PHD

Does Connectivity with Nature Alter Consumer Behaviour? Linking Ocean Connectedness and Consumer Views on Single-Use Packaging

Nuojua, Sohvi Katariina

Award date:
2023

Awarding institution:
University of Plymouth

UNIVERSITY OF
PLYMOUTH

DOES CONNECTIVITY WITH NATURE ALTER CONSUMER BEHAVIOUR? LINKING OCEAN CONNECTEDNESS AND CONSUMER VIEWS ON SINGLE-USE PACKAGING

by

SOHVI KATARIINA NUOJUA

A thesis submitted to the University of Plymouth
in partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

School of Biological and Marine Sciences

May 2023

Acknowledgements

I would firstly like to thank my fantastic supervisory team; Professor Richard Thompson, Professor Sabine Pahl, and Dr Kayleigh Wyles; for their guidance, professional and moral support, as well as for their patience during this PhD project. Thank you also for providing me with numerous opportunities to explore my research interests and to advance my professional career.

I would also like to thank the Psychology Technical Office for facilitating my research activities. Special thanks go to Mrs Lynne James for developing the computer software used to collect experimental research data for my thesis. Thank you also to Mr Anthony Mee for ensuring a Covid-safe laboratory environment for my research participants and myself. I would also like to thank Mr Mark Cooper for helping me set up the Virtual Reality equipment used in my experimental research. Thank you also to the undergraduate students who kindly took part in my research on campus.

Finally, I would like to thank the Plastics Team in the School of Biological and Marine Sciences for their friendship, support, and advice on all things.

Naturally, I would also like to thank my family and friends, in Finland and in the UK, for their love and support during this PhD adventure.

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University of Plymouth or at another establishment.

This study was financed with the aid of a studentship from CRH Trust and the University of Plymouth Faculty of Science and Engineering.

Published papers:

Nuojua, S., Pahl, S., & Thompson, R. C. (2022). Ocean connectedness and consumer responses to single-use packaging. *Journal of Environmental Psychology, 81*, 101814.

Nuojua, S., Cracknell, D., & Pahl, S. (2022). Human behavior and marine plastic pollution. In A. L. Andrady (Ed.), *Plastics and the Ocean: Origin, Characterization, Fate, and Impacts* (pp. 429-454). Wiley.

Papers in preparation:

Nuojua, S., Pahl, S., & Thompson, R. C. (Manuscript in preparation). *Does manipulating ocean connectedness with a Virtual Reality experience shape consumers' packaging preferences?*.

Nuojua, S., Pahl, S., & Thompson, R. C. (Manuscript in preparation). *Consumer responses to circular design and end-of-life scenarios for single-use packaging: Utilising the Kano model.*

List of conferences, workshops and seminars attended:

Lighthouse Lofoten conference, Norwegian Centre against Marine Litter (Svolvær, Norway), May 2022 – *Oral presentation (virtual)*

University of Oulu Psychology Research Colloquium, University of Oulu (Oulu, Finland), April 2022 – *Oral presentation*

Society for Risk Analysis – Europe 29th Annual Conference, Aalto University (Espoo, Finland), June 2021 – *Oral presentation (virtual)*

International Association of People-Environment Studies (IAPS) 26th Conference and Young Researchers' Workshop, Laval University (Quebec City, Canada), June 2020 – *Oral presentation (virtual)*

International Conference on Environmental Psychology (ICEP) 2019, University of Plymouth (Plymouth, United Kingdom), September 2019 – *Oral presentation*

School of Psychology 2019 Conference, University of Plymouth (Plymouth, United Kingdom), June 2019 – *Poster presentation*

IdentiPlast 2019 Conference, QEII Centre (London, United Kingdom), March 2019 – *Attendance*

MICRO2018 International Conference, Cabildo de Lanzarote (Arrecife, Lanzarote, Spain), November 2018 – *Oral presentation*

International Association of People-Environment Studies (IAPS) 25th Conference, Roma Tre University (Rome, Italy), July 2018 – *Poster presentation*

School of Psychology 2018 Conference, University of Plymouth (Plymouth, United Kingdom), June 2018 – *Oral presentation*

Word count of main body of thesis: 42,975

Signed Sohvi Nuojua

Date 30/05/2023

Abstract

DOES CONNECTIVITY WITH NATURE ALTER CONSUMER BEHAVIOUR? LINKING OCEAN CONNECTEDNESS AND CONSUMER VIEWS ON SINGLE-USE PACKAGING

Sohvi Katariina Nuojua

Single-use packaging items constitute a large proportion of the plastic litter found in the marine environment. Consumer behaviour is a key contributor to the accumulation of this pollution in the environment. This thesis outlines correlational and experimental research on consumer responses to environmentally relevant qualities of single-use packaging. Furthermore, it considers a novel concept of ocean connectedness as a psychological moderator of consumer response.

Studies 1 and 2 investigated consumer responses to recyclability of packaging as well as its raw material (plastic, glass, carton and aluminium) in undergraduate students and in a broader UK public sample. Ocean connectedness was assessed with a survey, and its associations with responses to packaging recyclability and material were explored.

Study 3 was implemented as a large-scale online survey and investigated consumer responses to the origin, design and end-of-life scenarios of packaging using the Kano model of consumer satisfaction. Consumer segments were further created based on respondent characteristics, including levels of ocean connectedness and sociodemographic variables, and differences in packaging responses across consumer profiles were explored. The collected survey data further enabled exploration of the conceptual differences and similarities between ocean connectedness and nature connectedness.

Studies 4 and 5 examined the potential of Virtual Reality (VR) technologies in inducing ocean connectedness. In two experimental studies, the impacts of VR manipulation on explicit and implicit ocean connectedness, as well as on subsequent responses to packaging recyclability and material, were tested.

Overall, these studies provide evidence of consumers valuing packaging designed using circular strategies. Furthermore, a correlational association between ocean connectedness and responses to packaging recyclability and material was found: Consumers with higher levels of ocean connectedness demonstrated more positive evaluations of sustainable packaging features and were more critical towards packaging made of plastic. However, no causal link between ocean connectedness and packaging responses could be established. Yet, this work advocates for the importance of psychological ocean connectivity, a concept shown to have a somewhat unique profile in comparison to general nature connectedness, in shaping consumer responses to packaging sustainability.

Table of Contents

List of Figures

List of Tables

Chapter 1: General Introduction

Parts of this chapter are extracts from a published peer-reviewed paper:
Nuojua, S., Pahl, S., & Thompson, R. C. (2022). Ocean connectedness and consumer responses to single-use packaging. *Journal of Environmental Psychology, 81*, 101814.

1.1 Marine Plastic Pollution

Anthropogenic debris is increasingly polluting the natural environment and particularly the world's oceans, accumulating in all regions of the marine environment. Plastics make up a large share, around 75%, of the litter encountered in marine and coastal environments. It is now found at the sea surface (Lacerda et al., 2019), in the deep sea (Woodall et al., 2014), in the arctic sea ice (Obbard et al., 2014) as well as on shorelines worldwide (Nelms et al., 2019; Pham et al., 2020). Plastics are released into the marine environment through various pathways, including in direct inputs at sea through shipping and fishing activities, littering on coastlines, and transport via rivers and atmospheric circulation (GESAMP, 2015). Marine plastics can thus vary in size from that of a large fishnet to a microplastic[1] particle undetectable to the naked eye. A substantial portion of marine plastic pollution is mismanaged waste originating from land-based activities: Improper waste management practices, such as open dumping,

[1] Microplastics are particles of plastic with a diameter of less than 5mm (Thompson et al., 2004). Types of plastic polymers most commonly encountered in the marine environment include polyethylene (PE), polypropylene (PP), polyvinylchloride (PVC), polyethylene terephthalate (PET) and polystyrene (PS; Bond et al., 2018).

disposal in uncontained landfill sites, and littering, contribute to over 8 million metric tonnes of plastic waste entering the waterways every year (Jambeck et al., 2015). The world is now experiencing a plastics crisis that also contributes to the climate emergency: If the global demand for plastics continues in its present course, carbon dioxide emissions from the plastics industry may increase by 90% by year 2050 (Wood Mackenzie, 2021).

Items designed for single-use applications, such as disposable bags, containers and wrappers, make up a large part of marine plastic pollution (Morales-Caselles et al., 2021). The plastic in these applications only rarely undergoes circular value recovery. For example, in 2016, only a small portion of such items were recycled (14%) or incinerated (14%) globally, with the rest ending up landfilled (40%) or littered into the natural environment (32%; Chen et al., 2021). Given that single-use plastic items can persist in the natural environment for years (Napper & Thompson, 2019), they accumulate in the marine environment at an alarming rate. As a response, efforts to tackle pollution from single-use plastics have ensued in recent years, at both local and transnational scales. For example, governments at the United Nations Environment Assembly initiated negotiations in March 2022 of an international legally binding treaty addressing the production, design and disposal of plastics (UNEP, 2022).

1.1.1. Impacts

An extensive evidence base exists for the harmful impacts of plastic debris on the natural environment and society. Firstly, more than 700 species of marine organisms have been documented to have suffered physical harm, adverse impacts on functionality, or death, upon encountering plastic debris (Gall & Thompson, 2015). For example, ingestion of plastic debris can result in starvation caused by false perception of satiation or gut obstruction. In addition, concerns have been expressed about the

transferring of chemicals, such as hydrophobic organic pollutants or additives, to marine biota upon ingestion of plastics (Huang et al., 2021). Occurrences of ingestion of plastic debris have been documented for various marine species, including whales (Unger et al., 2016), birds such as northern fulmars (Van Franeker et al., 2011), turtles (Schuyler et al., 2014) various types of fish (Lusher et al., 2013) as well as a selection of invertebrate species (Cole et al., 2013; Courtene-Jones et al., 2019). Furthermore, incidents of entanglement have been reported widely: For example, Werner et al. (2016) report an incident rate of 2–9% of entanglement in plastic debris (e.g. ropes and netting) for some seabird and marine mammal populations. In addition to causing direct physical harm, plastics can have detrimental impacts on whole ecosystems: Plastic debris items and fragments can operate as rafting vessels for various organisms and microbial communities, aiding the dispersal of invasive species to new territories (Barnes & Miller, 2005).

Furthermore, plastic litter in the marine environment has negative repercussions to the economy and human wellbeing. According to estimates by Beaumont et al. (2019), each tonne of marine plastics causes an annual reduction in marine natural capital (i.e. the world's stocks of natural marine assets) of between $3,300 and $33,000. These costs were linked especially to fisheries and aquaculture, heritage values, and recreation. Impacts on fishing activity and industry relate to, for instance, ghost fishing and damage to maritime equipment. Ghost fishing – lost or abandoned fishing nets continuing to passively catch fish and other marine species (Brown & Macfadyen, 2007) – causes significant annual losses of commercial (and non-commercial) fish and crustacean stocks (Campbell & Sumpton, 2009; Webber & Parker, 2012). In addition, plastic litter poses a hazard of damage to fishing boats and other maritime vessels, potentially resulting in diminished productivity, injury, or even loss of life (Mouat et al., 2010).

Litter on the coast is an eyesore and can thus undermine experiential recreation substantially (Beaumont et al., 2019). For example, Welsh beach-goers mostly attribute their beach choice to absence of litter and cleanliness, over other considerations such as safety (Tudor & Williams, 2006). Losses in tourism revenues due to coastal litter have been realised globally, especially following significant weather events (Jang et al., 2014). For example, McIlgorm et al. (2011) estimated that marine debris causes a loss of $622 million for the marine tourism sector in the Asia Pacific region annually. Further costs to industry and local authorities are rendered by clean-up programs which can be expensive, time-consuming and relatively ineffective (Newman et al., 2015). For instance, UK municipalities invest approximately €18 million each in beach litter clean-up efforts annually (Mouat et al., 2010). Finally, litter on beaches can have a negative impact on the human psyche and wellbeing: The restorative benefits that coastal environments ordinarily provide to visitors are undermined by the presence of even small quantities litter (Wyles et al., 2016).

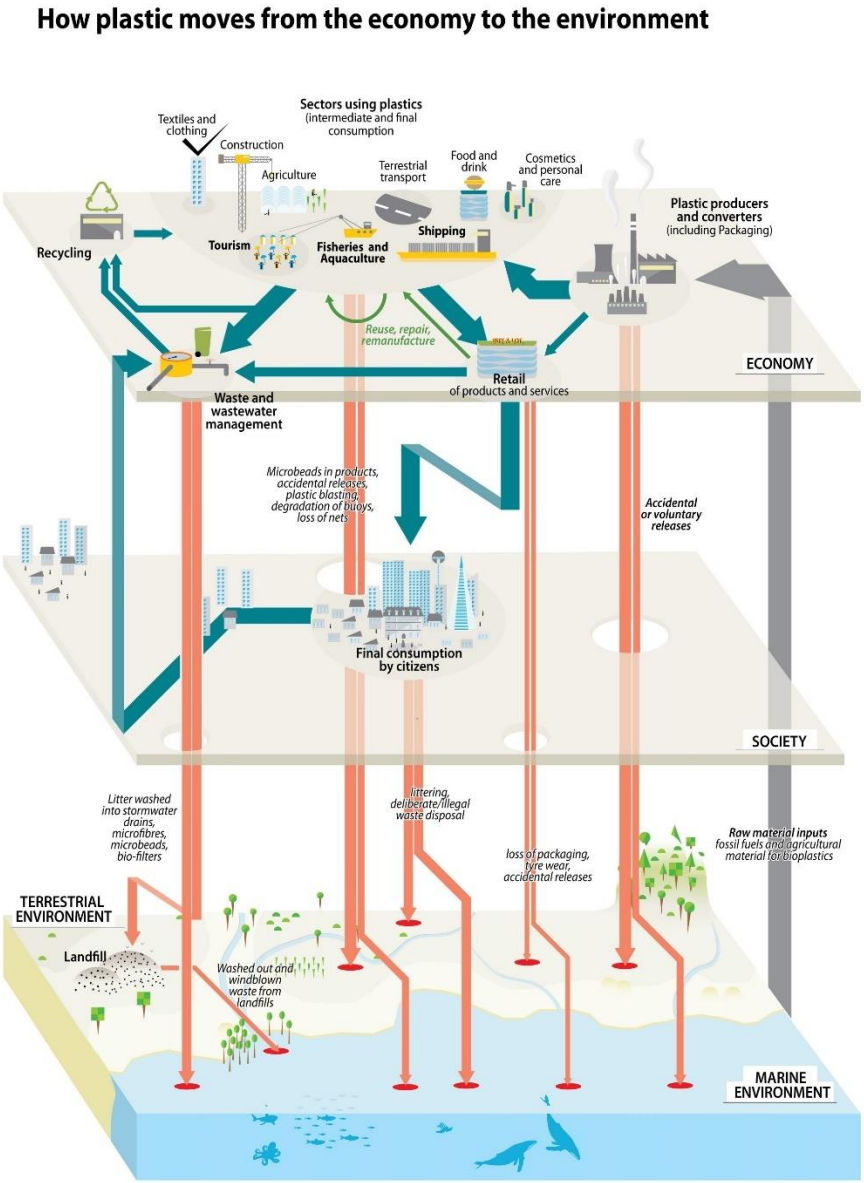
1.1.2. Behavioural Science Take on Plastic Pollution: How Can We Influence End-Users of Plastic?

There are various ways in which people operate within the plastics system (see Figure 1) – not only as consumers, but also as participants in organisations, community members, investors, and citizens (Löhr et al., 2017). Human decisions and choices, either individual or collective, contribute to the flow and fate of plastics through this system. These decisions and choices are partly governed by policy makers as well as legal, economic and technical factors. Due to this complexity of the plastics system and the multitude of operators within, responsibility for plastic pollution should not be assigned to a singular collective. Therefore, substantial reduction in plastic pollution can only be achieved by a holistic solutions-oriented approach where opportunities for

change are identified across the various sectors within the plastics system. It should be noted, therefore, that while the work presented in this thesis focuses on the societal sector of the system, consumers are not the only players in the field of plastics.

Figure 1

The Plastics System (Source: https://www.grida.no/resources/6908, Maphoto/Riccardo Pravettoni).



A behavioural science approach to plastic pollution can help address and potentially change how individuals as end-users interact with plastics: As noted by Heidbreder et al. (2019), insights from behavioural sciences are needed to complement technical solutions to plastic pollution, such as innovative packaging solutions (e.g. biodegradable packaging) or waste management strategies (circular value recovery). Such solutions can be undermined by psychological factors. For example, an individual's perceptions of and attitudes towards solutions, as well as their acceptance of the implementation of solutions, can govern end-users' behaviour substantially. These antecedents of behaviour, among others, can be targeted in efforts to change behaviours that may contribute to or help mitigate marine plastic pollution. Consumer decisions, waste management behaviours (e.g. recycling) and littering are key behavioural spheres where individuals' actions can determine the fate of plastics. Antecedents of these behaviours, as posited by scholars in the field of environmental psychology, are reviewed next.

Antecedents of Individual-level Behaviour in the Context of Plastic Pollution. Whether an individual engages in the aforementioned behaviours, and in what capacity, is naturally contingent on a variety of contextual opportunities and constraints. For example, consumer choices are limited by product availability and price; individuals may lack the facilities to engage in appropriate waste sorting; and littering may be attributed to a shortage of waste receptacles. In addition to such infrastructural and economic factors, conflicting motives and attitudes (e.g. desire for practicality and comfort) can function as barriers to pro-environmental action (Kollmuss & Agyeman, 2002). These external factors and competing motivations should therefore

be acknowledged as enablers of or hindrances to pro-environmental behaviour[2]. In addition, how an individual interacts with plastics and plastic waste can be influenced by a variety of psychological determinants, such as levels of knowledge and problem awareness; attitudes and values; the social norm; as well as a variety of sociodemographic variables.

Knowledge, Awareness and Risk Perception. A traditional approach to promoting pro-environmental behaviours is making people more knowledgeable and aware about environmental issues (Hungerford & Volk, 1990). Environmental education and informational campaigns are based on the premise that increasing knowledge or 'connecting the dots' between behaviour and its environmental consequences will generate behaviour change (Frick et al., 2004). Today, levels of awareness of marine plastic pollution are generally high in countries in the Global North (e.g. Forleo & Romagnoli, 2021; Hartley et al., 2018) as well as across nations in the Global South (Arulnayagam, 2020; Dalu et al., 2020; Mathis et al., 2022; Van Rensburg et al., 2020). This public interest and awareness around the issue has peaked relatively recently (SAPEA, 2019). In the Global North, heightened media awareness has been partly attributed to the 2017 BBC documentary series *Blue Planet II* (Thompson, 2019). The documentary demonstrated the presence and impacts of marine plastic pollution, stressing the urgent need for change in how plastics are used and managed in society. The resulting escalation in public awareness and concern, termed the "*Blue Planet effect*" (Hunt, 2017), is also believed to have pressured relevant governmental policies and actions, such as bans on single-use plastics (Schnurr et al., 2018).

Awareness is closely linked to the concept of risk perception. According to Syberg et al. (2018), risk perception is defined as the subjective evaluation of a negative

[2] According to the definition by Steg and Vlek (2009), *pro-environmental behaviour* refers to "behaviour that harms the environment as little as possible, or even benefits the environment" (Steg & Vlek, 2009, p. 309).

event occurring together with concern of its consequences. Therefore, evaluations of risk can guide individuals' reactions to environmental issues such as plastic pollution. Risk perceptions around marine plastic pollution have evolved over the last decades due to it becoming more widely reported, visible, and traceable to specific peoples or companies (Syberg et al., 2018). Therefore, plastic pollution is now viewed as a more tangible threat to the natural world and society, creating momentum for mitigating actions globally.

