two-factor solution. Two separate EFAs were conducted for the factor solutions, and both included a factor with items pertaining to animals. The other factor for the 2-factor solution contained all non-animals (including technology and trees). In the 3-factor solution, items pertaining to technology were divided between the two remaining factors, and one of the factors contained items pertaining to nature. The 2-factor solution was chosen as the factors were more interpretable (see Table 1). Only the factor containing items pertaining to animals was retained for further analyses, and the factor containing a mixture of technology/nature was not included in further analyses. The 2-factor solution yielded a stable structure (after removing items 11 and 13 due to cross-loading), with a total variance of .56 explained. The first factor (variance .33) corresponded to the animal items, and the second (variance .24) corresponded to the technology/nature items.

Table 1: Factor Loadings of Items in the Individual Differences in Anthropomorphism Questionnaire.

Item	Technology/ Nature	Animals
1. To what extent does technology—devices and machines for manufacturing, entertainment, and productive processes (e.g., cars, computers, television sets)—have intentions?	*.51*	.08
2. To what extent does the average fish have free will?	.09	*.54*
3. To what extent does the average mountain have free will?	*.72*	.11
4. To what extent does a television set experience emotions?	*.75*	-.21
5. To what extent does the average robot have consciousness?	*.74*	-.10
6. To what extent does a car have free will?	*.77*	-.21
7. To what extent does the ocean have consciousness?	*.67*	.16
8. To what extent does the average computer have a mind of its own?	*.84*	-.01
9. To what extent do cows have intentions?	-.03	*.77*
10. To what extent does a cheetah experience emotions?	-.06	*.90*
11. To what extent does the environment experience emotions?	*.57*	*.32*
12. To what extent does the average insect have a mind of its own?	.15	*.77*
13. To what extent does a tree have a mind of its own?	*.60*	*.35*
14. To what extent does the wind have intentions?	*.79*	.07
15. To what extent does the average reptile have consciousness?	-.02	*.76*
Eigenvalues[a]	4.25	3.09
% of variance[a]	.33	.24
Cronbach's α[a]	.87	.88

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Grey rows are items that were removed from the measure. Red items ("Animals" factor) were used in analyses.

[a]After removing items.

10. Awareness of Consequences (Chapter 7 data)

The scree plot, parallel factor analysis, and Kaiser's criterion all suggested a one-factor solution. The one-factor solution EFA yielded a stable structure (see Table 1).

Table 1: Factor Loadings of Items Reflecting Awareness of Consequences.

Item	Awareness of Consequences
1. The release of toxic substances into air, water, and soil	*.83*
2. Deforestation and the loss of tropical forests	*.80*
3. Climate change	*.83*
4. The spread of non-native plants and animals	*.55*
5. Hunting and poaching	*.66*
6. The pet breeding industry	*.56*
7. The large-scale meat and dairy industry	*.46*
8. Littering	*.53*
9. The use of single-use plastics	*.70*
10. The animal fur industry	*.59*
Eigenvalues	4.41
% of variance	.44
Cronbach's α	.75

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Red items were used in the main analyses (as they correspond to the "AR-Environment" items of the ascription of responsibility measure). Blue items correspond to the "AR-Animals" items.

11. Ascription of Responsibility (Chapter 7 data)

The scree plot, parallel factor analysis, and Kaiser's criterion all suggested a two-factor solution. The two-factor solution EFA yielded a stable structure (see Table 1). All items were retained.

Table 1: Factor Loadings of Items Reflecting Ascription of Responsibility.

Item	Environ-ment	Animals
1. I feel jointly responsible for deforestation and the loss of tropical forests	*.68*	.15
2. I feel jointly responsible for the spread of non-native plants and animals	.26	*.56*
3. I feel jointly responsible for the large-scale meat and dairy industry	*.73*	-.11
4. I feel jointly responsible for the animal fur industry	.00	*.74*
5. I feel jointly responsible for the release of toxic substances into air, water, and soil	*.72*	.11
6. I feel jointly responsible for the pet breeding industry	.13	*.56*
7. I feel jointly responsible for littering	.03	*.64*
8. I feel jointly responsible for climate change	*.84*	-.06
9. I feel jointly responsible for hunting and poaching	-.09	*.82*
10. I feel jointly responsible for the use of single-use plastics	*.70*	.02
Eigenvalues	2.90	2.42
% of variance	.29	.24
Cronbach's α	.82	.86

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above 0.32. Red items are those representing ascription of responsibility (AR) Environment factor ("AR-Environment") and were used in main analyses. Blue items correspond to the "AR-Animals" factor.

12. Personal Norm (Chapter 7 data)

The scree plot, parallel factor analysis, and Kaiser's criterion all suggested a one-factor solution. The one-factor solution EFA yielded a stable structure (see Table 1). All items were retained.

Table 1: Factor Loadings of Items Reflecting Personal Norm.

Item	Personal Norm
1. I feel morally obligated to do what I can to stop the pet breeding industry	*.72*
2. I would feel guilty if I were responsible for the spread of non-native plants and animals	*.71*
3. I feel a personal obligation to do whatever I can to prevent deforestation and the loss of tropical forests.	*.87*
4. I feel a personal obligation to do whatever I can to prevent climate change.	*.84*
5. If I were to litter I would feel guilty	*.48*
6. I feel a sense of personal obligation to take action to stop hunting and poaching	*.72*
7. People like me should do whatever we can to avoid using single-use plastics	*.56*
8. I feel a sense of personal obligation to do what I can to stop the disposal of toxic substances into air, water, and soil	*.76*
9. I feel obliged to bear other species in mind in my daily behaviour	*.75*
10. I feel personally obligated to take action to stop the large-scale meat and dairy industry	*.73*
11. I feel a moral obligation to do what I can to stop the animal fur industry	*.81*
Eigenvalues	5.87
% of variance	.53
Cronbach's α	.84

Note. Numbers next to items are standardised factor loadings. Numbers in italics are factor loadings above .32. Red items were used in the main analyses (as they correspond to the "AR-Environment" items of the ascription of responsibility measure). Blue items correspond to the "AR-Animals" items.

Appendix I: Prevalence of Nature Beliefs and Sustainable Behaviour in the UK

1. General Population (Chapter 6)

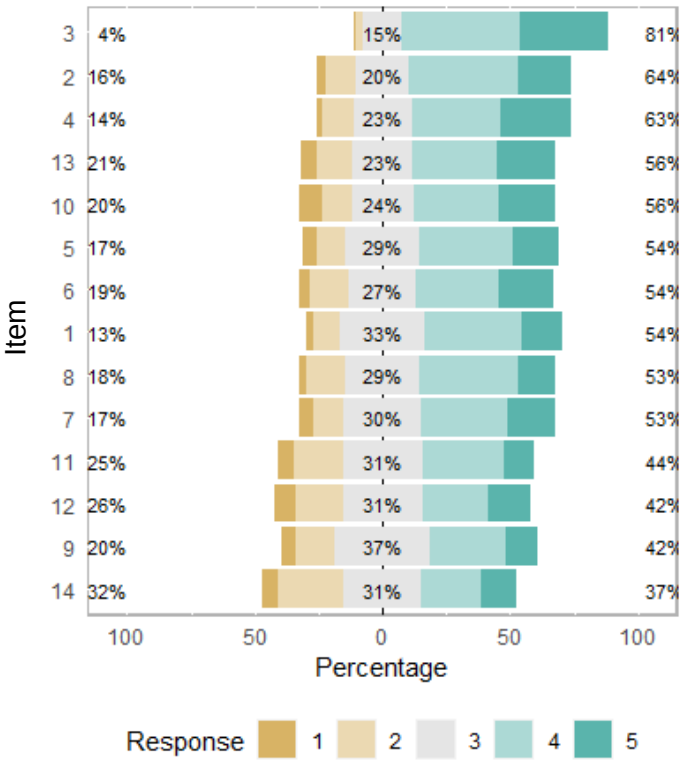
a) Connectedness to Nature & Empathy Toward Nature:

Connectedness to Nature Scale (Mayer & Frantz, 2004)