However, mere increase in knowledge or awareness rarely determines individual-level pro-environmental behaviours, such as mindful consumer action (Abrahamse & Steg, 2013; Carmi et al., 2015). For example, Dunn et al. (2020) showed in an experimental setting that viewing an episode of *Blue Planet II* increased environmental knowledge, as tested immediately after, but it did not have an impact on whether consumers chose plastic or paper packaging. Overall, the success of informational and environmental messaging as an intervention strategy for shaping plastics- or packaging-related behaviours has been mixed (reviewed in Nuojua et al., 2022). To illustrate, informational messaging about the benefits of recycling single-use (plastic) packaging was shown to influence consumer preferences and demand in Klaiman et al. (2016) but not recycling behaviour in further work (Klaiman et al., 2017). One explanation for the role of environmental knowledge in shaping pro-environmental behaviour was offered by Carmi et al. (2015): Their research posited that knowledge only affects behaviour indirectly, and that its impact is fully mediated by environmental emotions, including subjective perceptions of connectedness with nature.

Attitudes and Values. Caring for the environment is an often-cited reason for individual-level pro-environmental actions. Caring can be conceptualised in multiple ways: Positive attitudes towards the environment, nature connectedness and values are all constructs often demonstrated to guide pro-environmental behaviour (Kaiser et al.,

1999; Mackay & Schmitt, 2019; Van der Werff et al., 2013). Attitudinal orientations are considered an important determinant of behaviour according to widely accepted behavioural models such as the theory of planned behaviour (TPB; Ajzen, 1991), the norm-activation-theory (NAT; Schwartz & Howard, 1981), and the value-belief-norm theory (VBN; Stern et al., 1999). Although some have argued against the role of environmental concern in effecting pro-environmental consumer behaviour, especially when economic concerns are present (Grunert et al., 2014; Kalafatis et al., 1999), a strong evidence base exists that links environmental concern with pro-environmental behaviours (Huddart Kennedy et al., 2015; Magnier & Schoormans, 2015; Newton et al., 2015; Poortinga et al., 2004; Prakash & Pathak, 2017; Schultz et al., 2005; Stern, 2000). For example, in Hartley et al. (2018), concern over marine litter was associated with intentions to engage in actions to reduce litter entering the oceans, such as buying re-usable products and picking up litter. Furthermore, sustainable packaging is preferred by those manifesting concern for natural environments (Koenig-Lewis et al., 2014), and recycling behaviour has been associated with concern for aquatic environments (Klaiman et al., 2016).

Similarly, one's general relationship to the natural environment can motivate pro-environmental behaviour. A robust association has been documented between pro-environmental behaviour and nature connectedness, defined as the sense of connection with the natural world (Mackay & Schmitt, 2019; Martin et al., 2020; Mayer & Frantz, 2004). Whereas environmental awareness and concern reflect cognitive perceptions and beliefs, nature connectedness typically involves a strong affective and experiential component of one's relationship to nature. Nature connectedness, as well as the novel concept of ocean connectedness, are discussed in detail in section 1.3.

Attitudes towards the environment are believed to derive from values (Stern, 2000; Stern & Dietz, 1994). Values are higher-order guiding principles that are rather

static across contexts (Schwartz, 1992), and three types of values have been distinguished in the environmental psychology literature: biospheric value orientation (i.e. tendency to appreciate the natural environment and the biosphere), altruistic value orientation (i.e. tendency to appreciate the welfare of other humans), and egoistic value orientation (i.e. tendency to appreciate the welfare of self; De Groot & Steg, 2008). In particular, a biospheric value orientation is regarded as the basis for environmentally significant beliefs and intentions (De Groot & Steg, 2008; Nguyen et al., 2016; Van der Werff et al., 2013). Similarly, altruistic values predict pro-environmental behaviour, such as purchasing eco-friendly packaging (Prakash et al., 2019; Steg et al., 2014), while egoistic values have a lesser impact and may lead to pro-environmental action due to external motivations (Prakash et al., 2019; De Groot & Steg, 2010).

Social Norm. The prevailing social norm, either descriptive (meaning one's perception of what others in society do) or injunctive (perception of what others think should be done), is considered a key determinant of pro-environmental behaviour (Abrahamse & Steg, 2013; Farrow et al., 2017; see also theory of normative social behaviour, TNSB; Lapinski & Rimal, 2005). Scholars agree that waste disposal behaviours such as recycling and littering are guided by social norms (Barr, 2007; Cialdini et al., 1990; Hartley et al., 2018; Schultz, 1999). Furthermore, Borg et al. (2020) found descriptive norms to be the strongest predictor of single-use plastic avoidance. Therefore, normative messages have been used widely in communications with the public, as well as in interventions aimed at changing consumer or waste management behaviours (Cialdini et al., 1990; Salazar et al., 2021; Thomas & Sharp, 2013). For example, in a field study by De Groot et al. (2013), a normative message was found to be even more effective than an environmental message in reducing plastic bag use in a supermarket setting.

Sociodemographic Factors. In addition to psychological antecedents of behaviour, sociodemographic variables such as age, gender and level of education have been shown to regulate pro-environmental behaviour (Barr, 2003; Chen et al., 2011; Tanner, 1999), including use and recycling of plastics (Soares et al., 2021). More specifically, women are more likely to engage in reducing, reusing and recycling behaviours (Kurisu & Bortoleto, 2011; Madigele et al., 2017; Ryan et al., 1996) and were shown to have greater motivations to reduce littering in Hartley et al. (2018). Furthermore, in a study by Afroz et al. (2017), older and more highly educated people were more likely to abstain from using a plastic bag. However, findings from another study on food packaging preferences showed that younger consumers were more willing than older consumers to sacrifice their own convenience to help preserve the environment (Elgaaïed-Gambier, 2016). Furthermore, higher education levels have been associated with lower degrees of littering (Santos et al., 2005) and lower willingness to pay for plastic bags (Madigele et al., 2017).

1.2 Ocean Connectedness

1.2.1. From Nature Connectedness to Ocean Connectedness

As mentioned in Section 1.1.2.., a plethora of literature suggests that pro-environmental inclinations coincide with connectedness to the natural world (Barbaro, & Pickett, 2016; Nisbet et al., 2009; Schultz, 2002; Zelenski et al., 2015). Connectedness to nature has been associated with sustainable consumption (Dong et al., 2020), willingness to sign petitions for nature protection (Kals et al., 1999) as well as a variety of other environmentally significant behaviours (Barbaro & Pickett, 2016; Mackay & Schmitt, 2019; Martin et al., 2020).

Previous literature on human-nature relations has largely revolved around the concept of general nature connectedness (Barbaro & Pickett, 2016; Mayer & Frantz,

2004; Pritchard et al., 2019), while the human-ocean relationship has remained relatively unexplored (Pahl et al., 2017). This is rather surprising, as the wellbeing of oceanic environments is a prevalent issue and has recently attracted public as well as scientific concern worldwide (Haward, 2018; Schuldt et al., 2016; White et al., 2016; Wyles et al., 2014), and the importance of personal connections with the ocean is being increasingly recognised (McKinley & Burdon, 2020). Furthermore, understanding about oceans and their significance, or 'ocean literacy', has become an important topic (Costa & Caldeira, 2018), and the beneficial effects of marine environments on human health and wellbeing are increasingly documented (McGowan et al., 2016; White et al., 2020; Wyles et al., 2014). Moreover, little differentiation has been made in previous nature connectedness literature between terrestrial and aquatic environments (as reviewed in McKinley & Burdon, 2020). The two are markedly different in terms of landscape and biota as well as the natural resources and utility that they provide. For example, aquatic environments provide unique opportunities for recreational activity, and are therefore likely to hold significant psychological value. On the other hand, marine environments may be perceived by many as vast, remote or 'unknown', creating psychological distance between humans and the ocean and thus demotivating protective measures and behaviours (McKinley & Burdon, 2020; Pahl et al., 2017). Whilst the level of conceptual overlap between nature and ocean connectedness has not yet been established, it is probable that an affinity towards the oceans is a particularly potent motivator for 'pro-marine behaviours', such as supporting sustainable fishing and minimising plastic waste (White et al., 2016; Wyles et al., 2013).

Previous research on place attachment has addressed perceived attachment to coastal regions and associated environmental beliefs or behaviours (e.g. Spence et al., 2018; Tonge et al., 2015). However, this line of research tends to focus on confined areas of interest, such as coastal parks or protected reserves, and not on general

connectivity to the marine environment. Ocean connectedness merits a particular empirical focus because it could provide a powerful link between day-to-day experiences, decisions and higher-order values. Pahl et al. (2017) suggested that emotional affinity, or 'passion' for the ocean might trigger more sustainable behaviour when making purchase decisions. Therefore, ocean connectedness can help link everyday behaviours that contribute to environmental problems with people's more generic system of values and emotions that might not be active otherwise at the point of decision. Ocean connectedness is defined here as a psychological sense of belonging with the natural marine environment.

1.2.2. Theoretical Underpinnings and Operationalisations of Nature Connectedness

Nature connectedness is thought to involve affective as well as cognitive aspects (Hind & Sparks, 2008; Mayer & Frantz, 2004; Perrin & Benassi, 2009). Some operationalisations of nature connectedness address emotional affinity towards nature: Kals et al. (1999) suggested that feelings of love towards and unity with nature are essential for nature-protective behaviour, and that this emotional affinity toward nature stems from previous and present experiences in natural environments. Similarly, according to Schultz (2000), environmental connectedness and concern are fostered by feelings of empathy towards nature. Moreover, in a study by Hind and Sparks (2008), an affective connection with nature predicted people's intentions to engage with and spend time in nature, whereas an environmental identity had no further contribution to such intentions. These findings align with the biophilia hypothesis (Wilson, 1984; Wilson, 1993) which advocates for the innate affiliation that humans have to nature. This emotional affiliation is thought to originate from the evolutionary bond between humans and nature, and it manifests in a need to be with and belong to the natural world.

Mayer and Frantz (2004) developed the Connectedness to Nature Scale (CNS) as a measure of dispositional emotional connection with the natural world. This widely used scale consists of fourteen items, including statements such as "*I think of the natural world as a community to which I belong*". The scale has high validity, as evidenced by correlations with attitude towards the environment (e.g. the New Environmental Paradigm scale; Dunlap et al., 2000) and environmental identity measures (Mayer & Frantz, 2004; Olivos et al., 2011).

An alternative conceptualisation of nature connectedness focuses on the cognitive schemata of the self-nature connection. Clayton (2003) operationalised connectedness with nature as a primarily cognitive concept, an individual's evaluation of the extent to which nature contributes to their personal identity. Connectedness with nature can, therefore, be conceptualised as environmental identity; encompassing attitudes, values and behaviours that reflect an individual's self-concept. Furthermore, according to Schultz's (2001; 2002) conceptualisation, nature connectedness contains both cognitive (connectedness) and affective (caring) elements, as well as a behavioural (commitment) component of the human-nature relationship. As such, it can be understood and assessed as *inclusion with nature*: the overlap between an individual's self-construal and the natural world. Following this conceptualisation, Schultz (2001) developed the Inclusion of Nature in the Self scale (INS). The scale consists of sets of two circles labelled "self" and "nature" with an increasing level of overlap, and respondents choose the set of circles that best depicts their perceived relationship with nature. The scale has been shown to correlate with scores on the CNS (Mayer & Frantz, 2004) as well as with biospheric concern and pro-environmental behaviour (Schultz, 2001), providing evidence of its convergent validity.

In addition to these explicit measures, nature connectedness can be assessed as an implicit, automatic association between the self and natural environments: Schultz et

al. (2004) used an adapted implicit association test paradigm (IAT; Greenwald et al., 1998) to measure implicit nature connectedness, the strength of automatic associations between self and nature, in comparison to associations between self and built environments (discussed in more detail in Chapter 4). Schultz et al. (2004) found the nature IAT scores to correlate positively with biospheric concern and scores on the INS measure.

Regardless of the differences in conceptualisations of nature connectedness, the various measures of psychological connection with nature all attempt to establish the degree to which nature is incorporated into one's self-definition (Mackay & Schmitt, 2019). Self-definition is considered a key determinant of attitudes, personal goals and behaviour (e.g. Baumeister, 1999; Tajfel & Turner, 1979), and when nature is a fundamental part of this self-definition, threats to the natural world may be experienced on a personal level or perceived as more severe (Schmitt et al., 2019). Those with a high degree of nature connection may, therefore, be more inclined to engage in attempts to produce pro-environmental outcomes (Schmitt et al., 2018), as evidenced previously in both correlational studies (e.g. Geng et al., 2015; Bamberg & Möser, 2007; Martin et al., 2020) and in experimental research (e.g. Arendt & Matthes, 2016; Mackay & Schmitt, 2019; Soliman et al., 2017).

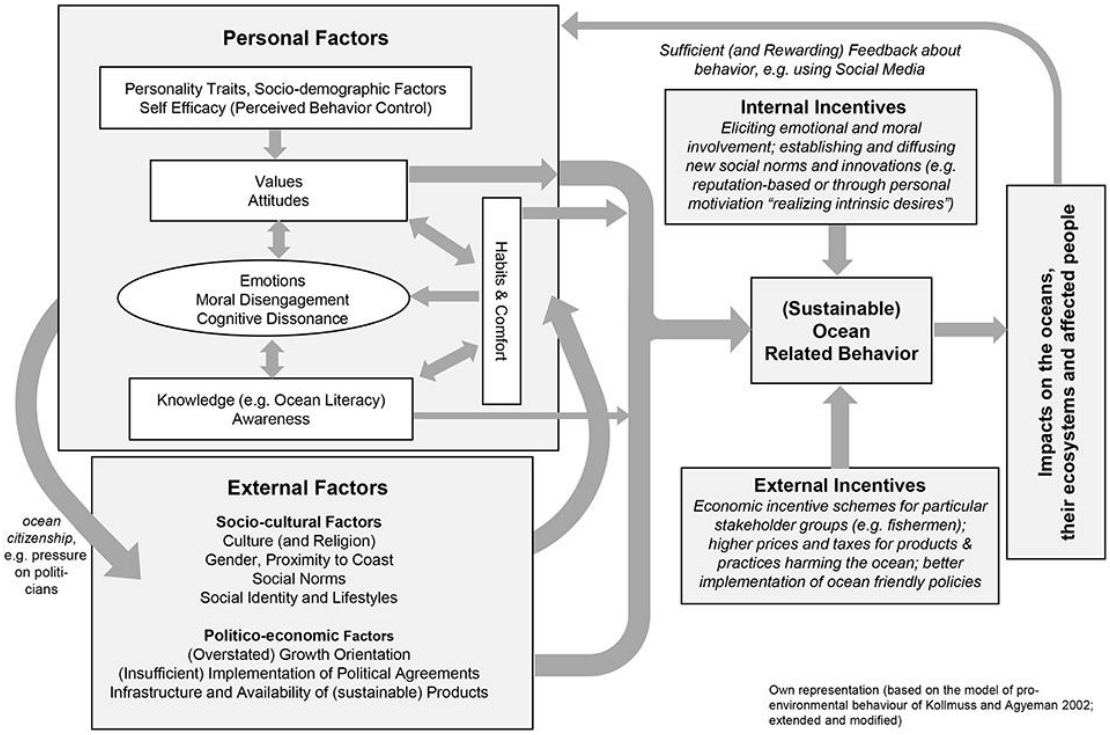
1.2.3. Ocean Connectedness and Pro-Environmental Behaviour

The concept of ocean connectedness is novel, and therefore no scientific evidence exists yet that links it to pro-environmental behaviours. The importance of harnessing a psychological connection with the ocean and including ocean connectedness in the discourse about ocean health has been recognised in recent scientific literature. Stoll-Kleeman (2019) formulated a conceptual model of factors impacting ocean-relevant

pro-environmental behaviour (see Figure 2), based on the Model of Pro-environmental Behaviour by Kollmuss and Agyeman (2002).

Figure 2

Conceptual Model of Factors Influencing Ocean-related Sustainable Behavior by Stoll-Kleeman (from Stoll-Kleeman, 2019).



The conceptual model by Stoll-Kleeman (2019) is informed by existing literature on the relationship between ocean literacy and behaviour change, and as such involves factors already embedded in the notion of ocean literacy, such as knowledge and awareness about marine issues. As noted by McKinley and Burdon (2020), the current conceptualisations of ocean literacy (e.g. definition by College of Exploration, 2013) do not incorporate and consider emotional processes in the development of ocean literacy and related behavioural changes to a sufficient degree. For example, according to the traditional ocean literacy framework (College of Exploration, 2013), the

connection between humans and the oceans is one of the *essential principles of ocean science* ("The ocean and humans are inextricably interconnected"; College of Exploration, 2013). However, fostering a psychological connection with the oceans as a key objective of ocean literacy efforts may not have been sufficiently realised to date. Similarly, Stoll-Kleeman (2019) discusses the importance of values, such as one's moral standing in relation to marine issues, in the goal of achieving effective ocean literacy and marine conservation, bearing relevance to the discussion around connectivity with the ocean.

As mentioned previously, a strong psychological connection with the oceans may motivate 'pro-marine' or ocean-related behaviours, such as supporting sustainable fishing and minimising oceanic pollution (White et al., 2016; Wyles et al., 2013). Efforts to connect people with the oceans can be observed in public and media communications: For example, nature documentaries such *Blue Planet II* can be considered an attempt to bring people closer to marine environments and provide an opportunity to experience the wonders and awe therein, reducing alienation from the oceans and, ultimately, potentially producing pro-marine inclinations and behaviour. Depicting marine biota in the recently introduced European Union packaging labels (European Commission, 2020; see Figure 3) can be similarly regarded as a prompt 'connecting the dots' not only between consumer behaviour and its potential environmental outcomes, but also between humans and the marine environment. Similar conservational communications involving images of charismatic marine species in distress were used in recently published studies by Luo et al. (2022), where the use of recycling signage depicting a marine animal trapped in plastic debris reduced plastic waste by 17%. Therefore, a preliminary theoretical and evidence base exists that assumes the relevance of a close human-ocean relationship in marine-relevant behaviours, especially plastics use and its post-use management.

Figure 3

Harmonised European Union -Wide Marking Specifications for Beverage Cups (from European Commission, 2020).

1.2.4. Promoting Ocean Connectedness

Ocean connectedness can be brought about in several ways, for example by mere engagement: It is likely that people who live closer to the coast or who are more involved in marine and coastal activities feel more connected to the ocean (Stoll-Kleemann, 2019; for nature connectedness see for example Mayer et al., 2009; Schultz & Tabanico, 2007). Regular and frequent experiences in marine and coastal environments through the life span are likely to strengthen *trait* ocean connectedness, that is, connectedness as a dispositional quality. In addition, actively learning about the oceans can help foster ocean connectedness (e.g. Kossack & Bogner, 2012; Liefländer et al., 2013). For example, promoting ocean literacy may be a viable strategy for strengthening ocean connectivity (Guest et al., 2015). Taking part in activities by the coast that are perceived as particularly meaningful, such as beach cleans (Wyles et al., 2017), or fostering place attachment to coastal locations in other ways, such as through visits to marine parks (Halpenny, 2010; Pittman et al., 2019; Ramkissoon et al., 2012), can similarly help strengthen ocean connectivity.

Existing literature suggests that direct physical contact with nature is decreasing (Rosa et al., 2018). Furthermore, developing ocean connectedness can be a challenge for

individuals who do not have access to coastal and marine environments. Modern technologies such as Virtual Reality (VR) can be used to provide these individuals and others with interactive and 'immersive' coastal or oceanic experiences: Even brief exposures to a nature setting in VR have been shown to increase nature connectedness (Breves & Heber, 2020; Yeo et al., 2020). Therefore, in addition to dispositional connectivity, *state* ocean connectedness can be promoted momentarily, potentially with the objective of influencing behaviour and decisions immediately after. The means of promoting state ocean connectedness are discussed in more detail in Chapter 4.

1.3 Single-Use Plastic Packaging

Of the over 360 million metric tonnes of plastic produced annually (PlasticsEurope, 2021), around 40% are used for packaging applications (Geyer et al., 2017), most of which are single-use by nature. In Europe alone, plastic packaging demand amounts to nearly 20 million metric tonnes annually (PlasticsEurope, 2021). Packaging for foodstuffs provides a number of essential functions including hygiene, transportability and protection (Marsh & Bugusu, 2007). As such, packaging contributes to sustainability within the fast-moving consumer goods (FMCG) sector by enabling longer shelf life and reduced food wastage (Verghese et al., 2015). Moreover, packaging helps one distinguish between products and brands in the store and may thus determine one's choice of product. In addition, packaging communicates brand meaning (Underwood, 2003) and it can provide the consumer with written or visual testimonies of brand values such as ethicality and environmental consciousness (Bech-Larsen, 1996). Furthermore, plastic is often the preferred material for single-use packaging due to its well-known advantages over other material types: Plastic is lightweight, malleable, durable, relatively inexpensive, and resistant to corrosion (Andrary & Neal, 2009). However, due to the challenges associated with its post-use management and

potential to pollute the oceans, single-use plastic packaging poses a considerable threat to the natural environment. As a result, researchers and companies have recently put considerable effort into minimising the environmental impact of single-use packaging (Sundqvist-Andberg & Åkerman, 2021). Similarly, consumer demand for packaging sustainability is currently at its all-time high (Boz et al., 2020; Schnurr et al., 2018).

1.3.1. Packaging Sustainability

Sustainable packaging – also referred to as 'environmentally-friendly', 'eco-friendly' or 'green' packaging (Prakash & Pathak, 2017) – has various definitions: According to Steenis et al. (2017, p. 287), sustainable packaging is "packaging that has a comparatively low environmental impact as measured by life-cycle assessment models". In contrast, the definition by Magnier et al. (2016) encompasses the environmental impact of the offering or product as a whole: Sustainable packaging is described in Magnier et al. (2016, p. 132) as "the endeavour to reduce the product's footprint through altering the product's packaging, for example, by using more environmentally-friendly materials". Moreover, the definition suggested by Han et al. (2018) comprises the use of raw materials, processes of production and management upon disposal of packaging. This conceptualisation of packaging sustainability proposes a shift towards the use of recycled materials and renewable resources, energy-efficient production, and post-use value recovery through biodegradation, reuse or recycling. All in all, a transition from a linear take-make-dispose model towards a *circular economy,* where the circular use of limited natural resources throughout the packaging life cycle is practised and maximised, is a desirable and often prioritised development on the packaging sustainability agenda (European Commission, 2018).

It should be noted that these definitions of sustainability primarily pertain to the *environmental* sustainability of packaging, without consideration for the social aspect of

sustainability (e.g. principles of social justice; Nordin & Selke, 2010) or its economic dimension (e.g. fulfilment of a circular economy to achieve economic growth; Batista et al., 2018). Similarly, throughout this thesis, the terms '*sustainability*' and '*sustainable*' are used to refer to the environmentally relevant aspect of sustainability.

The objective of improving sustainability in the packaging sector has generated various national initiatives and programs. In the UK, the Waste and Resources Action Programme (WRAP) has contributed to the redesigning of the plastics system since 2000. They currently lead the UK Plastics Pact initiative and report a 46% reduction in problematic and unnecessary plastic items in the UK since 2018 (WRAP, 2021). Furthermore, according to their recent audit (WRAP, 2021), the UK reached the target of 70% of plastic packaging being reusable, recyclable or compostable in 2020 (WRAP, 2021). In the US, the Sustainable Packaging Coalition has taken action toward sustainability of packaging since 2005 and envisions a closed loop system for all packaging materials (GreenBlue, 2011). Thus, although improving packaging sustainability has been a central objective within the packaging sector for the last two decades (Azzi et al., 2012; Verghese et al., 2015), many companies remain dependant on environmentally degrading packaging options, in part due to technical challenges hampering a more widespread realisation of novel packaging solutions such as bio-based packaging (Guillard et al., 2018). Therefore, packaging design for the environment is a concept of immense interest to the industry and its various stakeholders, as well as to academic scholars, today more than ever (Herrmann et al., 2022; Phelan et al., 2022). Similarly, as the successful implementation of sustainable packaging applications is contingent on consumer uptake and acceptability, research on consumer perceptions and behaviour in regards to packaging has been on the increase (see e.g. Ketelsen et al., 2020; Otto et al., 2021).

1.3.2. Consumer Perceptions and Responses regarding Packaging Sustainability

Today's consumers are increasingly cognizant of the environmental impact of packaging. Yet, packaging eco-friendliness has been recognised as a critical factor for determining consumer purchasing decisions for some time (Rokka & Uusitalo, 2008; Thøgersen, 1999; van Birgelen et al., 2009). More recently, in an international study by Popovic et al. (2020) with survey data from eleven countries, most consumers (73%) reported a willingness to pay more for environmentally friendly packaging. No definition for 'environmentally friendly' packaging was provided in the consumer survey, however. In a review by Otto et al. (2021), European consumers were found to judge packaging sustainability on the basis of its contribution to the circular economy (i.e. recyclability), as well as by the natural look of the material and design. Magnier and Crié (2015) defined sustainable (or environmentally friendly) packaging design, from the consumer perspective, as "a design that evokes explicitly or implicitly the eco-friendliness of the packaging" (Magnier & Crié, 2015, p. 361). As postulated by the cue utilisation theory (Olson, 1987), consumers rely on a set of cues that indicate specific product attributes, such as sustainability, before arriving at an evaluation of the product and ultimately at a purchasing decision. The cues on packaging that may signal sustainability can be structural (e.g. recyclability or material), graphical (e.g. colours, images or logos), or informational (e.g. sustainability claims; Magnier & Crié, 2015). Lindh et al. (2016) showed that material was the most important attribute on which consumers based their packaging sustainability judgments. Furthermore, Herbes et al. (2020) found that consumers in Germany, France and the US rely on packaging labelling, such as the recycling label, as the primary cue that signals packaging sustainability.

These two environmentally relevant packaging attributes[3], namely *packaging material* and *recyclability labels*, and consumers' responses to them, are the primary topics of interest in the remainder of this literature review and throughout the thesis. As discussed, consumers readily identify and engage with these attributes when making their evaluations about packaging sustainability. However, the impacts of these attributes on consumer responses, such as purchase intentions and affective reactions, merit further examination for various reasons: Firstly, although previous research has shown that consumers value packaging recyclability (Rokka & Uusitalo, 2008; Songa et al., 2019), trends in environmental consciousness are volatile (McCallum & Bury, 2013). Furthermore, the UK public have expressed confusion around recycling rules and labelling (WRAP, 2018), which may have shifted consumers' demand for and overall attitude towards recyclability. Another issue is trust: Consumers in the UK have previously attributed the failure to recycle their waste to mistrust in the waste management sector and the local authorities (WRAP, 2017). Similarly, sustainability cues on packaging, such as recyclability claims, may be perceived by some consumers as 'greenwashing'[4] (Szabo & Webster, 2020). Therefore, lack of trust in the waste management system and in environmentally relevant packaging credentials may have shaped the trends in consumer response to packaging recyclability lately.

Similarly, how consumers respond to different types of packaging raw material (e.g. plastic or glass) is worth investigating. It bears noting that judging the environmental sustainability of different material types is not a straightforward task: Plastic packaging may produce relatively large volumes of persistent waste, but conclusions as to which material type is most environmentally friendly or sustainable

[3] Because there is debate regarding the relative sustainability of different material types for packaging (Pasqualino et al., 2011; von Falkenstein et al., 2010), the term *environmentally relevant packaging attributes* is used here (instead of *packaging sustainability attributes*) to refer to those attributes of packaging that are generally perceived to affect its sustainability either positively or negatively.
[4] Greenwashing is defined by the Oxford English Dictionary as "The creation or propagation of an unfounded or misleading environmentalist image" (OED Online, n.d., Definition 1).

are equivocal (Pasqualino et al., 2011; von Falkenstein et al., 2010; discussed in more detail in Chapter 3). The emphasis that today's consumers place on packaging material is likely due to the global marine plastic pollution issue attracting public and scientific concern (Dunn et al., 2020; Haward, 2018). The alleged phenomenon of 'plastic bashing' (e.g. Otto et al., 2021) may have shifted sustainability perceptions in regard to packaging material types, but whether this effect is reflected in consumer response (e.g. willingness to buy) has received little research attention (but see Dunn et al., 2020 study on packaging choice).

Consumer Response to Packaging Recyclability. As discussed, one of the apparent indicators of packaging sustainability is the recyclability label. Consumers are known to value packaging recyclability (Heiniö et al., 2017; Songa et al., 2019; Venter et al., 2011) but research on the impacts of recycling labels and logos on consumer responses, such as purchase intentions, is somewhat scarce. For example, Rokka and Uusitalo (2008) showed that consumers are willing to pay more for packaging that is recyclable; however, this study used written vignettes to signal recyclability instead of actual labels on the packaging. Similarly, Klaiman et al. (2016) demonstrated that consumers received positive utility from packaging recyclability when presented with a product choice task. Thus, verbal claims of packaging recyclability can guide product choice. Recyclability logos were investigated by Songa et al. (2019) who found more positive emotional reactions to packaging with a recyclable logo than with a nonrecyclable logo. As recyclability of single-use packaging is primarily communicated to consumers with logos, this way of conveying information about recyclability is worth investigating further.

Eco-labels pertaining to product ethicality or sustainable sourcing, as well as consumer characteristics associated with their use, have been explored in previous

literature (Grunert et al., 2014; Horne, 2009; Thøgersen et al., 2010). Unlike these sustainability claims that often proclaim environmental responsibility at the product's origin or manufacturing process, recyclability claims pertain to the packaging and its potential as an environmentally advantageous option. That is, recycling labels do not only communicate sustainability but also provide the consumer with instructions for appropriate disposal that is ultimately within the consumer's discretion. Therefore, recycling labels on packaging differ from eco-labels in that they serve multiple functions, and thus their role in consumer decisions merits further examination.

Although the literature on determinants of perceived importance of packaging recyclability is scarce, Klaiman et al. (2016) distinguished consumers with higher willingness-to-pay (WTP) for packaging recyclability from those with lower WTP for recyclability by their reported motives for recycling: Those with higher WTP not only more often reported that they recycle in order to feel good for helping the environment, but also that they do so in order to preserve marine environments. This evidence suggests a link between purchasing recyclable packaging and concern over the well-being of oceanic environments.

Consumer Response to Packaging Material. In addition to packaging recyclability, the type of packaging material (such as plastic or glass) can affect perceived sustainability and thus purchasing behaviour. Lindh et al. (2016) showed that material was the most important attribute on which consumers based their packaging sustainability judgments. This finding is likely due to consumers being able to identify packaging material more readily than other sustainability cues. According to a review by Ketelsen et al. (2020), consumers tend to perceive plastics and metal as the least sustainable material types, whereas paper-based packaging is often judged more positively in terms of its environmental impact. Yet, in a study by Klaiman et al. (2016),

consumer demand (operationalised as willingness to pay) was highest for plastic packaging, followed by glass, carton and aluminium. As discussed, the plastic pollution crisis has likely made consumers more critical about plastic packaging since. Furthermore, today's consumers respond more positively to packaging produced using circular design strategies, such as biodegradable packaging, than to packaging with superior functional properties (Steenis et al., 2018). Even though there is considerable debate over the environmental sustainability of such materials (Hottle, 2013; Iwata, 2015), and consumers' perceptions of packaging sustainability may not correspond to findings from comprehensive life-cycle analyses (Boesen, et al., 2019), packaging material likely plays a role in determining purchasing decisions.

In addition to investigating consumer responses to plastic packaging, responses to three other commonly used material types for beverage packaging, namely glass, aluminium and carton, are examined in the work presented in this thesis. Although consumer preferences across these material types is not addressed as a central research question *per se*, findings on the impact of environmental orientations (e.g. ocean connectedness) on such preferences are reviewed in this thesis, particularly in Chapters 2 and 4.

1.4 Overview of Thesis

1.4.1. Aims of Thesis

The research outlined in this thesis explores the motivational underpinnings of consumer behaviour in regard to single-use packaging. More specifically, I present empirical work examining the relevance of affective and cognitive connectedness with the marine environment to how consumers respond to single-use packaging and its environmentally relevant properties. Moreover, the conceptual profile of the novel ocean connectedness construct, particularly as it compares to that of nature

connectedness, is explored in this thesis. The outlined research aims to address four principal research questions:

RQ1) How do consumers respond to environmentally relevant attributes of single-use packaging, and what is the role of ocean connectedness in shaping these views?

RQ2) Does the human-nature relationship amongst other environmental orientations impact consumer responses to the circular design and end-of-life scenarios of packaging?

RQ3) Does ocean connectedness with its role in shaping environmental intentions differ from overall nature connectedness, and how?

RQ4) Can state ocean connectedness be induced using Virtual Reality technologies, and does this subsequently alter consumer responses to the environmentally relevant attributes of packaging?

By seeking answers to these questions, the research reported in this thesis aids our understanding of the antecedents of pro-environmental consumer responses, and ultimately behaviour. Furthermore, I showcase that the unique psychological importance and value of the marine environment can potentially be utilised to help conserve the oceans from the harms of anthropogenic pollution.

1.4.2. Outline of Studies

The above research questions are addressed in five studies. Firstly, in Studies 1 and 2 (Chapter 2) conducted in laboratory conditions and online, respectively, consumer responses to single-use packaging and its environmentally relevant features were investigated. These studies used an experimental research design where packaging recyclability and type of packaging raw material were manipulated systematically. In addition, ocean connectedness was assessed and its moderating role in consumer responses to packaging was studied (RQ1).

Secondly, Study 3 (Chapter 3) involved a large-scale online survey in which consumers' responses to environmentally relevant properties of packaging across all phases of its lifecycle were assessed (RQ2). More specifically, consumer responses to the origin, design and post-consumption scenarios of packaging were assessed using the Kano model of consumer satisfaction. Furthermore, different consumer segments were created based on environmental orientation variables (e.g. ocean connectedness and nature connectedness) and sociodemographic factors, and differences in packaging responses across these consumer profiles were explored. In addition, the collected survey data further enabled the appraisal of whether ocean connectedness is in fact a unique construct: The similarities and disparities between ocean connectedness and overall nature connectedness, in regard to their associations with other environmentally relevant variables and consumer responses to packaging, were evaluated on the basis of the rich consumer data (RQ3).

Finally, Studies 4 and 5 (Chapter 4) examined the potential of VR technologies in connecting people with the natural marine environment both explicitly and implicitly (RQ4). In two laboratory studies, I induced state ocean connectedness using VR and immediately assessed responses to environmentally relevant features of single-use packaging. I compared these outcomes on ocean connectedness and packaging

responses between two experimental groups in Study 4 (ocean VR and urban VR), and across three experimental conditions in Study 5 (ocean VR, built VR and a control condition that consisted of a cognitive task).

Chapter 2: Ocean Connectedness and Consumer Responses to Single-Use Packaging

This chapter is a version of a published peer-reviewed paper:

Nuojua, S., Pahl, S., & Thompson, R. C. (2022). Ocean connectedness and consumer responses to single-use packaging. *Journal of Environmental Psychology, 81*, 101814.

2.1 Introduction

As noted in Chapter 1, disposable food and beverage containers constitute a major part of marine plastic litter and are frequently encountered in coastal areas (Barnes et al., 2009). The abundance of these items in the marine environment is solely due to humans (Pahl et al., 2017). For example, inappropriate disposal of plastic packaging items, either within the household or in public arenas, contribute to marine plastic pollution (Sheavly & Register, 2007). Going further 'upstream', although consumers can only operate within the confines of availability of goods and waste management systems, their decisions are part of the problem (Coe & Rogers, 2012). In order to effect change in consumption habits and consequently reduce plastic packaging waste, it is essential that we understand what drives these decisions.

The empirical research presented in this chapter investigates responses to single-use packaging varying in recyclability and material and asks whether the novel construct of ocean connectedness interacts with these evaluations by consumers. A brief literature review is presented next where consumers' environmental orientations

associated with packaging preferences are discussed. In addition, operationalisations of consumer response, namely rational and affective (i.e. emotional) approaches, in existing consumer research are reviewed, in the context of single-use packaging and its environmentally relevant attributes.

2.2 Literature Review

2.2.1. Relationship with Nature and Consumer Response to Sustainable Packaging

As noted in the previous chapter, packaging sustainability has an impact on consumers' evaluations and choice of packaging. Yet, not all consumers' purchasing is affected by the extent to which product packaging is sustainable (e.g. Heidbreder et al., 2019), as competing product attributes, such as price and quality, are often prioritised (Ketelsen et al., 2020). Most existing research on the environmentally relevant attitudes associated with responses to sustainable packaging have looked at environmental concerns and beliefs: Packaging sustainability is important to consumers who are concerned about the environment (Koenig-Lewis et al., 2014). Furthermore, those who favour sustainable packaging are more likely to think that purchasing products in sustainable packaging solves environmental problems, whereas those who place less importance on packaging sustainability do not believe so (Martinho et al., 2015). This link between concern and behaviour seems to require the situation-specific cognitions effected by environmental concerns to be considered and assessed, rather than environmental concern as a general orientation (Bamberg, 2003). In Hartley et al. (2018), concern and risk awareness of marine litter were shown to predict intentions to engage in actions to reduce litter entering the oceans, such as buying re-usable products and picking up litter.

Whereas environmental awareness and concern often reflect cognitive perceptions and beliefs, nature connectedness depicts one's affective, cognitive and experiential relationship with the natural environment. As reviewed in Chapter 1, nature

connectedness is thought of as a powerful predictor of efforts to conserve nature as embedding oneself with nature means that harm to the environment is conceptualised to an extent on a personal level. Jaiswal and Bihari (2020) found nature connectedness to predict green purchase intentions, such as choosing sustainable packaging. Perceived environmental responsibility was found to mediate this link between connectedness and behaviour. Recently, Kautish et al. (2021) investigated the relationships among environmental concern, nature connectedness, love for nature, perceived consumer effectiveness, and choice behaviour for plastic consumption in a sample of Indian consumers. While environmental concern did not directly influence plastic consumption in this study, connectedness to nature was found to partially mediate the relationship between concern and plastic consumption behaviour. Overall, previous research indicates that psychological connectedness with nature is associated with packaging perceptions and responses, but the exact means and mechanisms of this association are not yet clear.

As today's consumers readily associate plastics and packaging waste with harm to marine environments (Trivium Packaging, 2020), it is reasonable to expect that connectivity with the ocean shapes consumers' responses to sustainability cues on packaging. Ocean connectedness, as well as the relationship between ocean connectedness and plastic- or packaging-relevant perceptions and behaviours, have not been addressed previously. Therefore, the empirical work presented in this chapter endeavours to investigate and establish this relationship. Evidence demonstrating such link can provide empirical support for interventions, such as messaging and labelling, that make ocean connectedness more salient in the purchase situation, to promote sustainable decision-making.

In sum, and as discussed in Chapter 1, ocean connectedness may motivate pro-environmental behaviours that are particularly relevant to marine environments, such as

sustainable packaging choice and avoidance of plastic. Therefore, in light of the reviewed evidence, higher levels of ocean connectedness are expected to be associated with preferences for sustainable (here: recyclable) packaging. Furthermore, it is believed that those higher in ocean connectedness are likely to be wary of packaging that is made of plastic.