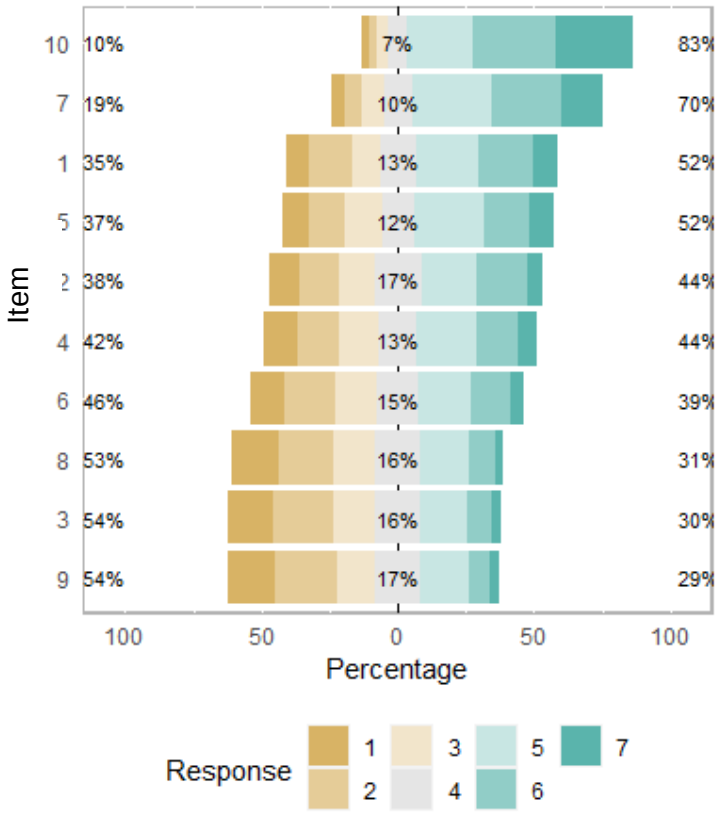
Dispositional Empathy Toward Nature Scale (Tam, 2013)

Percentage agreement with items for connectedness to nature (left) and empathy toward nature (right). Both scales have anchor points of strongly disagree (Response = 1) to strongly agree (Response = 5). Midpoint (Response = 3) is "*neither agree nor disagree*". See *Appendix H* for item wording.

Connectedness to nature



Empathy toward nature

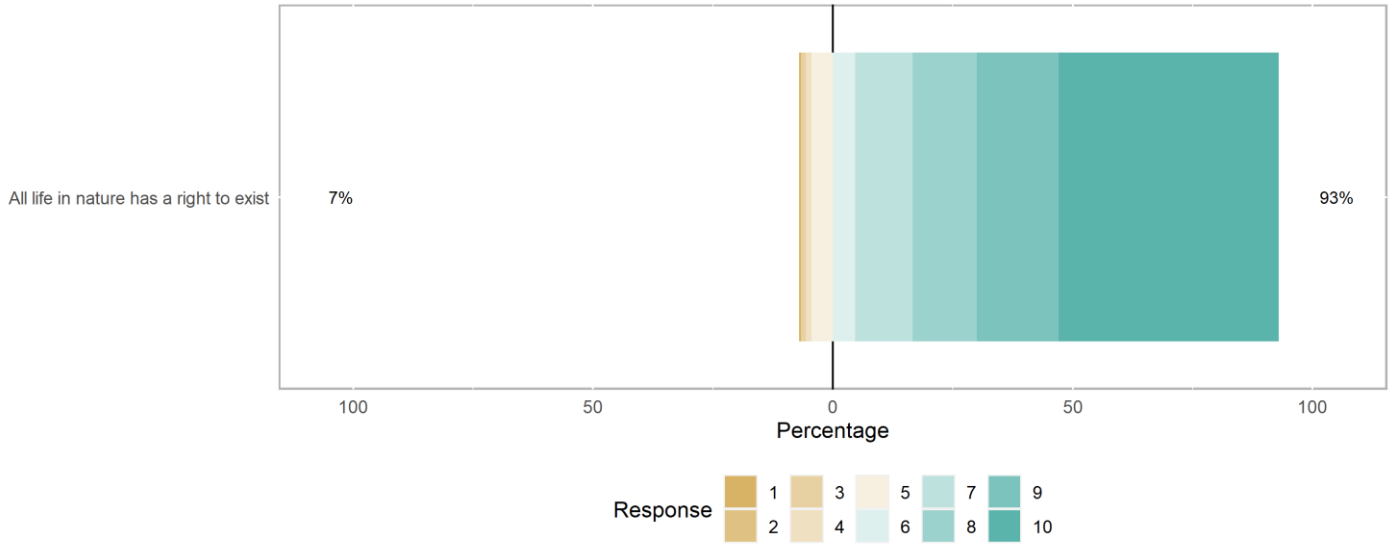


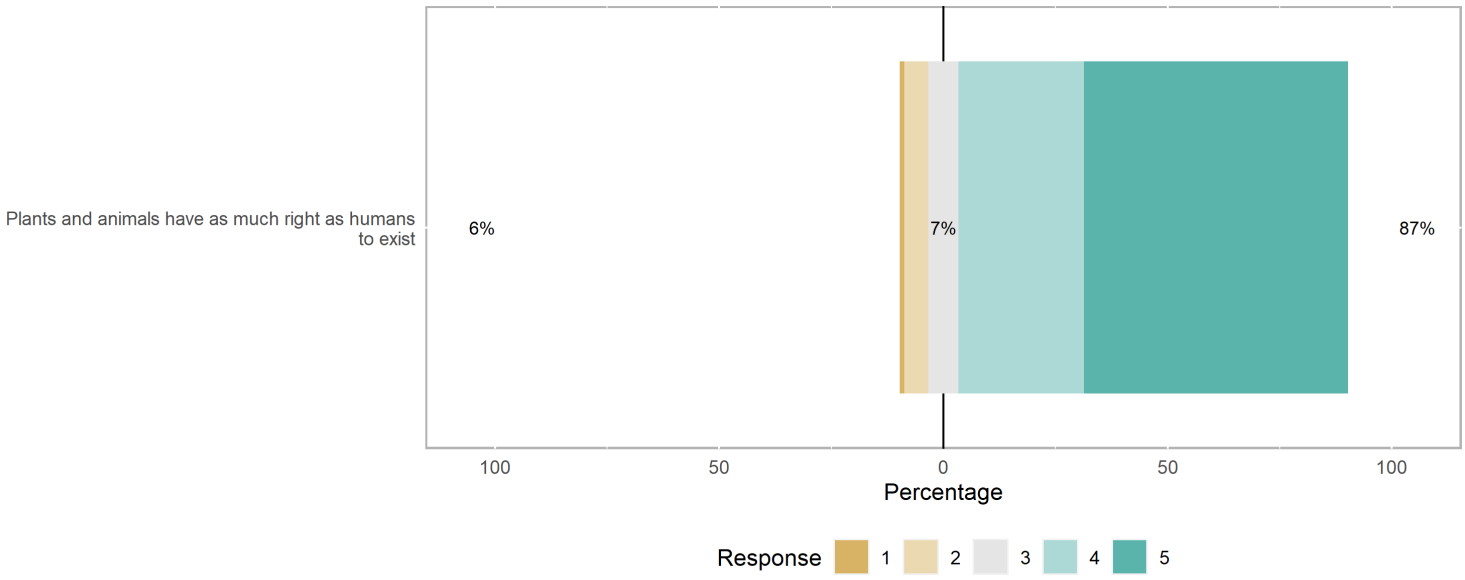
b) Intrinsic Value Beliefs:

New Ecological Paradigm Scale (Dunlap et al., 2000)

Environmental Attitudes Questionnaire (adapted from Rauwald & Moore, 2002)

Percentage agreement with two items (Y axes) reflecting intrinsic value beliefs. The top plot indicates the degree of importance (from Response = 1 [unimportant] to Response = 10 [very important]). The bottom plot has anchor points of Response = 1 (strongly disagree) to Response = 5 (strongly agree); midpoint (Response = 3) is "*unsure*".

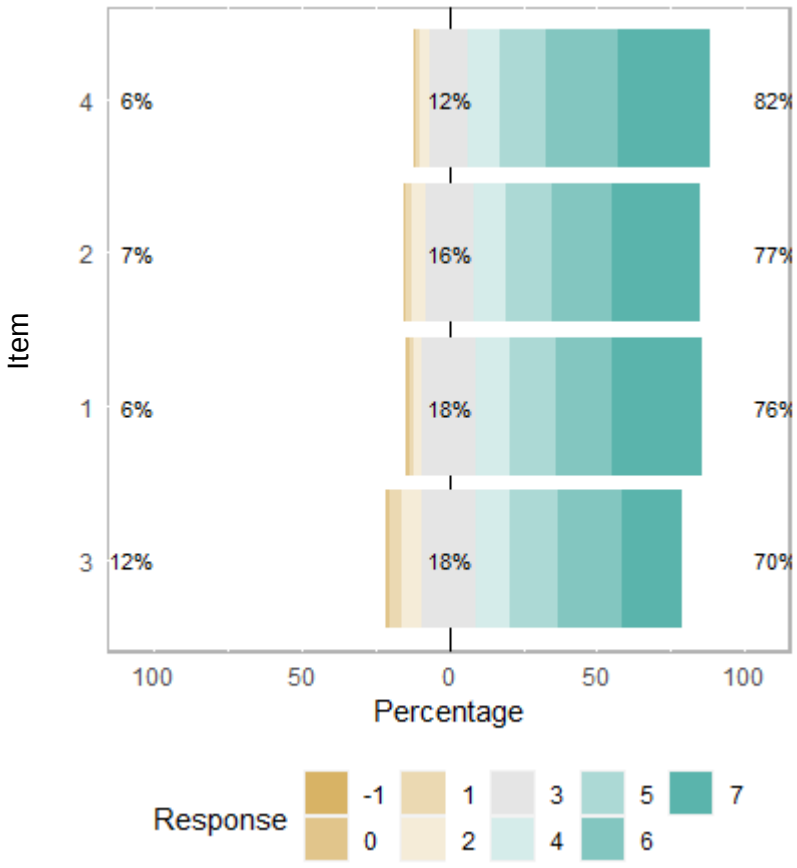




c) Biospheric Values:

Value Orientations Scale (De Groot & Steg, 2008)

Percentage agreement with items for biospheric values, from -1 (opposed to my values) to 7 (extremely important). Midpoint (Response = 3) is "*important*". See *Appendix H* for item wording.

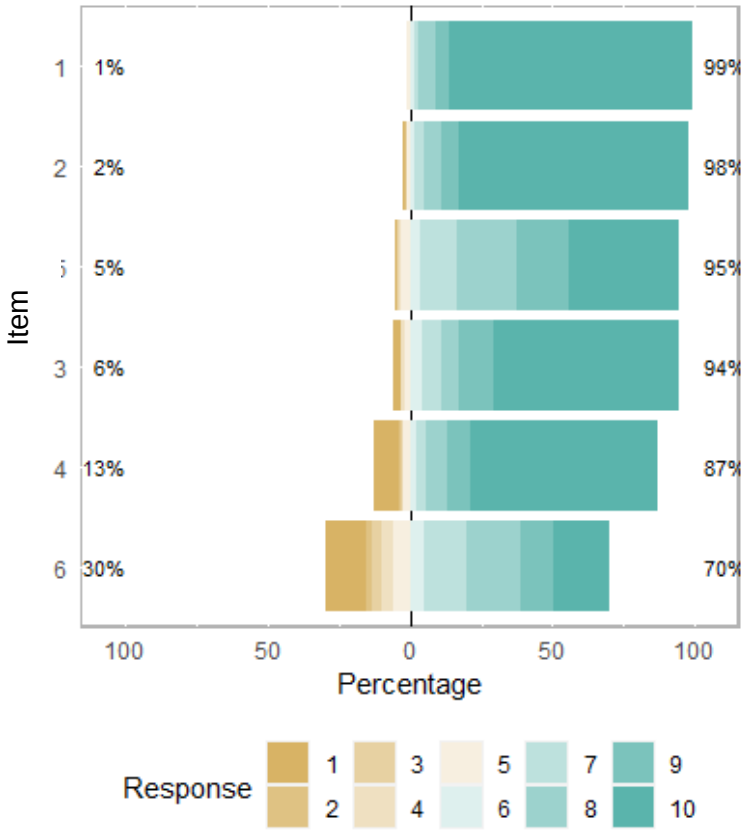


d) Pro-Environmental Behaviours:

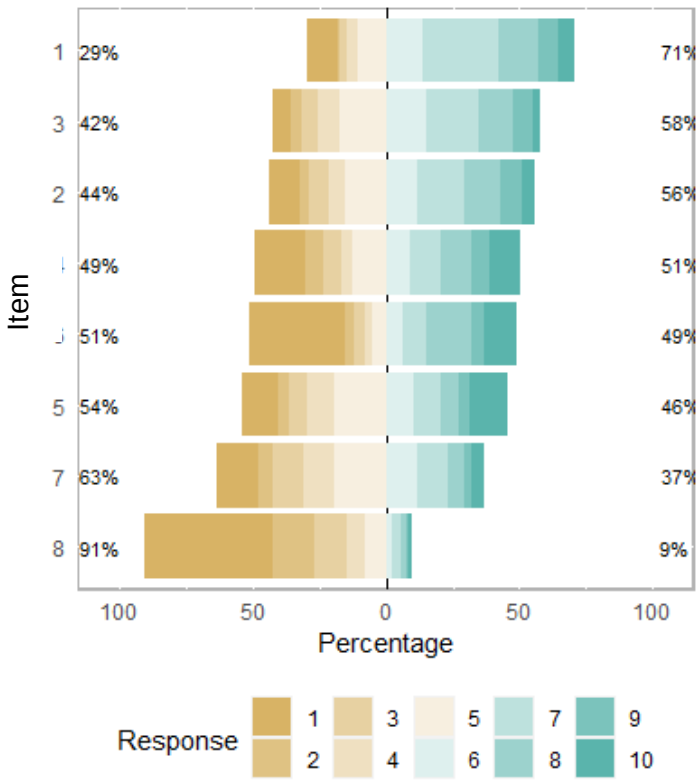
Pro-Environmental Behaviours Scale (Whitmarsh et al., 2017)

Percentage indicating different levels of frequency on items reflecting pro-environmental behaviours: resource conservation (left) and consumption (right). See *Appendix H* for item wording.

Resource conservation



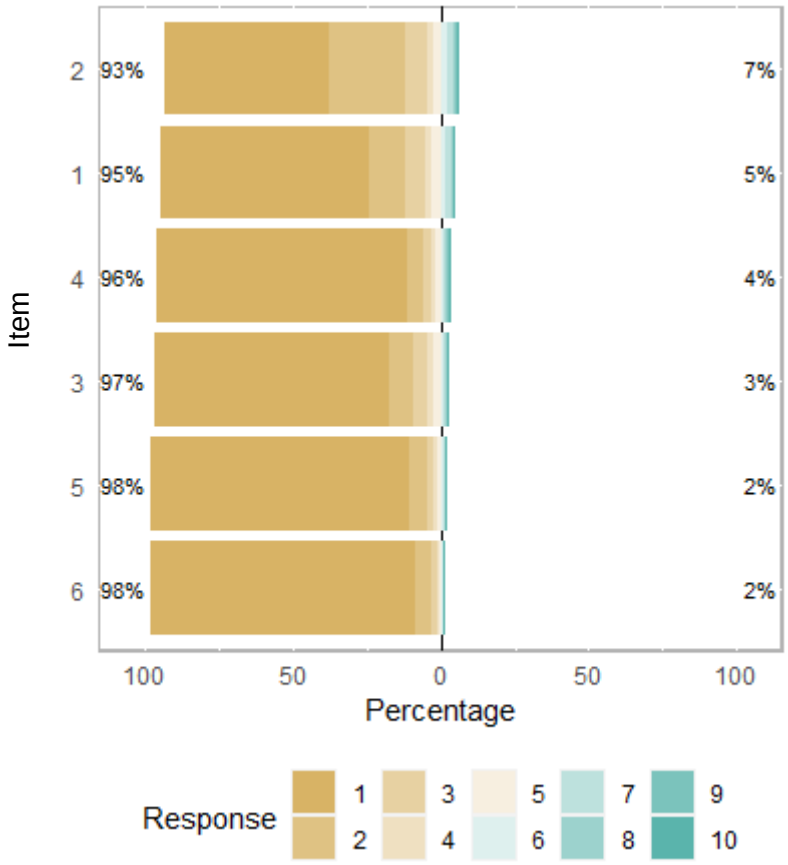
Consumption



Key:

Not at all in the past year (1)	About once in the past year (2)	About 2 to 3 times in the past year (3)	About 4 to 6 times in the past year (4)	About once a month (5)	About 2 to 3 times per month (6)	About once a week (7)	About 2 to 3 times per week (8)	About 4 to 6 times per week (9)	At least once a day (10)

Percentage indicating different levels of frequency on items reflecting high-cost pro-environmental behaviour items. See *Appendix H* for item wording.