2.2.2. Assessment of Consumer Response to Packaging Sustainability

As the assessment of actual consumer behaviour as it unfolds is laborious and thus only rarely carried out in research activities, studies on consumer behaviour often utilise and assess various proxies of behaviour. A traditional method for analysing consumer preferences is choice-based conjoint analysis, where respondents state their preferences by choosing a product from a selection of products or product profiles each representing a unique combination of the product attributes of interest (Carroll & Green, 1995; Green & Srinivasan, 1990). Conjoint analysis has been used previously to gauge the utilities that environmentally relevant packaging attributes render to consumers (Isa & Yao, 2013; Rokka & Uusitalo, 2008). Another popular methodology in consumer research is the willingness to pay paradigm (Breidert et al., 2006) which can be used, for instance, to determine the highest monetary amount that a consumer would be willing to pay for a product attribute. For example, Klaiman et al. (2016) demonstrated that consumers are willing to pay a premium for packaging recyclability, and especially so when the packaging is made of plastic.

The studies reported here used a rating-based experimental design where products in different types of packaging were rated on a series of scales that indicate consumer liking and purchase intent. A factorial design where the material type and recyclability of packaging were varied systematically enabled assessment of consumer

response that is robust to social desirability effects[5] in comparison to direct questioning formats or paradigms where only one example product is evaluated (Cerri et al., 2019; Walzenbach, 2019). Furthermore, using a rating-based design enables attainment of rich consumer attitude data, as there are virtually no limits to the number of rating scales used per product profile (naturally while being mindful of respondent fatigue). Finally, rating-based paradigms may be more sensitive than choice-based paradigms in detecting the impacts of consumer characteristics (e.g. ocean connectedness) as moderators of consumer response (Asioli et al., 2016).

Willingness to Buy and Affective Response. Intention to behave generally renders a moderate to good indication of true behaviour across various behavioural domains (Ajzen, 1991; Armitage & Conner, 2001; Sheeran, 2002; Sheeran & Webb, 2016), including pro-environmental behaviour (Bamberg & Möser, 2007). Willingness to buy (WTB) has been used in previous research as a measure of purchase intent (Bartels & Onwezen, 2014; De Magistris & Gracia, 2008; Wang & Lamb, 1983). However, as noted by Koenig-Lewis et al. (2014), and by Magnier and Schoormans (2015), antecedents of behavioural intention often assume rationality and logic in behaviour and may overlook the affective element in decision-making. This is problematic, as emotional components are thought to be eminently present in environmental awareness, and more specifically in consumption and waste management behaviours (Carrus et al., 2008; Kollmuss & Agyeman, 2002; Meneses, 2010). In the context of general consumption, one's anticipated emotional response to a product or service can be a particularly strong predictor of future decision to buy (Morris et al., 2002; Perugini & Bagozzi, 2001). Similarly, anticipated positive emotions have been

[5] Social desirability is defined by Chung and Monroe (2003, p. 291) as "the tendency of individuals to deny socially undesirable actions and behaviors and to admit to socially desirable ones".

shown to guide pro-environmental purchase decisions (Kim et al., 2013; Rezvani et al., 2017). Therefore, when consumer evaluations of a product are of interest, it is desirable to consider both consumers' stated intentions to purchase and their anticipated emotional reactions.

In addition to anticipated positive emotional response, self-conscious emotions such as guilt have been shown to shape consumer behaviour (Dahl et al., 2003; Tangney, 1999). In particular, decisions to purchase products with perceived ethical or ecological ramifications are guided by anticipated guilt (Kabadayı, et al., 2015; Peloza et al., 2013). For example, Zwicker et al. (2020) found that feeling guilty about plastic use was strongly negatively associated with willingness to pay for bottled water. Yet, direct assessments of anticipated guilt responses to purchasing packaging made of different types of materials are lacking to date.

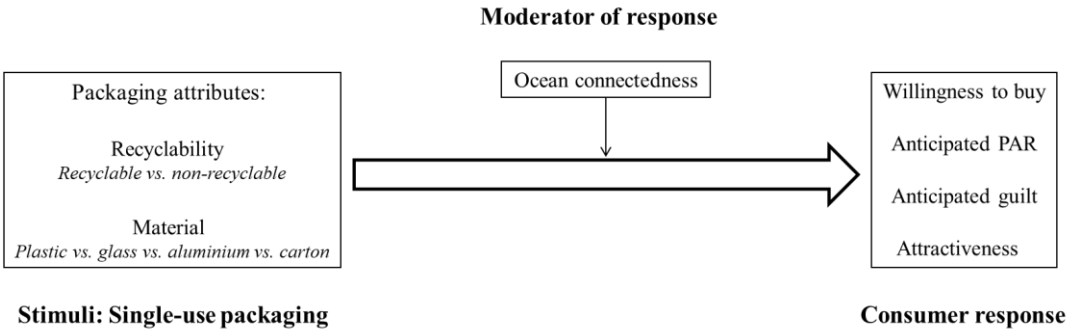
Willingness to buy and emotive response to a product can be brought about by attributes in the packaging design that draw the consumers' attention (Aday & Yener, 2014). Some consumers are attracted to functionality or detail on the label, whereas others are persuaded by overall visual appearance of the packaging (Silayoi & Speece, 2004). Visual aesthetics and perceived packaging attractiveness, therefore, can guide buying behaviour. Furthermore, evidence by Magnier and Schoormans (2015) showed that not only does packaging attractiveness predict purchase intention and affective attitude, but it also has a positive impact on perceived brand ethicality. The present research employs a thorough assessment of consumer response to packaging involving measures for WTB, anticipated affective reaction and perceived attractiveness.

2.3 Studies 1 and 2: Research Aims, Conceptual Framework and Hypotheses

Consumer responses, including WTB, anticipated positive affective reaction (hereafter referred to as PAR), anticipated guilt and perceived attractiveness regarding single-use packaging are assessed across two studies. Moreover, ocean connectedness is investigated as a potentially important moderator of these consumer responses. The conceptual framework was formulated based on the reviewed literature and is presented in Figure 4.

Figure 4

The Hypothesised Effect of Packaging Recyclability and Material on Consumer Response to Single-Use Packaging, Moderated by Ocean Connectedness



Firstly, replicating previous research, it is suggested that recyclable packaging will be rated more positively in terms of WTB, PAR and attractiveness compared to non-recyclable packaging ($H1_A$, $H1_B$, $H1_C$, respectively). On the contrary, participants are expected to show lower anticipated guilt for recyclable than non-recyclable packaging ($H1_D$).

Additionally, ocean connectedness is expected to moderate the relationship between recyclability and response, meaning that a two-way interaction effect between recyclability and ocean connectedness is expected. More specifically, those high in ocean connectedness are expected to rate recyclable packaging higher for WTB, PAR

and attractiveness than non-recyclable packaging, whereas smaller differences between the two levels of recyclability for those low in ocean connectedness are expected ($H2_A$, $H2_B$, $H2_C$, respectively).

Analogously, it is expected that those high in ocean connectedness will respond with lower anticipated guilt to recyclable than non-recyclable packaging, and this difference in guilt responses is expected to be smaller in those low in ocean connectedness ($H2_D$).

No hypotheses are formulated for the main effect of material on consumer ratings. That is, no predictions are made regarding which material types (plastic, glass, aluminium or carton) are preferred over others. However, it is predicted that, due to the wide media coverage on marine plastic pollution, as well as the frequent association between plastic and harm to marine wildlife, consumers who are connected to marine environments are sensitised towards plastic packaging in particular. Thus, a moderating role of ocean connectedness on responses to packaging material is suggested, meaning that a two-way interaction effect between material and ocean connectedness is expected. In comparison to respondents low in ocean connectedness, it is expected that those high in ocean connectedness show larger differences between plastic and the other material types in their WTB, PAR, attractiveness and guilt ratings ($H3_A$, $H3_B$, $H3_C$, $H3_D$, respectively), where plastic is viewed more negatively than the other material types.

A number of additional variables were assessed in these studies (e.g. marine litter concern; see Appendix A) but these variables and their interactions with packaging evaluations are not central to the research questions investigated in this thesis, and thus these are not discussed further here.

2.4 Study 1: Consumer Responses to Packaging in a Laboratory Setting

2.4.1. Method

Research Design and Participants. Study 1 looked into consumer responses to packaging in a sample of UK undergraduate students. Before data collection commenced, the study procedure and materials used were reviewed and approved by the University's Faculty of Science and Engineering Human Ethics Committee. The first part of the study was implemented as a survey, and the second part followed a 2 (recyclability) × 4 (material) × 3 (drink) repeated within-subject experimental design. Sixty students (36 female, 24 male) at a British university with a mean age of 20.52 (*SD* = 2.34) participated in the University's research laboratory. Fifty-one of the participants were recruited from the School of Psychology Participation Pool. Each student received one research participation point that counted towards course credit. The remaining nine students were recruited from the campus area, and snacks were provided to these students as reward for study completion.

Materials. The stimulus material used in the experimental part consisted of 24 digital images of products that were specifically created for this study (see Figure 5). These products were common beverages (water, orange juice or cola) in packaging that was presented as varying in recyclability (recyclable or non-recyclable) in the given context, as well as varying in material type (plastic, glass, aluminium or carton). Thus, each of the 24 products displayed a unique combination of the aforementioned attribute levels. Different types of drink were used in order to increase generalisability over beverages. Furthermore, by including drink type as a third attribute in the factorial survey design, it was hoped to more effectively mask the focus on environmentally relevant packaging attributes. However, the effect of drink type on consumer ratings was not of interest. The products were labelled using an existing foreign bottled water

brand name in order to create the impression of a real-life product. Following recommendations from previous literature (Magnier & Schoormans, 2015), a beverage brand unfamiliar to consumers in the UK market was used in order to avoid any pre-existing attitudes or conceptions associated with brand image.

All product attributes were signalled on the packaging either visually or verbally: Packaging recyclability was indicated with recycling labels containing both image and text which were very similar to those used on food and drink packaging in the United Kingdom (see Figure 5). Packaging material was made easily detectible by using stereotypical designs with appropriate container shape and transparency for each material type. Finally, the type of beverage was displayed in clear writing on the packaging (see Figure 5).

Figure 5

Examples of Products Used as Stimulus Material.

Measures.

Survey. The survey comprised of statements that measured ocean connectedness along with other environmentally relevant constructs that are beyond the scope of this paper (see Appendix A).

Ocean Connectedness. Six items measured connectedness to the ocean. These items were mostly adapted from the Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004) which is a valid and reliable measure of the strength of affective and cognitive beliefs of belonging with the natural world (Perrin & Benassi, 2009). Modifications were made to the phrasing of the CNS items in order to reflect connectedness with the ocean, and those items of the scale that could not be re-worded in a cogent manner were omitted. In addition to the five modified statement items ("*I have a clear understanding of how my actions affect the ocean.*", "*I often feel a sense of oneness with the ocean around me*.", "*I usually feel disconnected from the ocean*.", "*My personal welfare is independent of the welfare of the ocean.*", and "*I recognise and appreciate the intelligence of living marine organisms*.") a sixth item "*I feel very close to the marine environment*." was included in order to ensure a balance between seemingly affective ('I feel') and cognitive statementss. Each statement was scored on a 7-point Likert-scale with a range from "strongly disagree" (1) to "strongly agree" (7). Across the current sample the adapted 6-item scale demonstrated good reliability (McDonald's omega ω = .81, M = 4.86, SD = 0.99, range from 2.67 to 6.83). Further psychometrics are reported in Appendix A.

Dependent and Control Variables.

Brand Familiarity. Although the assumption was that the brand is unknown to UK residents, the possibility of participants recognising the brand was checked. Brand familiarity was assessed by the question "Are you familiar with this brand of beverage?" displayed next to an example product.

Willingness to Buy. For each picture displayed, the respondent was asked "How likely would you be to buy this product?" on a 7-point response scale from "not at all likely" to "extremely likely". Although some studies have measured WTB using two or

more items (Grewal et al., 1998; Koenig-Lewis et al., 2014), a single item was preferred in the current study in order to avoid excessive repetition.

Anticipated Affective Response. Anticipated emotional response was measured with eight items for each picture. Four of these items measured positive emotions ("Buying this product would make me feel happy/content/relaxed/joyful"; Sweeney & Soutar, 2001). These items were integrated into a scale 'Anticipated Positive Affective Response' (PAR), with internal consistency reliabilities ranging from ω = .92 to ω = .96 across the 24 products. The remaining four items were designed to measure self-conscious emotions (Onwezen et al., 2013; "Buying this product would make me feel guilty/proud/awkward/embarrassed"). While guilt was the main affective response of interest here with a hypothesised effect based on existing literature, the remaining three items were exploratory in nature and are not included in this paper. The eight emotion items were scored on a 7-point scale from "not at all" to "extremely".

Attractiveness. Perceived attractiveness of each product was assessed with the statement: "To me this product is…"; with answers given on a 7-point semantic differential scale from "unattractive" to "attractive" (Magnier & Schoormans, 2015).

Procedure. Upon their arrival at the computer laboratory participants completed the survey measuring ocean connectedness and additional exploratory concepts. Next, the participants were presented with a description of a hypothetical shopping scene (see Appendix A). Following this, participants saw a vignette explaining that they would be presented with a series of products that varied in terms of packaging material, recyclability, and type of drink (see Appendix A). It was also made clear that the recycling system in the hypothetical shopping scenario may be different from what they are used to. This information was given in an effort to minimise the impact of any pre-existing conceptions in regard to recyclability of different packaging materials.

The 24 products were subsequently presented in a randomised order. Each product was displayed on its own page and rated for WTB, anticipated affective response and attractiveness, respectively.

Data Analysis. All statistical analyses were conducted using linear mixed effects models within the R environment (R Core Team, 2017). Such models bear several advantages over traditional linear models, including an account of individual variation and suitability for repeated-measures designs (Barr et al., 2013). Hypothesis testing was done using the 'lmerTest'-package (Kuznetsova et al., 2017) which enables automated linear mixed effects modelling and testing via Satterthwaite's degrees of freedom method. It should be noted that the *p*-values retrieved by using this method are not true *p*-values, however they can be treated and interpreted as such (Kuznetsova et al., 2015). Following recommendations from existing literature (Chapman & Feit, 2015; Næs et al., 2010), participant was treated as a random variable across all computed models, whilst packaging recyclability and material (as well as drink type) were included in the models as fixed effects. Furthermore, due to the complex structure of the repeated-measures design, only random intercepts were specified for the models in order to enable model convergence (Barr et al., 2013). Therefore, baseline differences in packaging responses were assumed between participants. Statistical models are specified in detail in Appendix A.

Ocean connectedness was included in the statistical models as a continuous variable. The moderating effects of ocean connectedness ($H2_{A-D}$, $H3_{A-D}$) were inferred from interactions in the analysis of variance, and were plotted using the 'effect' function in R (Fox et al., 2019). Further comparisons were made between recyclable and non-recyclable packaging, and across the four material types, separately for high and low levels of the moderator variable using the 'emmeans' package (Lenth, 2019). Here, one

standard deviation above the sample mean represented ‘high’ and one standard deviation below the mean represented ‘low’ level of ocean connectedness (Irwin & McClelland, 2001). Furthermore, sizes of the observed effects are included in the results as parameter estimates of the fixed effects (β). As recommended by Singmann and Kellen (2019), these estimates were derived using orthogonal contrast coding. Estimates for the effects of ocean connectedness on packaging material ($H3_{A-D}$) are presented separately for each material type, with plastic as the reference category. Sensitivity analyses were conducted in order to assess statistical power in the study sample (see next section).

2.4.2. Results

Descriptive Analyses. There were no missing data, and all participants’ responses are included in the following descriptive and inferential analyses. Table 1 displays mean WTB, PAR, attractiveness, and anticipated guilt ratings across different levels of packaging recyclability and packaging material.

Table 1

Means and Standard Deviations for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt across Different Levels of Recyclability and Material (n = 60)

	Recyclability		Material			
Measure	Rec.	Non-rec.	Plastic	Glass	Alum.	Carton
WTB	4.14 (2.06)	2.59 (1.78)	3.76 (2.07)	3.71 (2.10)	3.15 (1.99)	2.85 (2.02)
Anticipated PAR	3.50 (1.67)	2.35 (1.32)	3.11 (1.63)	3.15 (1.67)	2.81 (1.54)	2.65 (1.56)
Attractiveness	4.20 (1.96)	2.73 (1.75)	3.70 (1.89)	4.02 (2.07)	3.26 (1.92)	2.87 (1.92)
Anticipated guilt	1.85 (1.30)	3.61 (2.18)	2.84 (2.05)	2.78 (2.00)	2.68 (1.98)	2.62 (1.96)

Note: Standard deviations are in parentheses.

Analysis of Rating Data.

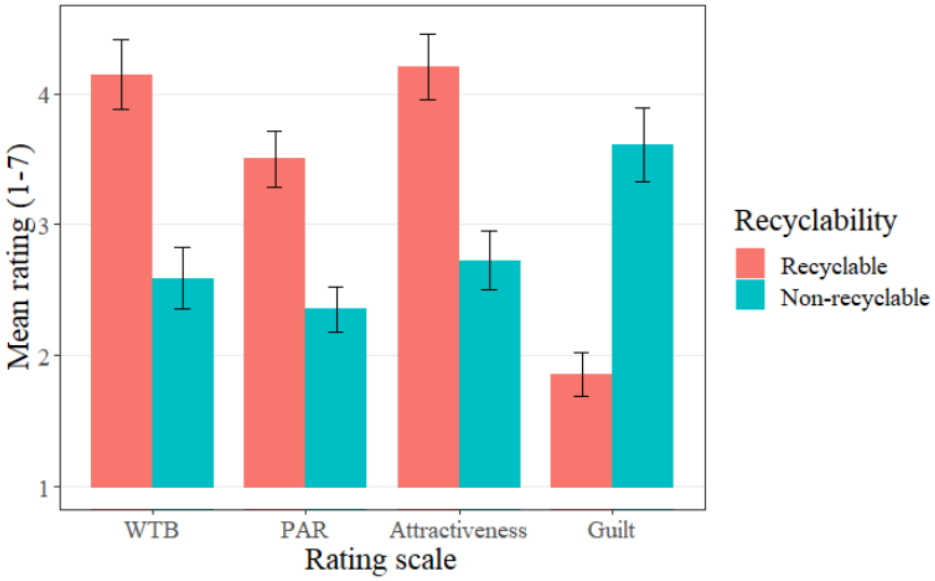
Effect of Recyclability on Consumer Ratings (Hypotheses $H1_{A-D}$).[6]

As can be seen in Table 1 and in Figure 6, average WTB, PAR and attractiveness ratings for recyclable packaging were higher than those for non-recyclable packaging. According to the simple main effects ANOVA with degrees of freedom obtained using the Satterthwaite method, this difference was significant for WTB ($F(1,1380) = 294.45$, $p < .001$, $\beta = .78$, 95% CI [0.69, 0.86]), PAR ($F(1,1380) = 356.19$, $p < .001$, $\beta = .57$, 95% CI [0.51, 0.63]), and attractiveness ($F(1,1380) = 307.96$, $p < .001$, $\beta = .74$, 95% CI [0.66, 0.82]). Furthermore, recyclable packaging was rated significantly lower for anticipated guilt than non-recyclable packaging ($F(1,1380) = 506.81$, $p < .001$, $\beta = -.88$, 95% CI [-0.96, -0.80]). Overall, recyclable packaging was rated more positively than non-recyclable packaging, which is in line with our hypotheses $H1_{A-D}$ and previous literature.

[6] As two participants reported being familiar with the brand used in the study, brand familiarity was initially added as an additional fixed effect predictor to the original WTB model. However, there was no improvement in model fit as determined by the maximum likelihood estimate, and therefore this variable was not included in further models and analyses.