Key:

Not at all in the past year (1)	About once in the past year (2)	About 2 to 3 times in the past year (3)	About 4 to 6 times in the past year (4)	About once a month (5)	About 2 to 3 times per month (6)	About once a week (7)	About 2 to 3 times per week (8)	About 4 to 6 times per week (9)	At least once a day (10)

2. Student Population (Chapter 7)

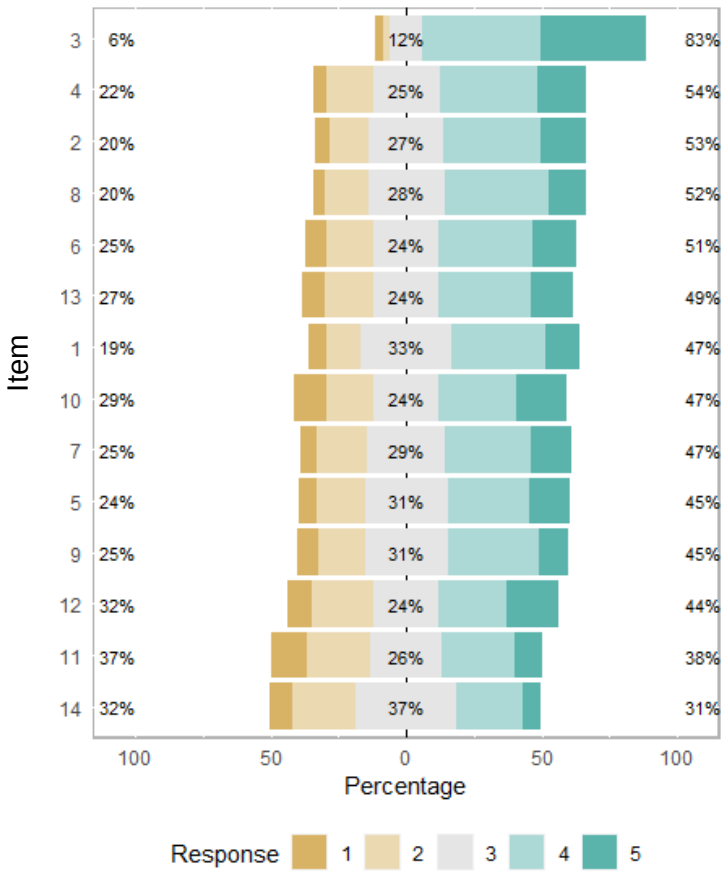
a) Connectedness to Nature & Empathy Toward Nature:

Connectedness to Nature Scale (Mayer & Frantz, 2004)

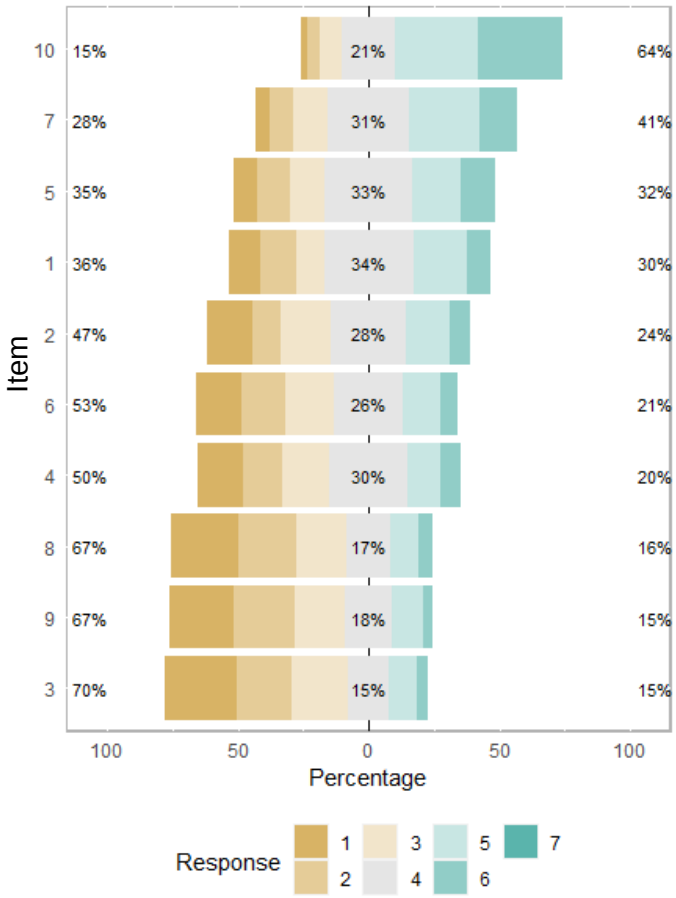
Dispositional Empathy Toward Nature Scale (Tam, 2013)

Percentage agreement with items for connectedness to nature (left) and empathy toward nature (right). Both scales have anchor points of strongly disagree (Response = 1) to strongly agree (Response = 5). Midpoint (Response = 3) is "*neither agree nor disagree*". See *Appendix H* for item wording.