Figure 6

Average Consumer Ratings for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt across Levels of Packaging Recyclability (n = 60).



Note. Error bars represent standard errors of the mean.

The Moderating Effect of Ocean Connectedness: Recyclability (Hypotheses $H2_{A-D}$).

WTB ($H2_A$). Adding ocean connectedness as a fixed effect into the original WTB model improved model fit significantly ($\chi^2(5) = 72.77$, $p < .001$). The ANOVA results showed a significant two-way interaction between recyclability and ocean connectedness for WTB ($F(1,1380) = 57.03$, $p < 0.001$, $\beta = .34$, 95% CI [0.25, 0.43]; see Figure 7 top left). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between recyclable and non-recyclable packaging more than those low in ocean connectedness in their WTB ratings ($t(1380) = 7.55$, $p < .001$, estimated marginal mean (EMM) difference: 1.33). EMMs and their confidence intervals for all post-hoc results of interest are reported in Appendix B.

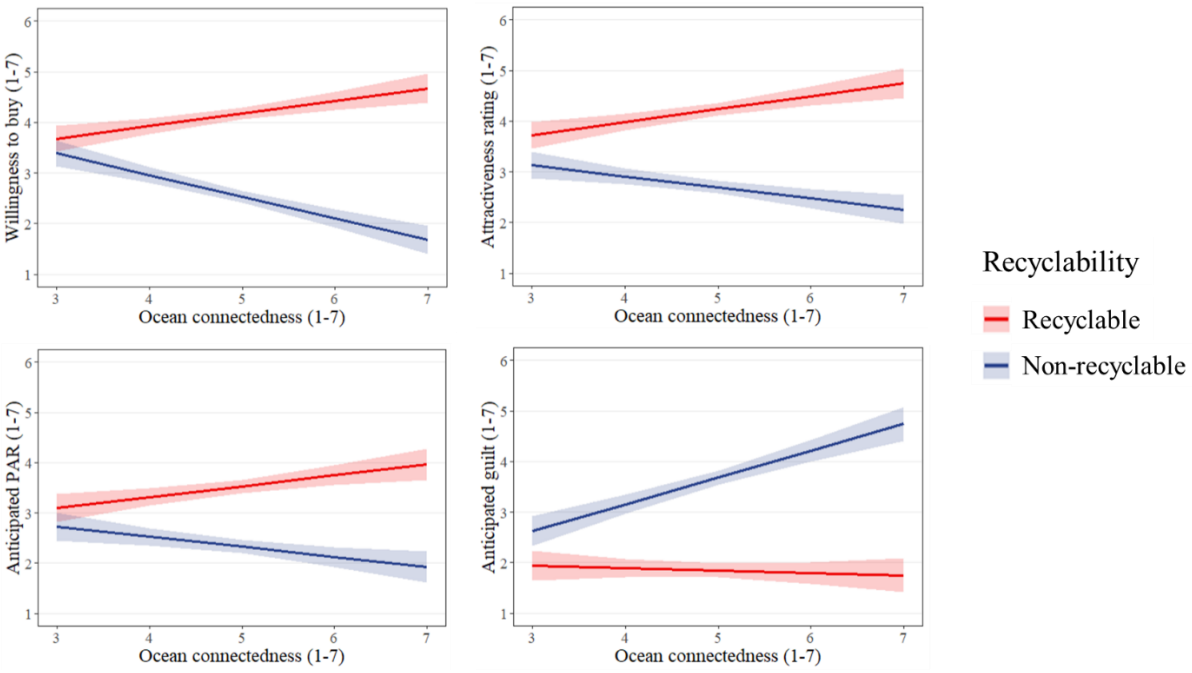
PAR ($H2_B$). Adding ocean connectedness as a fixed effect into the original PAR model improved model fit significantly ($\chi^2(5) = 53.75$, $p < .001$). A significant two-way interaction effect was found between recyclability and ocean connectedness for PAR ($F(1, 1380) = 47.54$, $p < .001$, $\beta = .21$, 95% CI [0.15, 0.27]; see Figure 7 bottom left). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between recyclable and non-recyclable packaging more than those low in ocean connectedness in their PAR ratings ($t(1380) = 6.90$, $p < .001$, EMM difference: .82).

Attractiveness ($H2_C$). Adding ocean connectedness as a fixed effect into the original attractiveness model improved model fit significantly ($\chi^2(5) = 40.78$, $p < .001$). A significant two-way interaction effect was found between recyclability and ocean connectedness for attractiveness ratings ($F(1,1370) = 31.67$, $p < .001$, $\beta = .24$, 95% CI [0.15, 0.32]; see Figure 7 top right). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between recyclable and non-recyclable packaging more than those low in ocean connectedness in their attractiveness ratings ($t(1380) = 5.63$, $p < .001$, EMM difference: .93).

Guilt ($H2_D$). Adding ocean connectedness as a fixed effect into the original guilt model improved model fit significantly ($\chi^2(5) = 57.73$, $p < .001$). A significant two-way interaction effect was found between recyclability and ocean connectedness for anticipated guilt ($F(1,1380) = 54.52$, $p < .001$, $\beta = -.29$, 95% CI [-0.36, -0.21]; see Figure 7 bottom right). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between recyclable and non-recyclable packaging more than those low in ocean connectedness in their anticipated guilt ratings ($t(1380) = 7.38$, $p < .001$, EMM difference: 1.13).

Figure 7

Two-Way Interaction Effect of Packaging Recyclability and Ocean Connectedness on Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt



Note. Standard errors are presented as ribbons. Scale ranges represent maximum and minimum values found in the study sample.

As hypothesised ($H2_{A-D}$) significant two-way interaction effects were found between recyclability and ocean connectedness for WTB, PAR, attractiveness and guilt ratings. As hypothesised, consumers high in ocean connectedness differentiated recyclable and non-recyclable packaging in their ratings more than those low in ocean connectedness, see Figure 7. In each case, recyclable packaging was rated much more positively and much less negatively than non-recyclable packaging by those high in ocean connectedness, whereas the difference was much smaller for those low in ocean connectedness.

The Moderating Effect of Ocean Connectedness: Material (Hypotheses $H3_{A-D}$).

WTB ($H3_A$). The ANOVA results showed a significant two-way interaction between packaging material and ocean connectedness for WTB ($F(3,1380) = 5.66$, $p < .001$, see Figure 8 top). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between plastic and carton less than those low in ocean connectedness in their WTB ratings ($t(1380) = -3.26$, $p = .001$, EMM difference: -.81). No differences were found between plastic and glass ($t(1380) = .52$, $p = .601$, EMM difference: .13) or between plastic and aluminium ($t(1380) = -1.27$, $p = .205$, EMM difference: -.32) across the two levels of ocean connectedness.

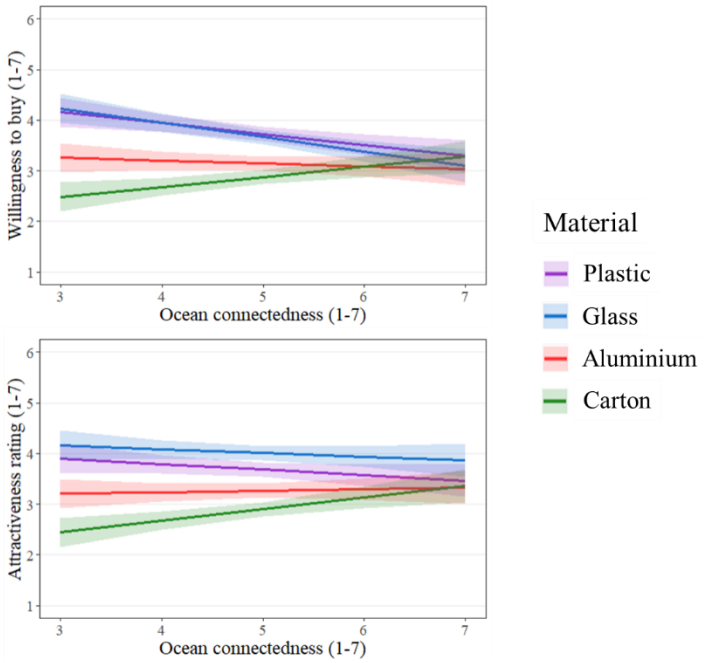
PAR ($H3_B$). According to the ANOVA results, there was no significant two-way interaction between packaging material and ocean connectedness for PAR ($F(3,1380) = 2.42$, $p = .065$.), and therefore this effect is not illustrated further.

Attractiveness ($H3_C$). The ANOVA results showed a significant two-way interaction between packaging material and ocean connectedness for attractiveness ratings ($F(3,1380) = 3.23$, $p = .022$, see Figure 8 bottom). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between plastic and carton less than those low in ocean connectedness in their attractiveness ratings ($t(1380) = -2.83$, $p = .005$, EMM difference: -.66). No differences were found between plastic and glass ($t(1380) = -.29$, $p = .774$, EMM difference: -.07) or between plastic and aluminium ($t(1380) = -1.15$, $p = .251$, EMM difference: -.27) across the two levels of ocean connectedness.

Guilt ($H3_D$). According to the ANOVA results, there was no significant two-way interaction between packaging material and ocean connectedness for anticipated guilt ($F(3,1380) = 0.35$, $p = .786$.), and therefore this effect is not illustrated further.

Figure 8

Two-Way Interaction Effect of Packaging Material and Ocean Connectedness on Willingness to Buy and Attractiveness



Note. Standard errors are presented as ribbons. Scale ranges represent maximum and minimum values found in the study sample.

Hypotheses $H3_{A-D}$ were not supported: Although significant two-way interaction effects were found between material type and ocean connectedness on WTB and attractiveness ratings, consumers distinguished plastic less from other materials (carton) at high levels of ocean connectedness. Therefore, there was limited evidence of sensitisation towards plastic packaging in those who demonstrated high connectivity with the ocean.

Sensitivity Analyses. To assess statistical power in the current sample, sensitivity analyses were conducted post-hoc for the specific effects of interest, using Monte Carlo simulations in the 'simr' package in R (Green & MacLeod, 2019). For the interaction effect between recyclability and ocean connectedness on WTB (observed effect size of

β = .34), the smallest effect size detectable with the current sample size (*n* = 60) whilst retaining acceptable level of statistical power (≥80%, alpha level 0.05) would be β = .13. That is, Study 1 was sufficiently powered to detect the two-way interaction effect of the obtained size. However, when looking at the interaction effect between material type and ocean connectedness on WTB (observed effect size of β = -.19 for the factor level glass, with plastic as the reference category), the smallest effect to be detected with the current sample whilst retaining acceptable level of statistical power is β = -.23. That is, the current sample did not have sufficient statistical power to detect an interaction effect between ocean connectedness and packaging material adequately. Therefore, the findings in Study 1 regarding the moderating effect of ocean connectedness on responses to packaging material should be viewed with caution. Study 2 addresses this issue with a larger sample size.

2.5 Study 2: Consumer Responses to Packaging in an Online Survey

2.5.1. Method

Study 2 used the same experimental paradigm as Study 1 to assess consumer responses to different types of packaging. The purpose of Study 2 was to extend the sample size in order to address any issues with statistical power and to enable generalisation of findings across a wider population. Study 2 was implemented as an online survey administered to consumers within the UK.

The required sample size was estimated using Monte Carlo simulations on the data collected in Study 1. According to this power analysis in order to detect a small effect (β = -.19) for the two-way interaction between ocean connectedness and packaging material on WTB (specifically for the factor level ‘glass’ with ‘plastic’ as reference category), with acceptable statistical power of 80% (alpha level 0.05), at least

175 participants would be needed. A larger sample size was desired in order to achieve better generalisability of the findings across the UK region.

Research Design and Participants. The research design was identical to that of Study 1: A survey was followed by the experimental part with a 2 (recyclability) × 4 (material) × 3 (drink) repeated within-subject design. Five-hundred-and-twelve British participants (251 female, 261 male; quota sampled for gender and age) took part in the study via an online survey panel platform. The mean age of participants was 40.38 (*SD* = 12.78), and the most commonly reported regions of residence were the Midlands region (*n* = 88), South-East (*n* = 76), North-West (*n* = 68), North-East Yorkshire & The Humber (*n* = 55), and London (*n* = 52). Each participant received a financial compensation of around £1.5 for taking part in the survey.

Materials. In the experimental part, the same set of images were used as stimulus material as in Study 1. The study was implemented online using the Jisc Online Surveys platform.

Measures.

Survey. Ocean connectedness was measured using the same scale as in Study 1. However, in this sample reliability for the full 6-item scale was somewhat low (McDonald's omega ω = .71). Omitting the item "*My personal welfare is independent of the welfare of the ocean"* resulted in reliability of ω = .80, and therefore this item was omitted from the scale in further analyses. Therefore, across the current sample the adapted 5-item scale demonstrated good reliability (McDonald's omega ω = .80, *M* = 5.07, *SD* = 1.14, range from 1.00 to 7.00). Further psychometrics and additional constructs measured in the survey are reported in Appendix A.

Demographic Data. Although comprehensive sociodemographic data were gathered from all survey respondents, a technical error meant that the participant identifiers were not shared between the survey panels and the online survey, and therefore matching the data at an individual level was not possible.

Dependent and control variables. Measures for brand familiarity, WTB and attractiveness were identical to those used in Study 1. Anticipated affective response to hypothetical purchase was measured with two items: Given that responses to the four positive emotions used in Study 1 (joyful, happy, content and relaxed) showed extremely high internal consistencies across the different products when inspected as a scale (from ω = .92 to ω = .97), only 'joyful' was used in the current study. Therefore, to measure anticipated PAR a statement "*Buying this product would make me feel joyful.*" was presented to the participants, with a 7-point response scale from "not at all" to "extremely" (Sweeney & Soutar, 2001). With 24 products rated by every participant, using one item only resulted in considerable reduction in survey duration and, therefore, potentially, in participant fatigue. Secondly, anticipated guilt was measured with one item "Buying this product would make me feel guilty." and answered on the same 7-point response scale ("not at all" to "extremely").

Procedure. Participants were directed to the online survey from their respective survey panel websites. Firstly, participants answered the survey questions. Following this, a preface to packaging waste as well as a description of a hypothetical shopping scene were displayed (same as in Study 1, see Appendix A). Instructions to the experimental paradigm and product attributes were also given on this page, before the 24 products were presented in a randomised order. Each product was presented on its own page together with rating scales for WTB, anticipated affective response (joyful and guilty) and attractiveness.

Data Analysis. Protocols for data analysis, effect inference and structuring of random effects were identical to those in Study 1. Statistical models are specified in detail in Appendix A.

2.5.2. Results

Control Variables. There were no missing data, and all participants' responses were included in the following descriptive and inferential analyses. As 22 per cent of the participants *(n* = 111) reported being familiar with the brand used, familiarity was added as a fixed effect variable onto the initial models. Adding familiarity improved model fit, as determined by the maximum likelihood estimate, and the effect was retained in the following models and analyses [7].

Descriptive Analyses. Table 2 displays mean WTB, PAR, attractiveness, and anticipated guilt ratings across different levels of packaging recyclability and packaging material.

[7] Those who reported being familiar with the packaging brand gave higher ratings overall than those consumers who reported not being familiar with the brand. This effect was significant for WTB ($F(1,512) = 119.09$, $p < .001$, $\beta = .77$, 95% CI [0.63, 0.91]), anticipated PAR ($F(1,512) = 101.39$, $p < .001$, $\beta = .68$, 95% CI [0.55, 0.81]), attractiveness ($F(1,512) = 89.26$, $p < .001$, $\beta = .61$, 95% CI [0.48, 0.74]) and guilt ($F(1,512) = 31.66$, $p < .001$, $\beta = .40$, 95% CI [0.26, 0.54].

Table 2

Means and Standard Deviations for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt across Different Levels of Recyclability and Material (n = 512)

	Recyclability		Material			
Measure	Rec.	Non-rec.	Plastic	Glass	Alum.	Carton
WTB	4.11 (2.14)	3.11 (1.90)	3.60 (1.79)	3.81 (1.74)	3.56 (1.68)	3.47 (1.75)
Anticipated PAR	3.59 (1.81)	2.77 (1.65)	3.10 (1.47)	3.38 (1.52)	3.16 (1.46)	3.08 (1.48)
Attractiveness	4.11 (1.90)	3.41 (1.79)	3.79 (1.55)	4.10 (1.56)	3.71 (1.47)	3.46 (1.59)
Anticipated guilt	2.95 (1.79)	4.10 (2.14)	3.79 (2.07)	3.31 (2.03)	3.49 (2.07)	3.51 (2.03)

Note. Standard deviations are in parentheses.

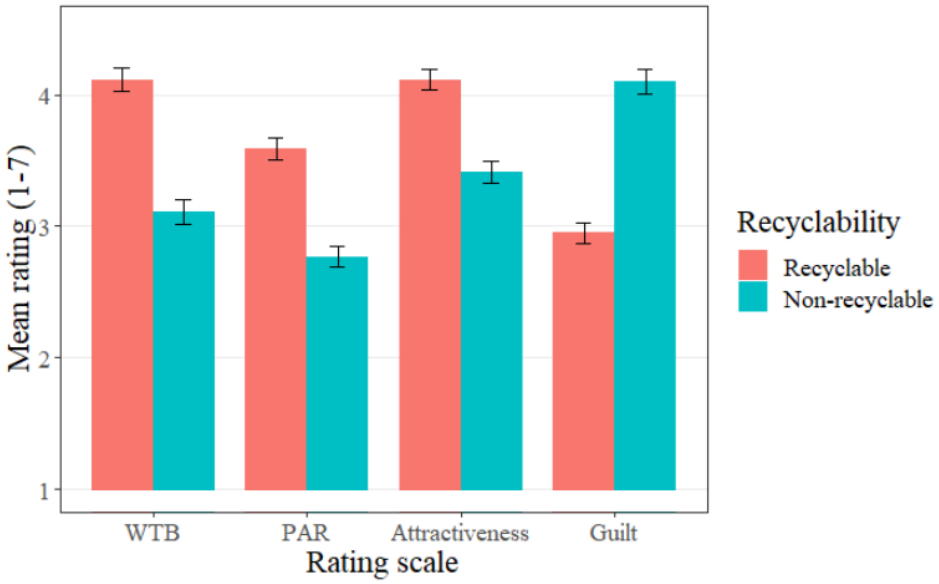
Analysis of Rating Data.

Effect of Recyclability on Consumer Ratings (Hypotheses $H1_{A-D}$)

As can be seen in Table 2 and in Figure 9, average WTB, PAR and attractiveness ratings for recyclable packaging were higher than those for non-recyclable packaging. According to the simple main effects ANOVA with degrees of freedom obtained using the Satterthwaite method, this difference was significant for WTB ($F(1,11776) = 1489.63$, $p < .001$, $\beta = .50$, 95% CI [0.47, 0.53]), PAR ($F(1,11776) = 1344.86$, $p < .001$, $\beta = .41$, 95% CI [0.39, 0.43]), and attractiveness ($F(1,11776) = 888.43$, $p < .001$, $\beta = .35$, 95% CI [0.33, 0.37]). Furthermore, recyclable packaging was rated significantly lower for anticipated guilt than non-recyclable packaging ($F(1,11776) = 1948.87$, $p < .001$, $\beta = -.58$, 95% CI [-0.60, -0.55]). Overall, recyclable packaging was rated more positively than non-recyclable packaging, which is in line with our hypotheses ($H1_{A-D}$).

Figure 9

Average Consumer Ratings for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt across Levels of Packaging Recyclability (n = 512)



Note. Error bars represent standard errors of the mean.

The Moderating Effect of Ocean Connectedness: Recyclability (Hypotheses $H2_{A-D}$)

WTB ($H2_A$). Adding ocean connectedness as a fixed effect into the original WTB model improved model fit significantly ($\chi^2(5) = 302.59$, $p < .001$). The ANOVA results showed a significant two-way interaction between recyclability and ocean connectedness for WTB ($F(1,11776) = 247.44$, $p < 0.001$, $\beta = .18$, 95% CI [0.15, 0.20]; see Figure 10 top left). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between recyclable and non-recyclable packaging more than those low in ocean connectedness in their WTB ratings ($t(11776) = 15.73$, $p < .001$, estimated marginal mean (EMM) difference: .81). EMMs and their confidence intervals for all post-hoc results of interest are reported in Appendix B.

PAR ($H2_B$). Adding ocean connectedness as a fixed effect into the original PAR model improved model fit significantly ($\chi^2(5) = 342.56$, $p < .001$). A significant two-way interaction effect was found between recyclability and ocean connectedness for PAR ($F(1, 11776) = 309.41$, $p < .001$, $\beta = .17$, 95% CI [0.15, 0.19]; see Figure 10 bottom left). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between recyclable and non-recyclable packaging more than those low in ocean connectedness in their PAR ratings ($t(11776) = 17.59$, $p < .001$, EMM difference: .77).

Attractiveness ($H2_C$). Adding ocean connectedness as a fixed effect into the original attractiveness model improved model fit significantly ($\chi^2(5) = 169.94$, $p < .001$). A significant two-way interaction effect was found between recyclability and ocean connectedness for attractiveness ratings ($F(1,11776) = 140.10$, $p < .001$, $\beta = .12$, 95% CI [0.10, 0.14]; see Figure 10 top right). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between recyclable and non-recyclable packaging more than those low in ocean connectedness in their attractiveness ratings ($t(11776) = 11.84$, $p < .001$, EMM difference: .55).

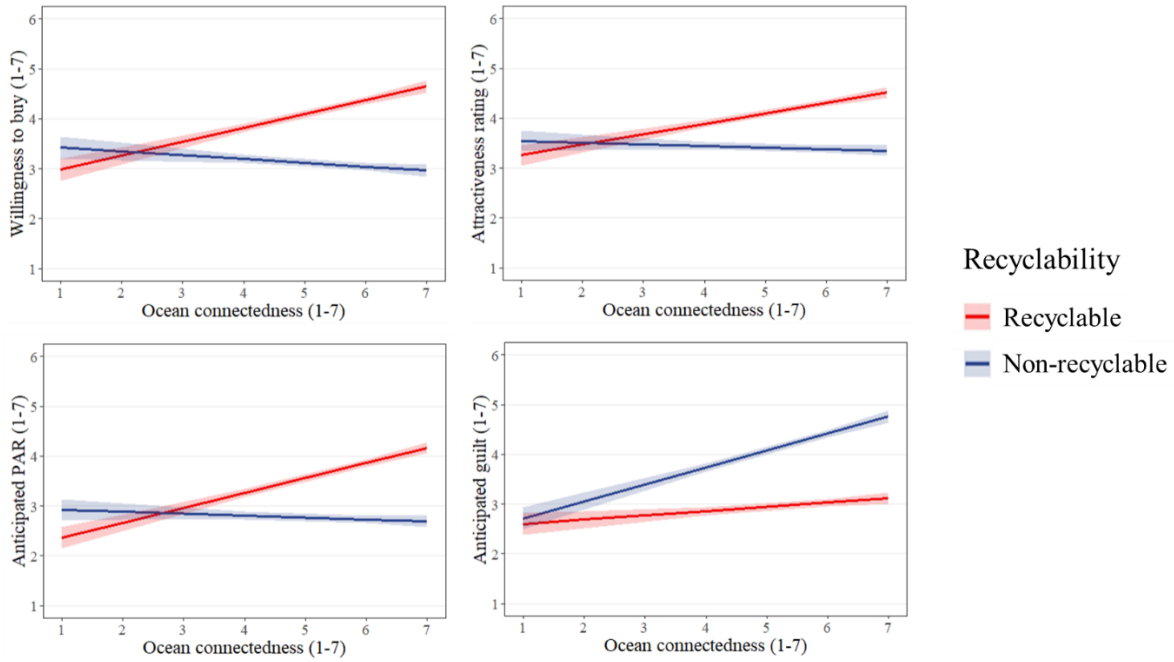
Guilt ($H2_D$). Adding ocean connectedness as a fixed effect into the original guilt model improved model fit significantly ($\chi^2(5) = 167.01$, $p < .001$). A significant two-way interaction effect was found between recyclability and ocean connectedness for anticipated guilt ($F(1,11776) = 125.67$, $p < .001$, $\beta = -.13$, 95% CI [-0.15, -0.11]; see Figure 10 bottom right). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between recyclable and non-recyclable packaging more than those low in ocean connectedness in their anticipated guilt ratings ($t(11776) = 11.21$, $p < .001$, EMM difference: .58).

As hypothesised ($H2_{A-D}$), significant two-way interaction effects were found between recyclability and ocean connectedness for WTB, PAR, attractiveness and guilt

ratings. As hypothesised, consumers high in ocean connectedness differentiated recyclable and non-recyclable packaging in their ratings more than those low in ocean connectedness, see Figure 10.

Figure 10

Two-Way Interaction Effect of Packaging Recyclability and Ocean Connectedness on Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt



Note. Standard errors are presented as ribbons. Scale ranges represent maximum and minimum values found in the study sample.

The Moderating Effect of Ocean Connectedness: Material (Hypotheses H3$_{A-D}$).

WTB (H3$_A$). The ANOVA results showed a significant two-way interaction between packaging material and ocean connectedness for WTB (F(3,11776) = 18.39, p < .001, see Figure 11 top left). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between plastic and glass more than those low in ocean connectedness in their WTB ratings (t(11776) = 6.77, p < .001,

EMM difference: .49). However, the other two material types were distinguished from plastic less at high than low levels of ocean connectedness (plastic and aluminium: $t(11776) = -4.95$, $p < .001$, EMM difference: -.36; plastic and carton: $t(11776) = -5.92$, $p < .001$, EMM difference: -.43).

PAR ($H3_B$). The ANOVA results showed a significant two-way interaction between packaging material and ocean connectedness for PAR ($F(3,11776) = 10.27$, $p < .001$, see Figure 11 bottom left). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between plastic and the other material types more than those low in ocean connectedness in their PAR ratings (plastic and glass: $t(11776) = 5.51$, $p < .001$, EMM difference: .34; plastic and aluminium: $t(11776) = 3.33$, $p < .001$, EMM difference: .21; and plastic and carton: $t(11776) = 2.96$, $p = .003$, EMM difference: .18).

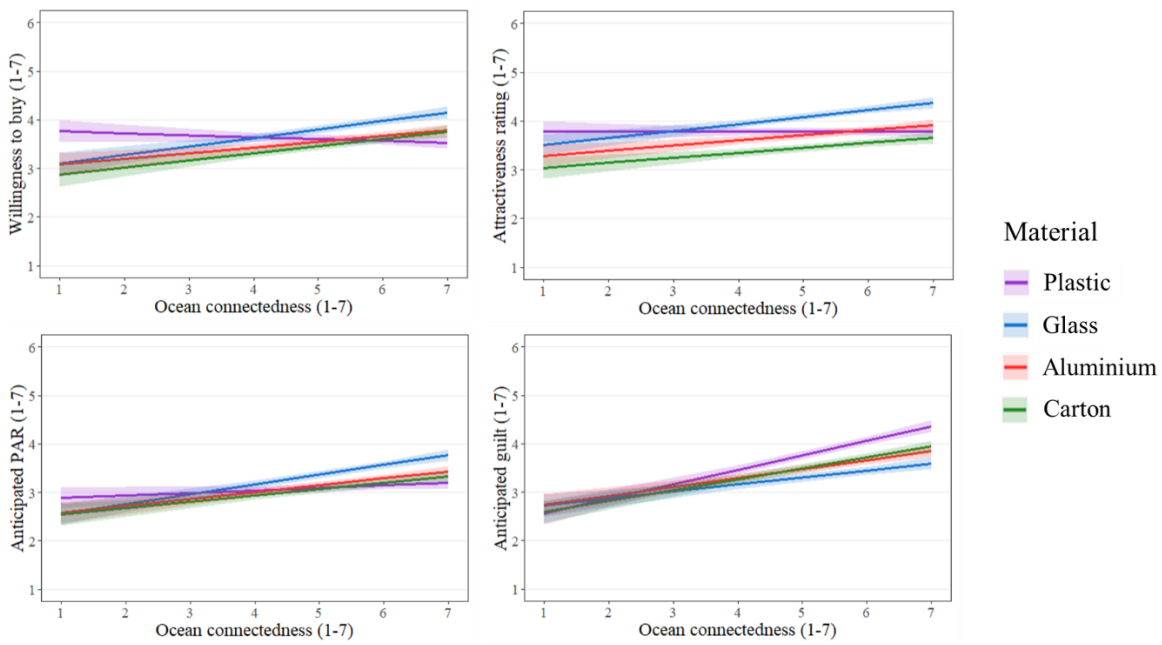
Attractiveness ($H3_C$). The ANOVA results showed a significant two-way interaction between packaging material and ocean connectedness for attractiveness ratings ($F(3,11776) = 9.20$, $p < .001$, see Figure 11 top right). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between plastic and glass more than those low in ocean connectedness in their attractiveness ratings ($t(11776) = 5.01$, $p < .001$, EMM difference: .33). However, the other two material types were distinguished from plastic less at high than low levels of ocean connectedness (plastic and aluminium: $t(11776) = -2.66$, $p < .001$, EMM difference: -.24; plastic and carton: $t(11776) = -3.59$, $p < .001$, EMM difference: -.24).

Guilt ($H3_D$). The ANOVA results showed a significant two-way interaction between packaging material and ocean connectedness for anticipated guilt ($F(3,11776) = 8.41$, $p < .001$, see Figure 11 bottom right). Post-hoc interaction comparisons showed that respondents high in ocean connectedness distinguished between plastic and the other material types more than those low in ocean connectedness in their anticipated

guilt ratings (plastic and glass: $t(11776) = 4.80$, $p < .001$, EMM difference: .35; plastic and aluminium: $t(11776) = 3.58$, $p < .001$, EMM difference: .26; and plastic and carton: $t(11776) = 2.34$, $p = .019$, EMM difference: .17).

Figure 11

Two-Way Interaction Effect of Packaging Material and Ocean Connectedness on Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt



Note. Standard errors are presented as ribbons. Scale ranges represent maximum and minimum values found in the study sample.

Hypotheses $H3_B$ and $H3_D$ were supported: As can be seen in Figure 11, for PAR and anticipated guilt plastic was found to be distinguished from the other materials more at high than low levels of ocean connectedness. Hypotheses $H3_A$ and $H3_C$ received limited support, as only glass was distinguished from plastic more at high than low levels of ocean connectedness in WTB and attractiveness ratings. However, aluminium and carton were distinguished from plastic less at high than low levels of ocean

connectedness. Therefore, these results provide some evidence of sensitisation towards plastic packaging, albeit mostly in the affective responses.

2.6 General Discussion

In Studies 1 and 2, the effects of packaging recyclability and type of material on consumer responses to products were investigated. Furthermore, the moderating effect of ocean connectedness on these responses was examined. While everyday consumer decisions often seem somewhat distanced from environmental impact, it has been argued that making consumers aware of potential impact at the point of decision can facilitate behaviour change, especially if the impacts are meaningfully linked to a passion, or connection, to the natural environment (Pahl et al., 2017). The findings presented here provide evidence that consumers 'connect the dots' between buying a product and environmental repercussions, especially when they manifest high connectivity to the ocean.

Both studies showed that recyclable packaging was rated more positively than non-recyclable packaging on average. This finding demonstrates a public appeal for minimising waste post-consumption. Considering that trends in environmental consciousness are volatile (McCallum & Bury, 2013), that the public tend to find recycling rules somewhat confusing (WRAP, 2018), and that some consumers may perceive sustainability cues as false claims or 'greenwashing' (Szabo & Webster, 2020), replicating previous findings showing a preference for recyclability is an encouraging finding. Furthermore, the on-packaging recyclability cues used in the current studies are ones that the public in the UK are exposed to on a regular basis. Therefore, results from Studies 1 and 2 enrich the existing evidence base on consumer responses to recyclability in that the products used as stimuli material were common every-day products, and that ecological cues on them were presented in a way that consumers are familiar with.

Ocean connectedness was shown to moderate recyclability preferences in both study samples: Packaging recyclability mattered more to those who sense a strong connection with the ocean, as evidenced by consumers high in ocean connectedness distinguishing between recyclable and non-recyclable packaging more than did consumers low in ocean connectedness. The obtained results therefore suggest that an affection for the ocean is associated with sustainable consumer behaviour. The mechanisms through which ocean connectedness may shape pro-environmental behaviours, such as consumer decisions, merit further research. For instance, literature on nature connectedness suggests that individuals with a stronger connectivity to natural environments are less likely to make decisions that can have a negative impact on the environment (e.g. Koenig-Lewis et al., 2014; Kollmuss & Agyeman, 2002) or on the 'common good' (Weinstein et al., 2009; Zelenski et al., 2015).

Based on the results for ocean connectedness and packaging material, it can be concluded that in comparison to other material types, plastic packaging was viewed as a more viable option by those who showed lower connectivity with the ocean. These findings reflect the importance of awareness about environmental harm associated with packaging choice. Condemnation of plastic by consumers can be partly attributed to the recognition of the harm caused by plastic waste to marine environments in media and by scientific communities in recent years (Gall & Thompson, 2015; Haward, 2018). Those who have a strong emotional investment and interest in marine environments are likely to become exposed to such messages about marine plastics through social media, interest groups and peers. Furthermore, upon the global 'plastic stigma', societal norms regarding packaging material may have shifted: To the least, media attention on marine plastics may have created an injunctive norm to reduce plastics use, therefore producing increased feelings of guilt for buying plastics in those who are connected with the ocean (Bamberg et al., 2007). On the other hand, consumers who manifest lower levels of

ocean connectedness may prioritise packaging properties that are less environmentally significant, such as the functionality of a plastic bottle in comparison to other materials.

As discussed earlier, judging the sustainability or environmental impact of different material types is not straightforward. The issue with plastic packaging is that it is (conventionally) made of limited fossil raw materials, it may end up polluting the marine environment, and as waste it is persistent. Yet, there is debate regarding the relative sustainability of different material types for packaging (Pasqualino et al., 2011; von Falkenstein et al., 2010). Therefore, the statement that findings from Studies 1 and 2 suggest that ocean connectedness is associated with sustainable packaging choice, only refers to the interaction between ocean connectedness and packaging recyclability. That is, it is not suggested that plastic packaging is less (or more) sustainable than glass, aluminium or carton. It is merely concluded here that there are differences between consumers with high and low levels of ocean connectedness in how they view plastic packaging in comparison to other material types.

Furthermore, the studies reported here used a range of outcome variables to assess consumer attitudes. Using affective measures to complement measures of stated intent such as WTB builds on previous work in consumer studies (Koenig-Lewis et al., 2014; Magnier & Schoormans, 2015; Morris et al., 2002). In the results reported here there was little variation in the response patterns between WTB, anticipated PAR and attractiveness. Furthermore, similar effect sizes were detected for the main and interaction effects of packaging recyclability and ocean connectedness on these outcome variables. Future research could investigate if the similarity in response patterns remains when different study designs and different types of products are used. The product used here is a common every-day commodity that requires minimal financial investment and risk. Thus, it is perhaps not surprising that responses across outcome measures followed

similar patterns, and if a high-involvement product were used there might be more substantial variation between response scales.

The implications, both theoretical and practical, of findings from Studies 1 and 2 should be acknowledged. Firstly, it was shown that packaging recyclability makes a difference in how every-day commodities are perceived by consumers: Products in recyclable packaging received a more positive response and were even perceived as more attractive. That is, it seems that consumers are persuaded by on-packaging claims pertaining to the potential for the material to be recycled. Therefore, prioritising recyclability or in other ways proclaiming circularity of packaging material may be a viable marketing strategy. For true impact, obviously this strategy and labelling need to be underpinned by strong evidence on actual recyclability and a functioning waste management system. Secondly, the findings highlight the importance of feeling connected to natural environments as a motivating factor for pro-environmental behaviour. While the value of issue awareness and concern should be recognised as instrumental to cultivating pro-environmental behaviours, the findings maintain that a strong connection to nature, and more specifically to the oceans, has the potential to not only encourage sustainable purchasing, but also to aid in minimising plastic litter and waste. Therefore, communications that highlight the potential harm caused by single-use packaging to the marine environment may prove successful in the consumer context (e.g. European Commission, 2020; Luo et al., 2022), and those who sense a strong connection with the ocean might be even more persuaded by such messaging.

Furthermore, the conceptualisation of ‘ocean connectedness’ in these studies is hoped to encourage further scientific inquiry on affinity toward the oceans and relevant pro-environmental behaviours. Psychological connectivity to the ocean was assessed here with a brief self-report measure that was constructed based on an existing scale (CNS; Mayer & Frantz, 2004). Construct validity of the scale, including convergent and

discriminant validity, remains to be explored in the following empirical chapters of this thesis. In addition, while Studies 1 and 2 did not enable linking of ocean connectedness with consumer sociodemographic data, the survey research reported in Chapter 3 addresses this point further.

Chapter 3: Consumer Responses to All Phases of the Packaging Lifecycle: Extending the Research Focus to Circular Design and End-of-Life Scenarios of Packaging

3.1 Introduction

As demonstrated in the previous chapter, consumers have preferences regarding the recyclability and material of single-use packaging. That is, these packaging features likely steer consumers' buying decisions, as shown also in previous research (e.g. Klaiman et al., 2016; Rokka & Uusitalo, 2008). A universal preference for recyclability demonstrates that consumers gain utility from packaging produced using circular design strategies. In addition, Studies 1 and 2 shed light on preferences across material types (e.g. plastic and glass) and how these are shaped by perceived connection with and concern for oceans. As such, although these findings do not permit conclusions regarding the perceived *sustainability* of single-use packaging, they indicate that consumers' preferences coincide with their environmental orientations. Indeed, previous research suggests that recyclability and type of raw material are among the key indicators that consumers take into consideration when judging the environmental impact of packaging (Otto et al., 2021). Overall, as suggested previously (Steenis et al., 2018; Thøgersen, 1999; van Birgelen et al., 2009), sustainability and circularity of single-use packaging matter to consumers.

However, consumers are likely to differ in what metrics they use to infer that packaging material is environmentally friendly or sustainable. How a consumer evaluates packaging sustainability likely stems from their personal understanding and prioritisation of sustainability at different stages of the packaging lifecycle (Otto et al., 2021): Some may be concerned about the carbon footprint of packaging, whereas others worry about generation of waste. For example, for plastic packaging carbon footprint considerations may be trumped by concerns about its accumulation in the marine environment as litter. Indeed, today's consumers are more and more concerned about leakage of packaging into the environment, whereas manufacturers' efforts are rather focused on promoting circularity and cutting carbon emissions (Hahladakis & Iacovidou, 2018). As a consequence, although these sustainability objectives are not mutually exclusive, such trade-offs can have adverse repercussions for consumer acceptance and behaviour, despite consumers having pro-environmental intentions (Boz et al., 2020). Unquestionably, a transition towards circular business models can help reduce the environmental burden of single-use packaging. However, this transition can be fully realised only if consumer acceptance is considered and ensured (Camacho-Otero et al., 2018).