Connectedness to nature

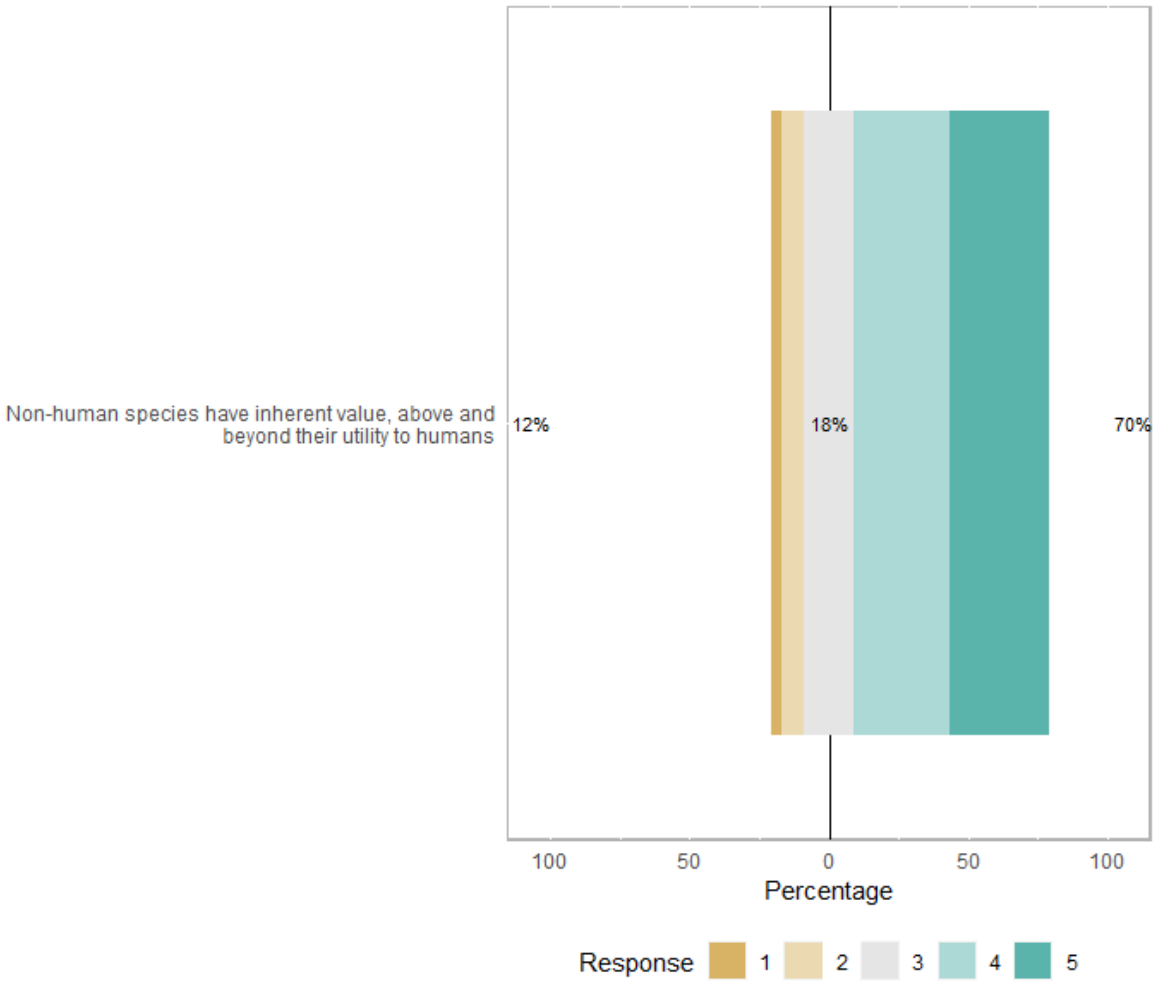


Empathy toward nature



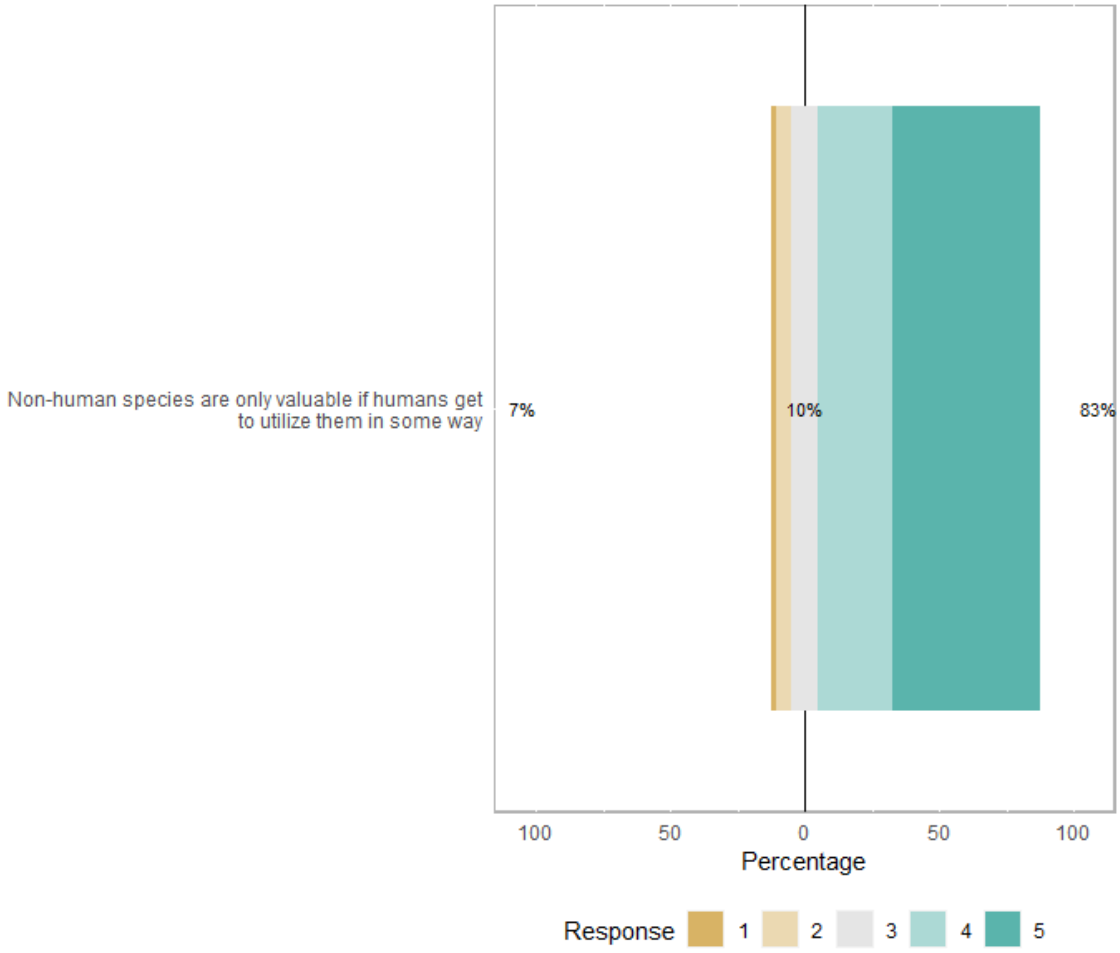
b) Intrinsic Value Beliefs (item taken from Wickizer, 2016)

Percentage agreement with items (Y axes) reflecting intrinsic value beliefs, from Response = 1 (strongly disagree) to Response = 5 (strongly agree). Midpoint (Response = 3) is "*neither agree nor disagree*".



c) Instrumental Value Beliefs (item taken from Wickizer, 2016)

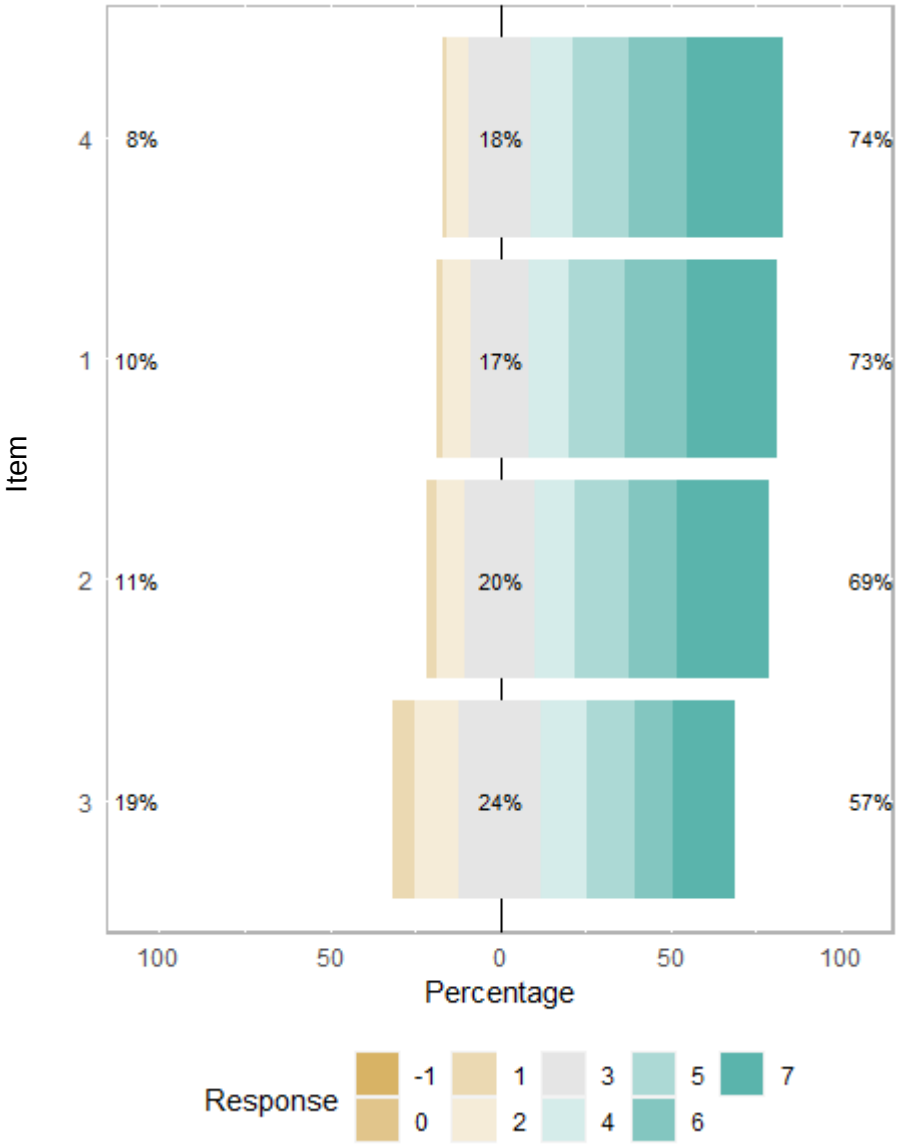
Percentage agreement with items (Y axes) reflecting instrumental value beliefs, from Response = 1 (strongly disagree) to Response = 5 (strongly agree). Midpoint (Response = 3) is "*neither agree nor disagree*".



d) Biospheric Values:

Value Orientations Scale (De Groot & Steg, 2008)