Understanding consumers' responses to the environmentally relevant properties of single-use packaging across its whole lifecycle is therefore a crucial starting point in attempts to promote circularity in the consumer sector. Acquiring a holistic view encompasses investigating consumer perceptions and behaviours from pre-purchase to post-consumption of packaging (Boz et al., 2020). This chapter presents findings from Study 3, implemented as a large-scale online survey assessing UK consumers' responses to circular design, disposal, and end-of-life scenarios for different types of single-use packaging. In addition, ocean connectedness and other (environmentally relevant) consumer variables were measured in order to permit consumer segmentation

and a more nuanced understanding of the interplay between perceptions around packaging and consumer attributes. Furthermore, the obtained data permitted inspection of the associations between ocean connectedness and other environmentally relevant variables, thus enabling the assessment of construct validity of the novel ocean connectedness measure. Moreover, these associations were contrasted with those observed between general nature connectedness and environmentally relevant consumer variables, including packaging responses, which enabled an explorative inquiry into the conceptual differences (and similarities) between ocean and nature connectedness.

3.2 Literature Review

3.2.1. Consumer Perceptions of Packaging Sustainability across the Packaging Lifecycle

As discussed above, consumers tend to focus on the post-use phase of packaging (e.g. recyclability) when making judgments about its sustainability. Similarly, research has traditionally addressed consumer perceptions of end-of-life attributes of packaging, with less attention paid to its beginning-of-life stage, involving origin of materials and environmental costs of manufacture (Herbes et al., 2020; Otto et al., 2021). One exception to this trend is a cross-cultural study by Herbes et al. (2018) where perceptions of environmentally relevant packaging attributes – and their relative importance – across the packaging lifecycle were studied in a sample of German, French and US consumers. They found that consumers place emphasis mainly on recyclability, reusability and biodegradability when determining how environmentally friendly packaging is, with German consumers expressing some concern for its beginning-of-life attributes (e.g. use of renewable materials). As noted by Herbes et al. (2018), consumers generally lacking concern for the beginning-of-life stage of packaging is at odds with packaging life cycle assessment studies. More specifically,

the production phase of the packaging lifecycle generally outweighs the post-use phase in terms of its environmental impact (Kang et al., 2017; Maga et al., 2019; Siragusa et al., 2014), although direct comparisons are hampered by the complexities of the circular economy of packaging and the heterogeneous nature of life cycle assessment studies. For example, the environmental burden of the waste management phase is contingent on the combination of packaging material type (e.g. plastic vs. glass), method of waste collection (e.g. kerbside collection vs. collection point) and, naturally, the means of material recovery used (e.g. recycling vs. incineration; Simon et al., 2016).

From the consumer perspective, this emphasis on end-of-life is not surprising: After all, consumers mostly engage in the end-of-life stage of packaging with their disposal decisions and behaviour. Furthermore, although consumers generally value an eco-friendly packaging manufacturing process (Nguyen et al., 2020; Scott & Vigar-Ellis, 2014), an average consumer does not possess sufficient knowledge about packaging production, and their perceptions are easily influenced by media (Clark et al., 2020). Sustainable packaging of fast-moving consumer goods has evolved rapidly over the past decades, due to recent technological advancements in the industry (e.g. Mohanty et al., 2018; Rai et al., 2021). It is therefore evident and unsurprising that consumers cannot keep up with the changing packaging landscape and may lack knowledge on environmentally advantageous novel packaging solutions (Ketelsen et al., 2020). For example, the often-used term ‘bioplastic’ is not easily understood by consumers, because it can refer to either bio-based plastic or plastic that is biodegradable (Dilkes-Hoffman et al., 2019).

3.2.2. Consumer Perceptions of Bio-Based Plastic Packaging

Bio-based plastics[8] are perceived to hold an advantage over conventional fossil-based plastics in that bio-based plastics use renewable material as the primary carbon source (Rosenboom et al., 2022). In terms of other metrics of environmental impact, such comparisons are more equivocal: Arable land is required for growing the feedstock used in bio-based plastic production, partly compromising the benefits associated with bio-based plastics in terms of reduction in greenhouse gas emissions (Van den Oever et al., 2017). Furthermore, as reviewed by Shen et al. (2020), wider use and development of bio-based plastic is currently hampered by its limited technological feasibility and thus relatively high material price. On the global scale, production of bio-based plastics is expected to increase from 2.11 million tonnes in 2019 to approximately 2.43 million tonnes in 2024 (Halonen et al., 2020). As their use in packaging solutions is on the increase, research on consumer perceptions towards bio-based plastics has emerged over the last decade. Onwezen et al. (2017) found that consumers' response to bio-based beverage packaging is determined not only by cognitive deliberation but also ambivalence and aversion. However, in two multi-country studies by Reinders et al. (2017) use of bio-based materials was consistently viewed as a positive utility by consumers, with increased content of bio-based material in packaging resulting in higher purchase intentions. Yet, Irish consumers and students showed reluctance to pay more for bio-based plastics, expressing scepticism towards the bio-based plastics industry and concerns about certain types of waste (e.g. animal waste) being used for packaging production (Mehta et al., 2021). The researchers note implications to informational strategies, suggesting that the industry could benefit from introducing

[8] Bio-based plastics are plastics that are at least partly derived from biological resources; including for example starch and cellulose polymers, polylactic acid (PLA) and poly-β-hydroxybutyrate (PHB; Pan et al., 2016).

transparency to consumer communications regarding the beginning-of-life processes and environmental impacts of bio-based plastics. Finally, research by Zwicker et al. (2020) found that consumers' willingness to pay more for a bottle made of bio-based plastics (as opposed to conventional plastic) was best predicted by feelings of guilt, signifying the impact of moral considerations on packaging preference.

3.2.3. Consumer Perceptions of Biodegradable Plastic Packaging

Some bio-based plastics, but not all, have been designed for biodegradability in the natural environment or in home/industrial composters[9]. In 2016 approximately 0.6% of plastic end products in the European market were biodegradable (Hann et al., 2020). Use of biodegradable plastic in single-use packaging solutions extends the variety of end-of-life disposal options beyond recycling, incineration and landfill (Davis & Song, 2006). As noted by Hottle et al. (2013), the environmental impact of biodegradable plastic is largely dependent on its end-of-life management, and the realisation of its advantages is currently limited by the lack of appropriate end-of-life infrastructure. However, as reviewed earlier, biodegradability as a packaging attribute is valued highly by consumers: In a consumer survey by Herbes et al. (2018), a majority of the respondents chose biodegradability as a key 'green' (i.e. environmentally friendly) packaging attribute. Moreover, in an online choice experiment by Wensing et al. (2020), German consumers showed a willingness to pay a price premium of 34.0% for compostable packaging, while premiums for recyclable and bio-based packaging were 30.2% and 22.8%, respectively. Furthermore, in an online survey of consumers from 42 countries (Filho et al., 2022), main barriers for using biodegradable products included limited availability, relatively high cost, concerns about material quality, and lack of

[9] Biodegradable plastics can be produced from fossil or bio-based raw material (Hann et al., 2020). These materials have been designed to biodegrade in soil, water or compost under certain conditions during disposal (e.g. temperature and presence of oxygen, nutrients and micro-organisms) in varying timeframes (Van den Oever et al., 2017).

awareness about their properties and benefits. Similarly, Allison et al. (2021) found high levels of skepticism over claims of packaging biodegradability among British consumers, demonstrating a need to reduce ambiguity around packaging labels 'biodegradable' and 'compostable'. In addition, environmental orientations are associated with a preference for biodegradable packaging, as they are with preferences for 'green' packaging in general. For example, individuals with high biospheric values showed higher willingness to pay for compostable and plantable plant containers (Khachatryan et al., 2014).

Consumers tend to dispose of biodegradable (compostable) packaging incorrectly (Taufik et al., 2020). Furthermore, concerns over unintended consequences of biodegradability of packaging have been expressed. More specifically, some people may believe that the negative impacts of littering do not apply to biodegradable items, and therefore discarding them into the environment may be seen as acceptable (Haider et al., 2019). Therefore, marketing of packaging as biodegradable or compostable might undermine consumers' perceived responsibility over its appropriate disposal. However, according to a review by Hann et al. (2020), recent empirical evidence correlating biodegradable plastics with increased tendency to litter is lacking, and further research is needed. Yet, increased availability of novel biodegradable packaging solutions paired with limited consumer knowledge might contribute to techno-optimism (Barry, 2012), potentially shifting end-users' perceptions around the issue.

3.2.4. Consumer Responses to End-of-Life Scenarios for Packaging

Although various studies have addressed consumer perceptions around the end-of-life stage of packaging (e.g. recyclability and disposability; Heiniö et al., 2017; Löfgren et al., 2011; Rokka & Uusitalo, 2008; Songa et al., 2019), research examining consumer responses to end-of-life scenarios and disposal strategies is lacking (but see Taufik et

al., 2020 for disposal behaviour). A crucial step in the production of circular products and services, including packaging solutions, is design for end-of-life (Marconi & Germani, 2017). Such strategies can only work if producers' intentions align with consumers' perceptions and behaviour at the end-of-life stage. For example, designing packaging for maximum value recovery is not desirable if end-users do not prioritise value recovery. Similarly, the benefits of implementing sophisticated recovery infrastructures (e.g. deposit return schemes) cannot be realised fully if consumers are content with currently available methods for value recovery. In such cases, producers can redirect efforts into maximising other aspects of packaging sustainability, such as cutting the carbon footprint of the packaging production supply chain. Therefore, mapping consumers' perceptions of end-of-life scenarios and disposal of packaging can guide the design of environmentally relevant features packaging and/or relevant infrastructures.

Furthermore, as noted by Herbes et al. (2020), environmentally relevant attributes of packaging are often credence attributes. That is, consumers cannot verify but must trust producers' claims regarding packaging material content and recyclability, for instance. Similarly, the ultimate end-of-life fate of packaging, such as it ending up in recycling or in landfill, is not within the consumers' control: The end-user can only trust that waste management authorities handle packaging waste in an appropriate manner post-disposal. Previously, in the context of waste recycling, consumers have attributed failure to recycle to mistrust in the local waste management authority (WRAP, 2017). Similarly, Rompf (2014) demonstrated that recycling behaviour is associated with high system trust. Therefore, trust in the waste management system is likely to shape consumers' perceptions of various end-of-life scenarios for packaging.

3.2.5. The Kano Model of Consumer Satisfaction

Various approaches exist for mapping consumers' perceptions of products and their features. The Kano model of consumer satisfaction (Kano, 1984) enables the assessment of the importance of product features (e.g. packaging recyclability) from a consumer's viewpoint, both qualitatively and quantitatively. Therefore, when consumer satisfaction and acceptance are of interest, the Kano model can be used to capture a more nuanced understanding of consumer response, in comparison to traditional rating-based questionnaires, choice paradigms and willingness-to-pay methods often used in consumer research. The Kano model is based on the theory of attractive quality (Kano, 1984) with the premise that product attributes that cause satisfaction in consumers are different from those that cause dissatisfaction. That is, different product attributes have differing degrees of sufficiency in causing user satisfaction. As such, the Kano model proposes a methodology for determining, for example, which product features are required and which are simply desired or irrelevant for consumers. More specifically, five categories of quality features that influence consumer satisfaction differently are specified: must-be features, one-dimensional features, attractive features, indifferent features, and reverse features.

Must-be Features. These are basic features that are taken for granted but cause dissatisfaction when not present in a product. Therefore, consumers would not specifically request these features, but simply expect them to be fulfilled. For single-use packaging, the ability to provide protection, for example, could be classified as a must-be feature (Löfgren et al., 2011).

One-dimensional Features. These features have a linear relationship with consumer satisfaction: Their fulfilment results in satisfaction, and consumers are dissatisfied when they are not fulfilled. For example, user-friendliness could be regarded as a one-dimensional feature of packaging (Löfgren et al., 2011).

Attractive Features. These features are considered positive surprise attributes which are not expected, nor does excluding them cause dissatisfaction, but their fulfilment results in consumer satisfaction. Attractive features are thought of as the most important 'delight' attributes for consumer satisfaction (Sauerwein et al., 1996). Packaging resealability, for example, could be categorised as an attractive feature (Löfgren et al., 2011).

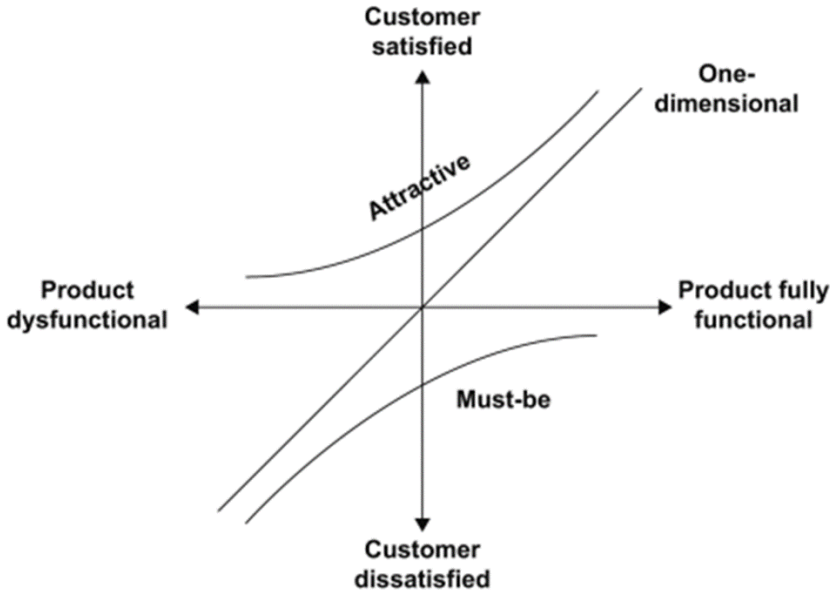
Indifferent Features. These features do not result in either satisfaction of dissatisfaction. In other words, consumers do not care about these features. For packaging, attractiveness of label print could be an indifferent feature (Löfgren et al., 2011).

Reverse or Questionable Features. These features result in consumer dissatisfaction when fulfilled and satisfaction when absent. Alternatively, a feature can be categorised as questionable if there is a lot of variability in consumer response to said feature.

The relationship between feature fulfilment (i.e. functionality) and consumer satisfaction for must-be, one-dimensional and attractive features is displayed in Figure 12.

Figure 12

Relationship between Product Functionality and Consumer Satisfaction (Kano, 1984).



The Kano model lends itself to assessment of consumer responses to, and acceptance of, various environmentally relevant features of single-use packaging. For example, Löfgren and Witell (2005) and Williams et al. (2008) applied the Kano method to investigate consumer satisfaction with various ergonomic, technical and communicative quality attributes of packaging. More recently, Kovačević and Bota (2021) used a Kano survey to assess consumer perceptions of 14 packaging attributes, including recyclability and disposability. Across these studies, recyclability of packaging material was classified as an attractive feature, signifying that consumers appreciate packaging recyclability but do not expect it. Furthermore, Atlason et al. (2017) applied the Kano method to study how end-users perceived different disposal methods (collection from home and delivery to shop) and end-of-life scenarios (reuse, recycling and remanufacturing) for household electronic products. Their findings showed that, in general, consumers found reuse as the most attractive end-of-life scenario for these products. In addition, women perceived all three end-of-life scenarios

more favourably than men, providing evidence that differences across user segments should be acknowledged in the design of product circularity.

3.2.6. Segmentation

Segmentation is a social marketing approach which entails grouping of individuals into clusters (segments) based on a selection of individual-level variables such as sociodemographic factors, attitudes and motivations (Lee & Kotler, 2015). Segmentation of the public on the basis of environmentally relevant attitudes and motivations, or, 'green segmentation', can inform the design of tailored communication approaches, which can help promote behaviour change and ultimately aid in the attainment of environmental and sustainability objectives (e.g. Do Paco & Raposo, 2009; Martel-Morin & Lachapelle, 2022). Existing green segmentation models can be roughly divided into general, problem-specific and domain-specific approaches. General approaches aim for a wide applicability across different pro-environmental behaviours and have been developed to address a variety of sustainability policy areas (Verplanken, 2018; Yilmazsoy et al., 2015). An example of such approach is the sustainability segmentation model of the Welsh population developed by Poortinga and Darnton (2016): Based on a collection of psychological variables, including personal values, sustainability perceptions, attitudes towards climate change and place attachment, members of the general public were segmented into six sustainability clusters ranging from 'enthusiasts' to 'self-reliant'. The discovered segments were shown to have unique profiles in terms of sociodemographic characteristics and self-reported pro-environmental behaviour. Problem-specific segmentation approaches, on the other hand, address particular environmental issues such as climate change (Detenber et al., 2016; Maibach et al., 2011; Martel-Morin & Lachapelle, 2022) or, more recently, plastic pollution (Adam et al., 2021; Borg et al., 2021); while domain-specific segmentation

approaches aim to uncover population segments in regard to specific behaviours, such as energy use (Gordon et al., 2015; Sütterlin et al., 2011), tourism and travel behaviours (Anable, 2005; Blamey & Braithwaite, 1997; dos Reis et al., 2022; Kastenholz et al., 2018) or environmental consumerism (Do Paco & Raposo, 2009; Golob & Kronegger, 2019; González et al., 2015; Gwozdz et al., 2017; Lee & Haley, 2022; Newton & Meyer, 2013, Su et al., 2019).

Although various existing segmentation models have addressed sustainable consumer behaviour, only few have recently focused on sustainable packaging (e.g. Beacom et al., 2021; Chirilli et al., 2022; McCarthy & Wang, 2022). As the public's interaction with packaging spans several behavioural domains (product purchase, use and disposal), segmentation for sustainable packaging could be most accurately described as its own context-specific segmentation approach. Understanding of consumer dynamics in sustainable packaging preferences can help in the development of marketing and policy strategies that cater to different packaging consumer groups based on their characteristics and values. This mission has become increasingly central to the packaging industry that is currently in the process of revolution due to emerging packaging alternatives and regulations (Boz et al., 2020). Marketers and policy makers operating within the sustainable packaging industry may therefore benefit from context-specific guidance on effective communication efforts and interventions. As an example of a segmentation approach to sustainable packaging, Chirilli et al. (2022) used data on self-reported packaging-related sustainability behaviours to identify four consumer segments ('More sustainable – packaging-role-oriented', 'More sustainable – packaging minimisers', 'Less sustainable' and 'Medium sustainable'). These segments could be further distinguished from one another in terms of consumers' perceptions of what makes packaging sustainable and what elements should be included on the packaging label. For example, the 'Less sustainable' group, in comparison to the other groups,

perceived packaging material as a less important attribute at the point of product purchase, and they less agreed that packaging is sustainable if it is made of recycled materials. Similarly, this group placed less importance on sustainability-relevant label information on packaging, such as instructions for disposal or general indications of packaging ecological footprint. Therefore, traditional means of communicating about packaging sustainability, for example via messages on packaging labels, may not be effective or sufficient in nudging more sustainable purchasing in this consumer segment. Moreover, the four segments identified by Chirilli et al. (2022) differed in regard to sociodemographic variables, with the 'More sustainable' groups having a higher proportion of females, and the 'Less sustainable' group including a higher proportion of young people. However, no differences were found across the segments in terms of educational level.

A key step in the consumer segmentation process is deciding on the selection of variables used to assign consumers to different segments. The segmentation criteria for green segmentation models commonly include generally accepted determinants of pro-environmental behaviour, such as sociodemographic characteristics (e.g. age, gender, level of education), and pro-environmental attitudes and values. As demonstrated by Sargisson et al. (2020), sociodemographic variables, although easy to measure and apply in market segmentation (Jain & Kaur, 2006), are an insufficient criterion for green segmentation and should therefore be accompanied by psycho-environmental variables such as value orientations. In addition, as noted by Yankelovich and Meer (2006), including behaviour-based variables in the marketing segmentation criteria ensures that profiling of the target population recognises the nuances of the respective context and can thus provide a fruitful requisite for behaviour change. Sustainable packaging segmentation approaches should therefore acknowledge the behavioural elements in how consumers relate to packaging, such as their waste management behaviours (e.g.