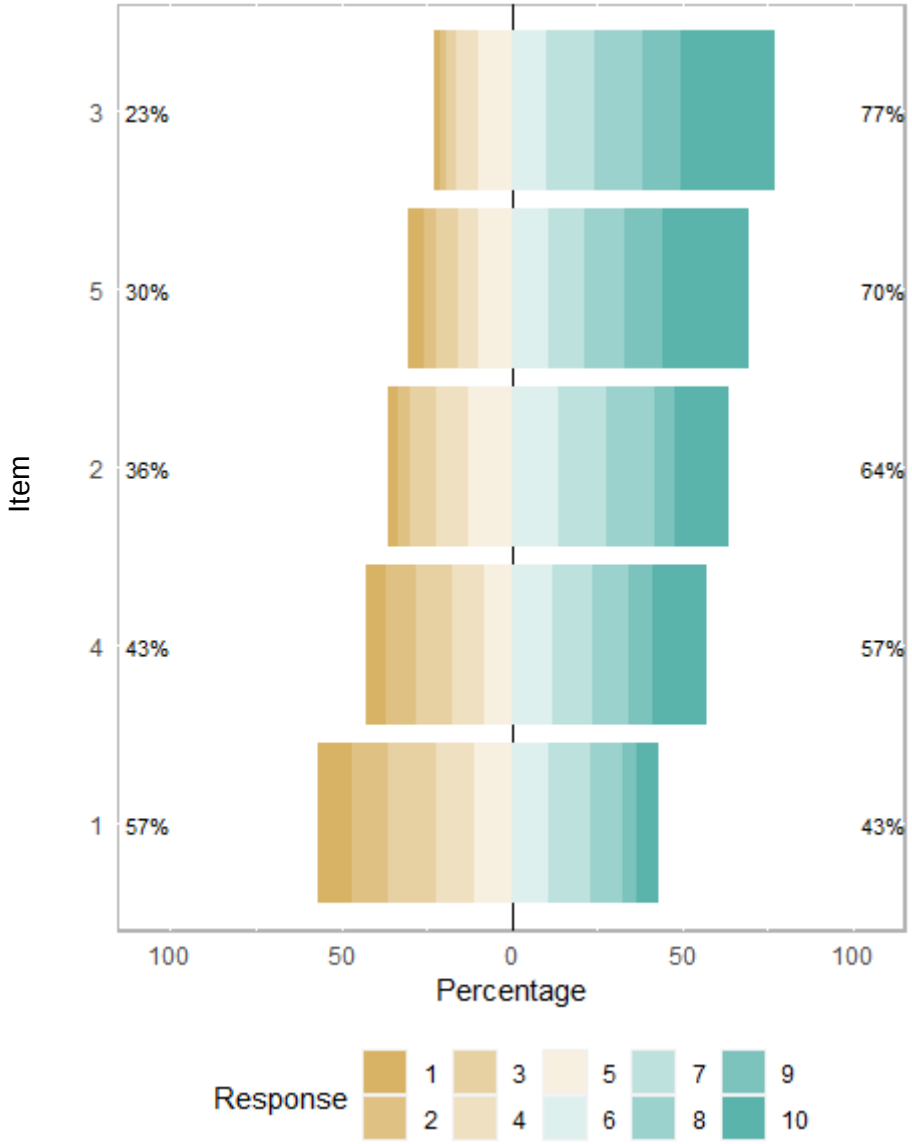
Percentage agreement with items for biospheric values, from -1 (opposed to my values) to 7 (extremely important). Midpoint (Response = 3) is "*imoportant*". See *Appendix H* for item wording.



e) Mind Attribution to Nature:

Individual Differences in Anthropomorphism Questionnaire (Waytz et al., 2010)

Percentage endorsement of mind attribution to nature items, from Response = 0 [not at all] to Response = 10 (very much). See *Appendix H* for item wording.

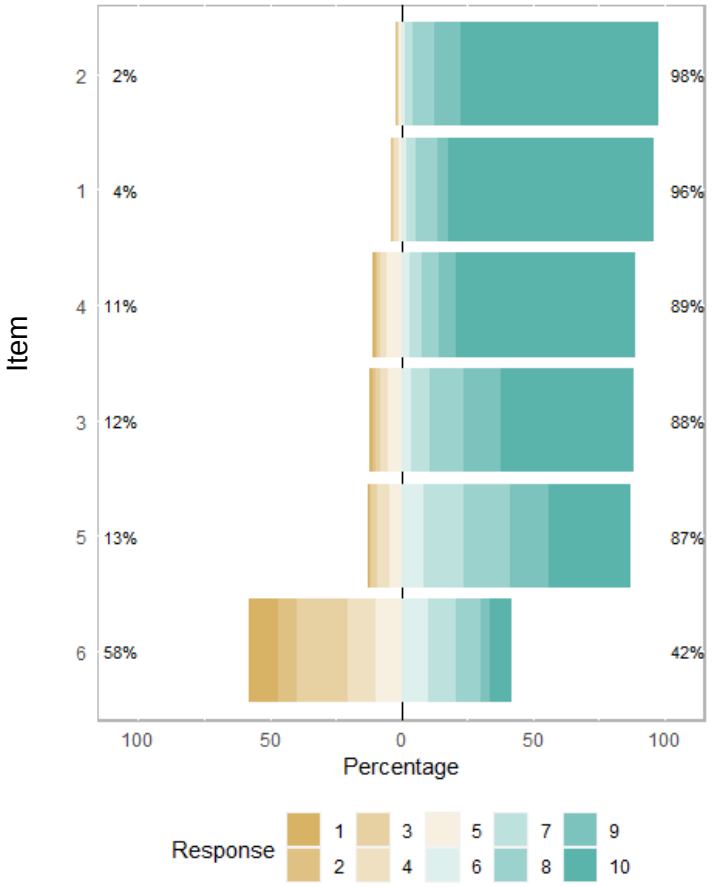


f) Pro-Environmental Behaviours:

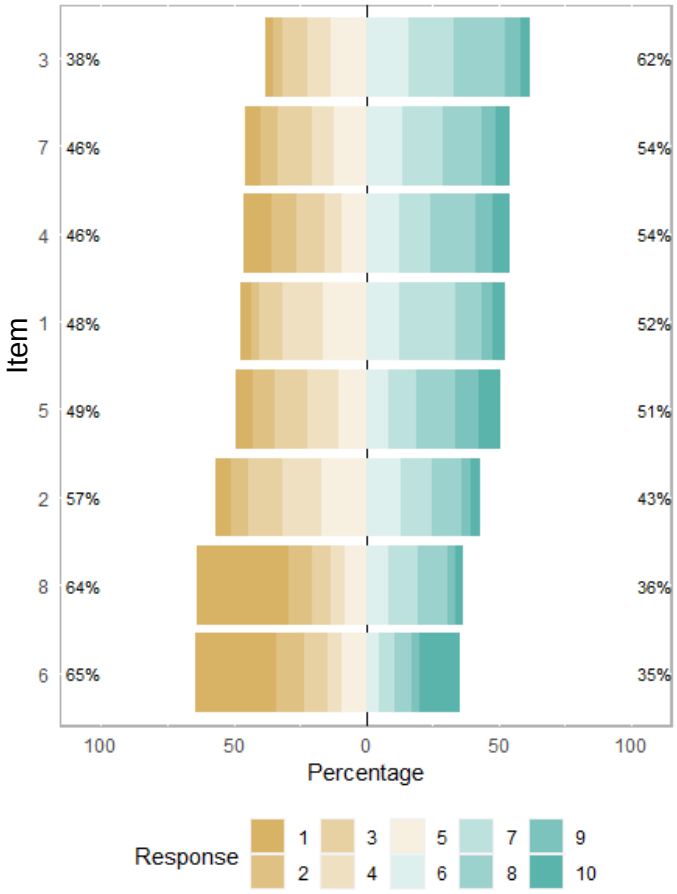
Pro-Environmental Behaviours Scale (Whitmarsh et al., 2017)

Percentage indicating different levels of frequency on items reflecting pro-environmental behaviours: resource conservation (left) and consumption (right). See *Appendix H* for item wording.

Resource conservation



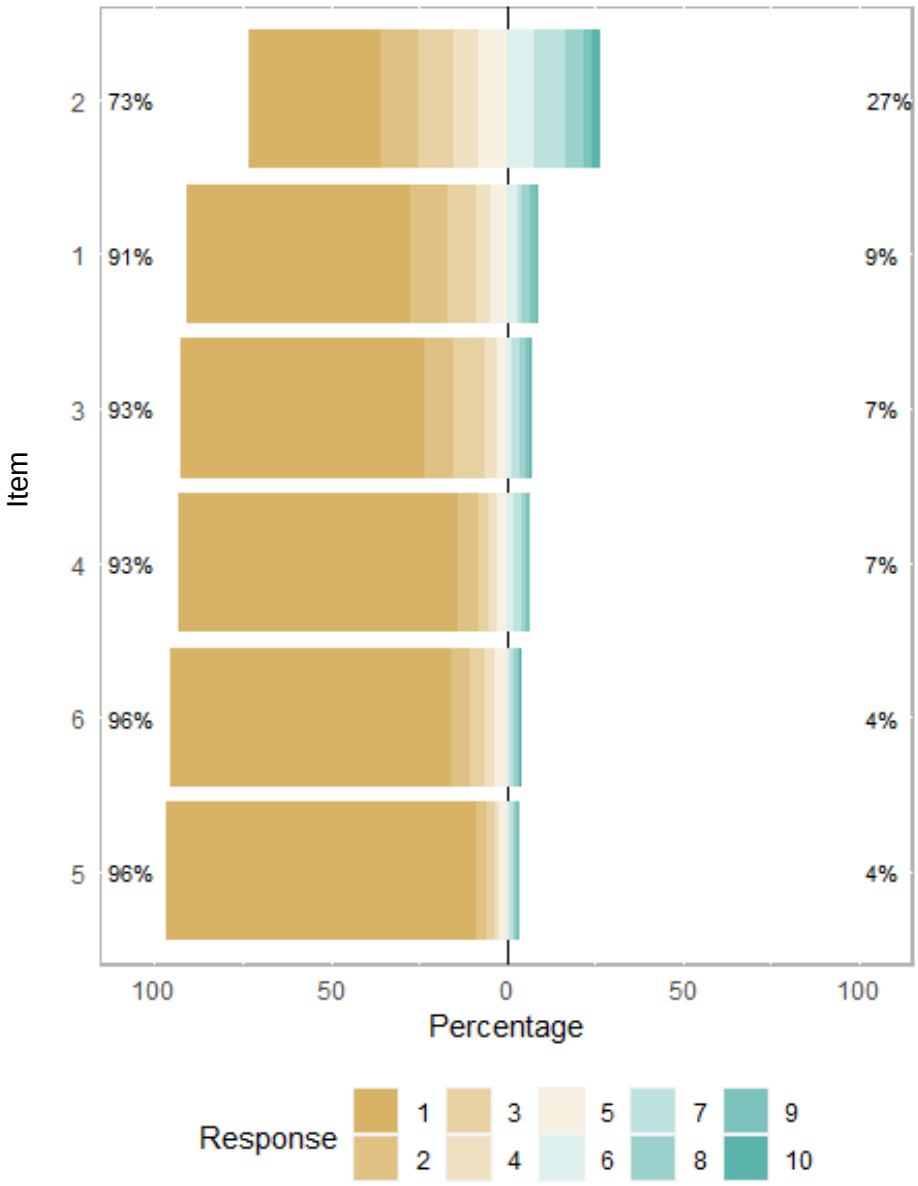
Consumption



Key:

Not at all in the past year (1)	About once in the past year (2)	About 2 to 3 times in the past year (3)	About 4 to 6 times in the past year (4)	About once a month (5)	About 2 to 3 times per month (6)	About once a week (7)	About 2 to 3 times per week (8)	About 4 to 6 times per week (9)	At least once a day (10)

Percentage indicating different levels of frequency on items reflecting high-cost pro-environmental behaviour items. See *Appendix H* for item wording.



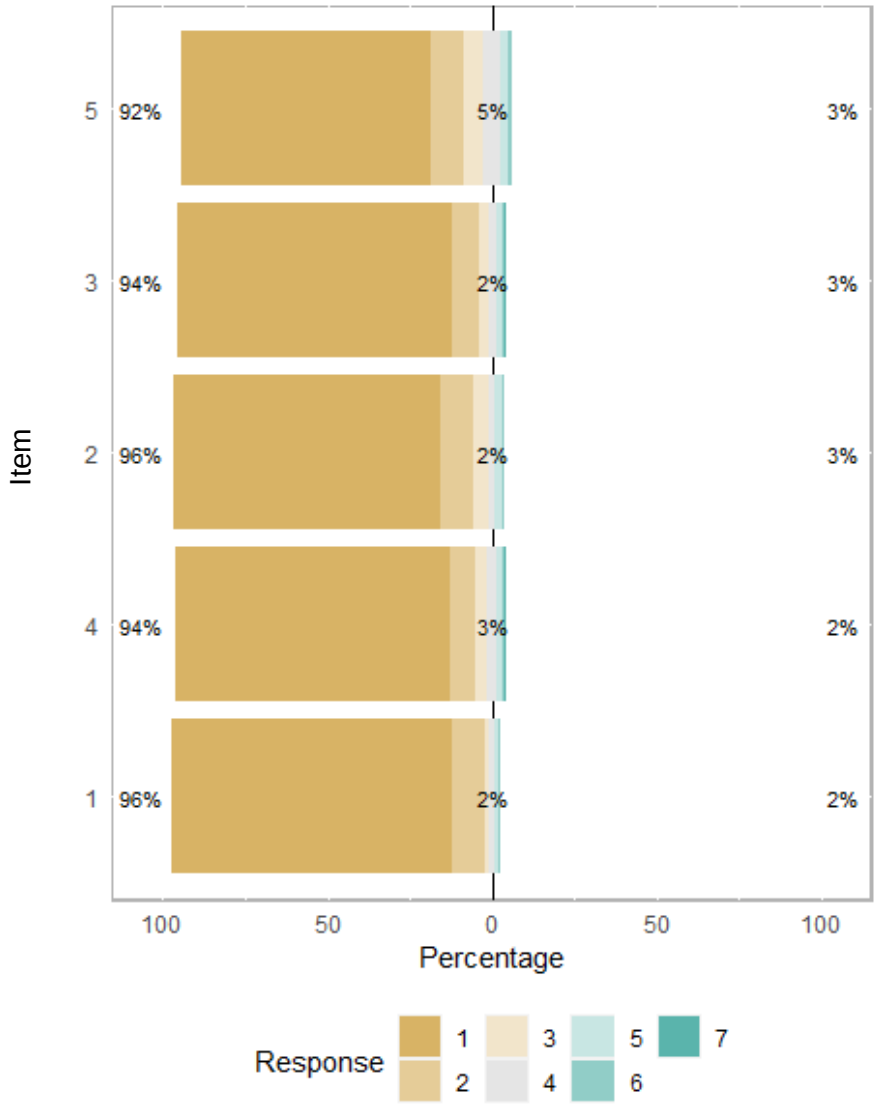
Key:

Not at all in the past year (1)	About once in the past year (2)	About 2 to 3 times in the past year (3)	About 4 to 6 times in the past year (4)	About once a month (5)	About 2 to 3 times per month (6)	About once a week (7)	About 2 to 3 times per week (8)	About 4 to 6 times per week (9)	At least once a day (10)

g) Pro-Nature Behaviours:

Pro-Nature Behaviours Scale (Barbett et al., 2020)

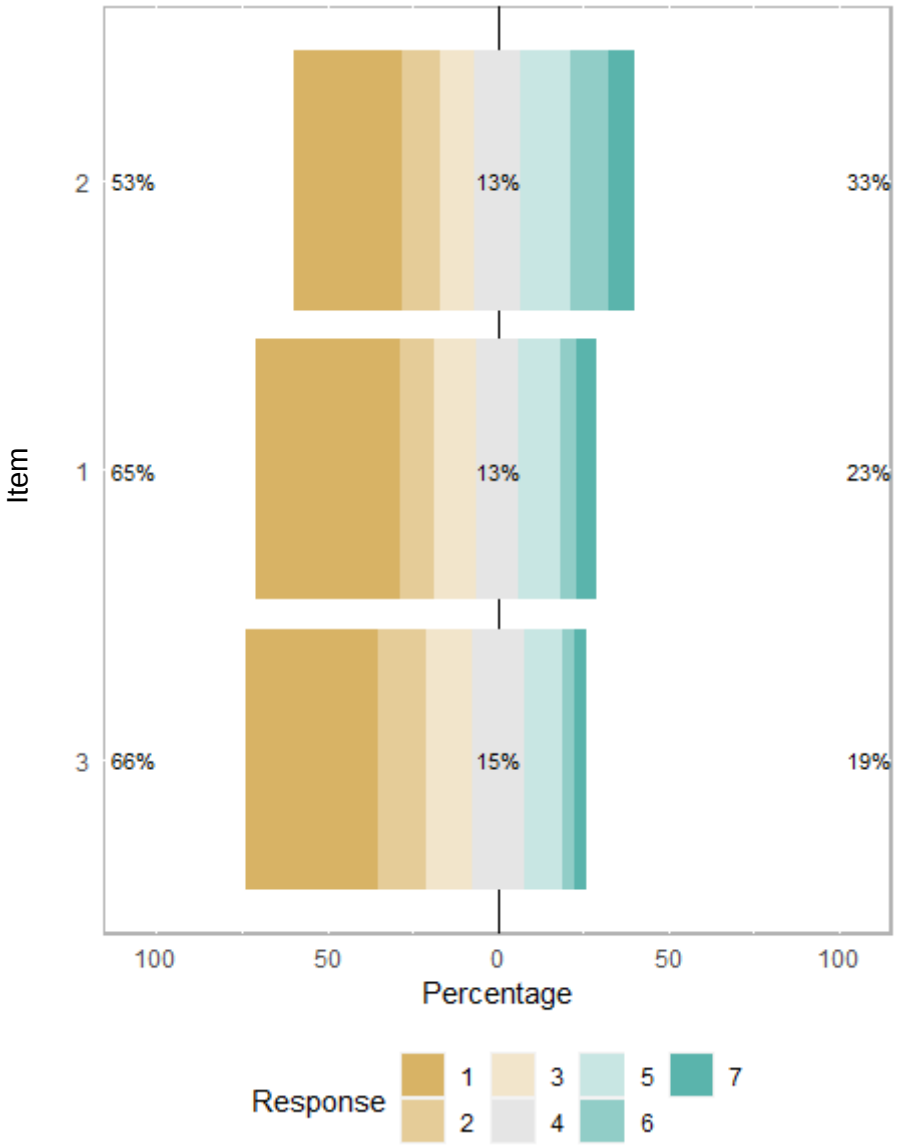
Percentage indicating different levels of frequency on items reflecting high-cost pro-nature behaviours from Response = 1 (Never) to Response = 7 (Always). See *Appendix H* for item wording.



Key:

Never (1)	Rarely (2)	Occasionally (3)	Sometimes (4)	Frequently (5)	Very Frequently (6)	Always (7)

Percentage indicating different levels of frequency on items reflecting personal pro-nature behaviours from Response = 1 (Never) to Response = 7 (Always). See *Appendix H* for item wording.

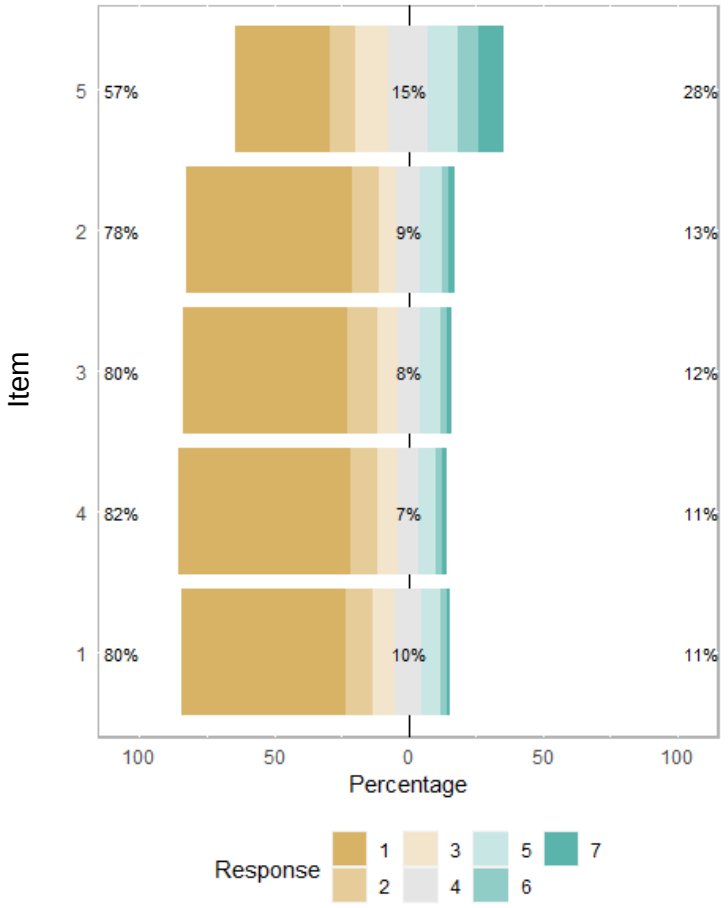


Key:

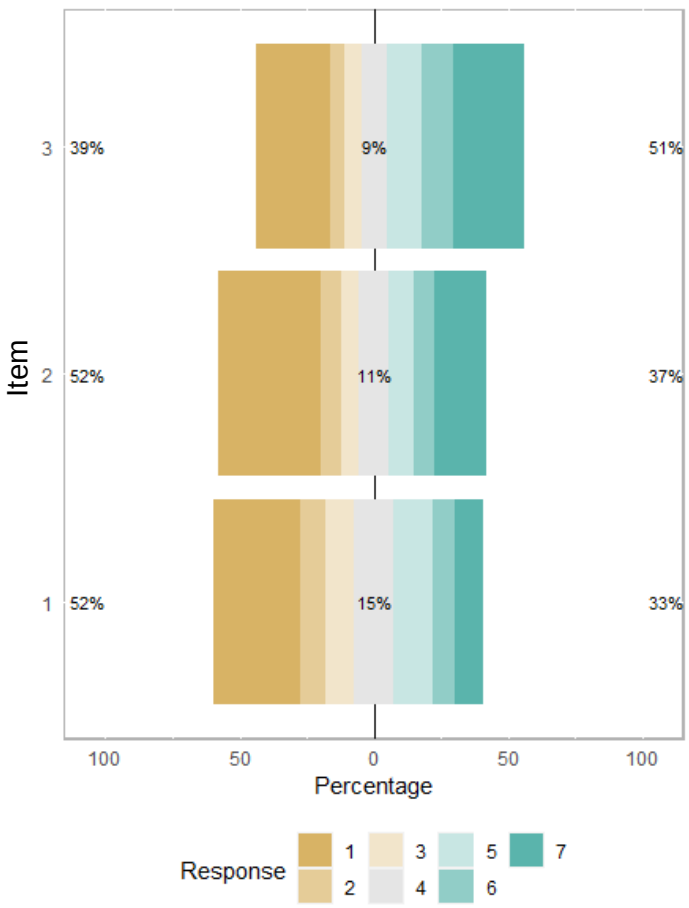
Never (1)	Rarely (2)	Occasionally (3)	Sometimes (4)	Frequently (5)	Very Frequently (6)	Always (7)

Percentage indicating different levels of frequency on items reflecting doing-for-wildlife (left) and avoiding-for-wildlife (right) pro-nature behaviours from Response = 1 (Never) to Response = 7 (Always). See *Appendix H* for item wording.

Doing-for-wildlife



Avoiding-for-wildlife



Key:

Never (1)	Rarely (2)	Occasionally (3)	Sometimes (4)	Frequently (5)	Very Frequently (6)	Always (7)

Appendix J: Factor Loadings for Latent Variables in the Extended Value-Belief-Norm model (*Chapter 7)*.

Table 1: Factor Loadings of Latent Variables Included in the Structural Equation Model of the Extended Value-Belief-Norm Model.

Latent variable	Item	Standardised factor loading	Standard error	*p*
Awareness of consequences	1	.86		< .001
	2	.99	.05	< .001
	3	.90	.04	< .001
	7	.75	.05	< .001
	9	.77	.04	< .001
Ascription of responsibility	1	.77		< .001
	3	.55	.06	< .001
	5	.73	.05	< .001
	8	.85	.05	< .001
	10	.74	.05	< .001
Personal norm	3	.81		< .001
	4	.80	.03	< .001
	7	.75	.05	< .001
	8	.79	.04	< .001
	10	.67	.04	< .001

Note. The path coefficient for the first item of each latent variable was fixed to 1; therefore, standard error estimates were not generated. Awareness of consequences (AC), ascription of responsibility (AR), and personal norm (PN) items are those based on the AR-Environment factor (see *Section 7.4.1*).