Chirilli et al., 2022). In summary, segmentation for sustainable packaging should include a collection of variables that bear relevance for consumer interactions with packaging across its lifecycle. These have been reviewed above and in more detail in Chapter 1.

3.3 Study 3: Consumer Responses to Circular Design and End-of-Life Scenarios for Packaging

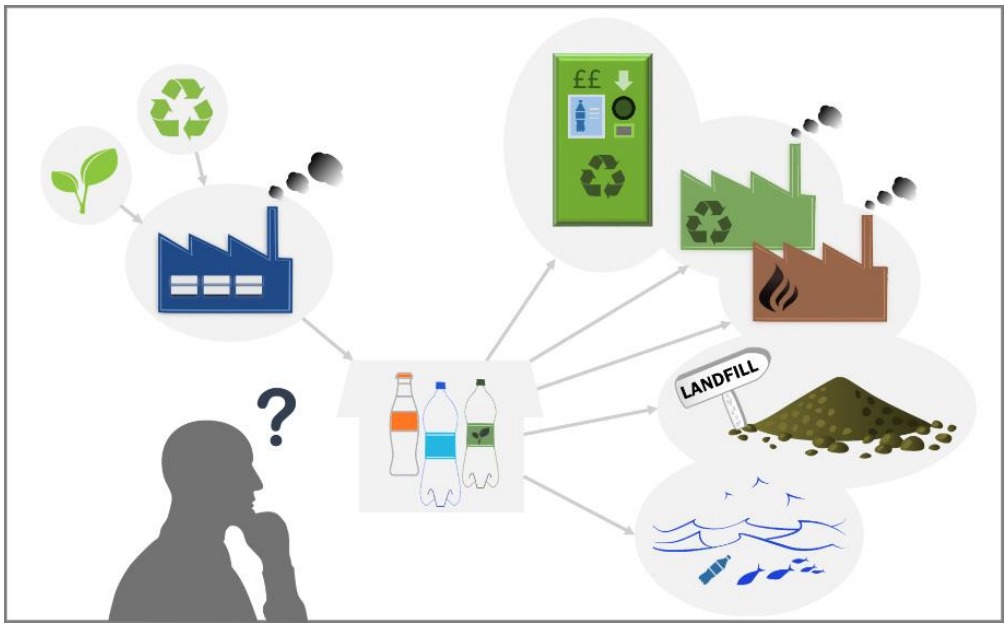
Following from Studies 1 and 2, Study 3 was designed to capture a thorough assessment of consumer perceptions regarding single-use packaging, through its entire lifecycle. Taking a marketing research approach, Study 3 used the Kano model for user satisfaction (Kano, 1984) to gauge the relative importance of various environmentally relevant features of packaging from the end user's perspective (see graphical abstract in Figure 13). Features pertaining to packaging circular design, disposal and environmental cost of production were examined, as well as a range of end-of-life scenarios for packaging. Following from the findings in Studies 1 and 2, where the largest contrasts in consumer evaluations were found between (conventional) plastic and glass, these two materials were inspected. In addition, biodegradable plastic packaging was included as a third material type. Furthermore, consumer demographics and environmental orientations previously associated with packaging preferences and pro-environmental behaviour (e.g. nature and ocean connectedness, marine litter concern and value orientations) were assessed, and consumer segments were created accordingly, in order to enable comparisons of the Kano results across various consumer profiles. In addition, the obtained survey data on consumer characteristics enabled further appraisal of convergent and discriminant validity of the novel measure of ocean connectedness, and permitted conceptual comparisons between ocean and nature connectedness.

Therefore, Study 3 addressed the following research questions:

1.) Which environmentally relevant features and end-of-life scenarios of single-use packaging matter to the consumer (if any)?
2.) How important are these features, both quantitatively and qualitatively?
3.) Does the importance of these features differ across material types?
4.) Does the importance of these features vary across consumer segments, and how?
5.) Are there conceptual differences between ocean connectedness and nature connectedness in terms of their associations with other environmentally relevant orientations, consumer characteristics and packaging responses?

Figure 13

Graphical Abstract for Study 3.



3.3.1. Method

Research Design and Participants. Study 3 was implemented as an online survey. Before data collection commenced, the study procedure and materials were reviewed and approved by the University's Faculty of Science and Engineering Human

Ethics Committee. Eligibility criteria for the study included regular participation in grocery and household goods shopping. 1,177 British consumers[10] (597 female, 575 male, 5 other; quota sampled for age and gender) participated in the study via an online survey panel platform and received a small financial compensation. The mean age of participants was 40.62 (*SD* = 13.15), with the majority being nationals of England (*n* = 417), followed by Scotland (*n* = 381) and Wales (*n* = 376).

Measures.

Willingness to Buy Single-use Packaging. In order to assess consumption habits, like in Studies 1 and 2, the questions "*How likely would you be to buy a drink bottle made of conventional plastic / glass / biodegradable plastic?*" were asked at the very beginning of the consumer survey. These questions were answered on a 7-point Likert scale from "not at all likely" to "extremely likely".

Kano Survey. A Kano survey was created in order to capture consumers' responses to seven environmentally relevant packaging features or end-of-life scenarios of interest, across three material types. Following a traditional Kano survey approach (Kano, 1984), two questions are asked for each feature: "*If feature X is present in the product, how do you feel?*" (i.e. the 'functional' question) and "*If feature X is not present in the product, how do you feel?"* (i.e. the 'dysfunctional question'). The features and end-of-life scenarios as well as the exact question pairs used in Study 3 are presented in Table 3. Each question was answered by choosing one of the following response options: 1) *I like it*, 2) *I expect it*, 3) *I'm neutral*, 4) *I can tolerate it*, and 5) *I dislike it* (wordings adapted from Dace et al., 2020 for brevity and clarity). At the end of the Kano survey, following recommendations from previous research (e.g. Berger et al.,

[10] As no guidelines exist for the sample size required for a Kano analysis, we aimed to collect 400 responses from each country in Great Britain, with a total aimed sample size of 1,200. Altogether 1,347 survey responses were obtained and screened for incomplete responses and 'one-liners', resulting in a final sample size of 1,177.

1993; Löfgren & Witell, 2005), a stated importance question "*How important is it to you that feature X is present in the product?*" was asked for each of the seven features (or end-of-life scenarios) of interest, across the three material types, in order to capture a quantitative measure of importance. These questions were answered on a 7-point scale from "not at all important" to "extremely important".

Recycling Habits. A question about recycling habits was included in the survey as a measure of pro-environmental behaviour, enabling consumer segmentation accordingly (like in Atlason et al., 2017). The question "*How often do you recycle the following materials at home?*" was asked, with five types of materials commonly recycled in the UK listed (paper or cardboard; plastic; glass; metal, aluminium or tin; and clothing or textiles). Answers were given on a 5-point scale from "never" to "always", and the mean of the five answers was computed in order to obtain a recycling score for each respondent (McDonald's omega reliability of the scale was ω = .83).

Nature Connectedness. Given that Studies 1 and 2 found an association between ocean connectedness and packaging preference, but did not assess overall nature connectedness, this measure was included in the current survey. The connectedness to nature scale (CNS; Mayer & Frantz, 2004) is designed to measure the sense of belonging with the natural world. The scale contains 14 statements (e.g. "*I often feel a sense of oneness with the natural world around me.*"). In the current survey, the statements were answered on 7-point Likert-scale with a range from "strongly disagree" (1) to "strongly agree" (7). The CNS has favourable psychometric properties (Mayer & Frantz, 2004), and reliability of the scale was high in the current sample (ω = .88).

Table 3

Environmentally Relevant Packaging Features and End-of-life Scenarios, and the Relevant Question Pairs Included in the Kano Survey in Study 3.

Packaging feature or end-of-life scenario	Functional question	Dysfunctional question
Made of recycled (or bio-based) material[a]	If a [MATERIAL TYPE] bottle is made of recycled material, how do you feel?	If a [MATERIAL TYPE] bottle is not made of recycled material, how do you feel?
Produced at low environmental cost	If a [MATERIAL TYPE] bottle has been manufactured at a low environmental cost / carbon footprint, how do you feel?	If a [MATERIAL TYPE] bottle has been manufactured at a high environmental cost / carbon footprint, how do you feel?
Recyclable (or compostable) material[b]	If the material in a [MATERIAL TYPE] bottle can be fully recycled after you have discarded it (i.e. it doesn't end up landfill), how do you feel?	If the material in a [MATERIAL TYPE] bottle cannot be recycled after you have discarded it (i.e. it ends up in landfill instead), how do you feel?
Value recovery in other ways[c]	If the material in a [MATERIAL TYPE] bottle ends up being incinerated in a waste-to-energy centre after you have discarded it (instead of it ending up in landfill), how do you feel?	If the material in a [MATERIAL TYPE] bottle does not end up being incinerated in a waste-to-energy centre after you have discarded it (and it ends up in landfill instead), how do you feel?
Clear instructions for disposal	If a [MATERIAL TYPE] bottle displays clear instructions on how to dispose of it (such as which bin to put it in), how do you feel?	If a [MATERIAL TYPE] bottle does not display clear instructions on how to dispose of it (such as which bin to put it in), how do you feel?
Captured in the waste management system	If a [MATERIAL TYPE] bottle stays within the waste management system after you have discarded it (rather than escapes into the natural environment), how do you feel?	If a [MATERIAL TYPE] bottle escapes into the natural environment after you have discarded it (rather than stays within the waste management system), how do you feel?
Deposit return scheme in place	If a [MATERIAL TYPE] bottle can be taken to a bottle return point for a refund after use (i.e. there is a deposit return scheme in place), how do you feel?	If a [MATERIAL TYPE] bottle cannot be taken to a bottle return point for a refund after use (i.e. there is no deposit return scheme in place), how do you feel?

Note: Material types included conventional plastic, glass and biodegradable plastic.

[a] This feature reflects circularity in the beginning-of-life phase of packaging. For biodegradable plastic, the following question pair was used: "*If a biodegradable plastic bottle is made from bio-based materials (such as plants) instead of fossil fuels, how do you feel?*" and "*If a biodegradable plastic bottle is made from fossil fuels, how do you feel?*".

[b] This feature reflects the preferred circular scenario for value recovery of packaging. For glass, the following question pair was used: "*If a glass bottle can be recycled into a new bottle after you have discarded it (i.e. it doesn't end up in landfill), how do you feel?"* and *"If a glass bottle cannot be recycled into a new bottle after you have discarded it (i.e. it ends up in landfill instead), how do you feel?"*. For biodegradable plastic, the following question pair was used: "*If the material in a biodegradable plastic bottle can be fully recovered by composting after you have discarded it (i.e. it doesn't end up in landfill), how do you feel?*" and "*If the material in a biodegradable plastic bottle cannot be recovered by composting after you have discarded it (i.e. it ends up in landfill instead), how do you feel?"*.

[c] This feature reflects alternative value recovery when optimal circular value recovery cannot be realised. For glass, the following question pair was used: *"If the material in a glass bottle can be fully recycled into some other product after you have discarded it (i.e. it doesn't end up in landfill), how do you feel?"* and "*If the material in a glass bottle cannot be recycled into any other product after you have discarded it (i.e. it ends up in landfill instead), how do you feel?".*

Ocean Connectedness. Following from Studies 1 and 2, the 6-item ocean connectedness scale[11] adapted from the CNS (Mayer & Frantz, 2004) was used to measure the strength of perceived affinity towards the oceans (e.g. "*I often feel a sense of oneness with the natural world around me.*" changed to "*I often feel a sense of oneness with the ocean around me."*). The statement items were answered on 7-point Likert-scale with a range from "strongly disagree" (1) to "strongly agree" (7). In the current sample the scale showed acceptable levels of reliability (ω = .74).

Marine Litter Concern. Due to the significant association between marine litter concern and packaging preferences found in Studies 1 and 2 (reviewed in the Appendix B), nine items adopted from the MARLISCO Perceptions about Marine Litter survey (Hartley et al., 2018) were used to measure awareness of and concern over marine litter in the present survey. Each statement (e.g. "*I am very concerned about the impacts of marine litter*.") was answered on a 7-point Likert-scale with a range from "strongly disagree" (1) to "strongly agree" (7). In the current sample the scale showed high reliability (ω = .90).

Trust in the Waste Management System. As trust in the waste management system is likely to shape how consumers respond to packaging end-of-life scenarios, this variable was assessed in the current survey. Based on the work by Rompf (2014), three statements assessing perceptions of system reliability ("*I can rely on the council to recycle the materials I put out for recycling.*"), effectiveness ("*I think that the council is effective in how it deals with my recyclable waste*.") and norm-enforcement ("*I think that my council enforces recycling.")* were included and answered on a 7-point Likert-scale with a range from "strongly disagree" (1) to "strongly agree" (7). The mean of the

[11] In Study 2, the ocean connectedness scale item *"My personal welfare is independent of the welfare of the oceans."* (reverse coded) correlated negatively with the other scale items, and therefore it was changed to "*My personal wellbeing does not depend on the wellbeing of the ocean.*" in Study 3.

three answers was computed in order to obtain a trust score for each respondent, and reliability of the three-item scale was high in the current sample (ω = .82).

Value Orientations. Value orientations predict a number of pro-environmental behaviours, such as participation in waste recycling (Barr et al., 2003) and pro-environmental intentions in general (De Groot & Steg, 2008). Therefore, value orientations are expected to predict consumer perceptions of packaging, too, but research on the issue is virtually non-existent (as reviewed in Chapter 1). Value orientations were assessed in the current study, as recommended by De Groot and Steg (2008): Altogether twelve core values were presented to the participants, and participants were instructed to rate the importance of each value on a 7-point Likert-scale from "not at all important" (1) to "extremely important" (7). Three main value orientations were assessed: Egoistic (including value items social power, wealth, authority and influential), altruistic (equality, a world at peace, social justice and helpful) and biospheric (preventing pollution, respecting the Earth, unity with nature and protecting the environment). Mean scores for each value orientation were computed, and scale reliabilities for all three were high (ω = .82; ω = .88; ω = .91, respectively).

Sociodemographic Questions. Sociodemographic questions included variables previously associated with pro-environmental orientations and packaging responses. In addition to age, gender and level of education, distance of home from the coast was included as an exploratory variable that was expected to associate with ocean connectedness and other environmentally relevant perceptions.

Data Analysis.

Kano Modelling. Kano modelling was conducted within the R environment (R Core Team, 2017), following the procedure outlined by Atlason and Giacalone (2018).

As the first step, the survey respondents' answers to the functional and dysfunctional questions (see Table 3) are collected into a classification table, presented in Table 4. Based on the mode of answers to each question pair from the surveyed sample, the product features of interest (here: packaging features and end-of-life scenarios) are classified into the Kano categories (must-be features, one-dimensional features, attractive features, indifferent features, and reverse/questionable features). In addition, two numerical values are calculated for each feature: consumer satisfaction score (*CS;* range from 0 to 1) and dissatisfaction score (*DS;* range from 0 to -1). These values denote user satisfaction when the feature is fully realised, and dissatisfaction when the feature is fully excluded, respectively. Equations for calculating these scores are outlined in Atlason and Giacalone (2018).

Kano categories, as well as *CS* and *DS* values, were determined for the seven packaging features and end-of-life scenarios of interest, separately for each material type (conventional plastic, glass and biodegradable plastic). Kano modelling was firstly done on the survey sample as a whole, and then for each of the consumer segments separately.

Table 4

Kano Classifications Based on Answers to Functional and Dysfunctional Questions.

Functional	Dysfunctional				
	1. I like it	2. I expect it	3. I'm neutral	4. I can tolerate it	5. I dislike it
1. I like it	Q	A	A	A	O
2. I expect it	R	I	I	I	M
3. I'm neutral	R	I	I	I	M
4. I can tolerate it	R	I	I	I	M
5. I dislike it	R	R	R	R	Q

Note: A = Attractive; O = One-dimensional; M = Must-be; I = Indifferent; R = Reverse; Q = Questionable.

Consumer Segmentation. The survey sample were clustered into segments on the basis of both sociodemographic variables (gender, age, level of education and distance from coast) and environmental orientations (recycling behaviour, nature connectedness, ocean connectedness, marine litter concern, trust in the waste management system, egoistic value orientation, altruistic value orientation and biospheric value orientation). Clustering enabled grouping of survey data into clusters, such that the data within the same cluster are as similar to each other as possible, yet as different as possible from the other clusters. Clustering was conducted using a k-prototype algorithm (Huang, 1998). This clustering method is an extension to traditional k-means clustering and can be applied to data containing both continuous and factor variables. K-prototype clustering was done using the '*clustMixType*' package in R (Szepannek, 2018). The algorithm computes cluster prototypes as cluster means for continuous variables and modes for factor variables. The optimal number of clusters to be extracted was determined by inspecting the within sums of squares for each cluster solution (also known as the elbow criterion; Syakur et al., 2018).

Comparing Ocean Connectedness and Nature Connectedness. In order to explore the conceptual differences and similarities between ocean connectedness and nature connectedness, their associations with other variables were assessed. These variables included those previously associated with nature connectedness and/or pro-environmental behaviour, namely sociodemographic variables age, gender, level of education, and distance from the coast; and environmental orientations (marine litter concern, value orientations and recycling behaviour). In addition, the associations between the two connectedness variables and consumer responses to packaging (willingness to buy single-use packaging made of conventional plastic / glass / biodegradable plastic) were explored. Bivariate Pearson correlations were used for continuous variables, while Spearman correlations were used for ordinal variables (level

of education and distance from the coast[12]). To assess whether there were reliable differences in the magnitudes of the computed correlation coefficients (i.e. whether ocean connectedness correlated more strongly or weakly than nature connectedness with the variables of interest), Zou's confidence intervals were computed using the '*cocor'* package in R (Diedenhofen & Musch, 2015). These confidence intervals are suited for comparing dependent and overlapping correlations (i.e. correlations within the same dataset that have one variable in common) and are easily interpretable (Zou, 2007). In addition, gender differences in ocean and nature connectedness were assessed with independent samples *t*-tests (female vs. male), with participants in the 'Other' gender category left out of the analysis due to very small sample size (n = 4).

3.3.2. Results

Kano Results: Whole Survey Sample (n = 1,177). Results from the Kano modelling on the whole survey sample are presented in Table 5. As shown, the majority of the features and end-of-life scenarios were perceived by the consumers as indifferent. Features 'clear instructions for disposal' and 'deposit scheme in place' were classified as indifferent for all material types.

The only feature classified as a must-be feature was 'captured in waste management system' for conventional plastic packaging, indicating that consumers were greatly dissatisfied if plastic packaging, but not glass or biodegradable, ends up in the natural environment. In addition, consumers valued glass packaging that is made of recycled materials, but did not expect it *per se*. Furthermore, feature 'produced at low environmental cost' only mattered for glass and biodegradable packaging, and it had a linear relationship with consumer satisfaction. Finally, recyclability (or compostability

[12] Distance from the coast was treated as an ordinal variable due to extreme values in the data. The ordinal categories were ≤ 1 miles; > 1 – 5 miles; > 5 – 20 miles; > 20 – 50 miles; and > 50 miles.

for biodegradable plastic) was valued for all material types, and this feature had a linear relationship with user satisfaction.

Table 5

Kano Classifications, CS Scores, DS Scores and Mean Stated Importance Scores for Packaging Features and End-of-life Scenarios, across Three Material Types.

	Packaging material type *											
	Conventional plastic				Glass				Biodegradable plastic			
Packaging feature or end-of-life scenario	Kano class.	*CS*	*DS*	Mean stated imp. (*SD*)	Kano class.	*CS*	*DS*	Mean stated imp. (*SD*)	Kano class.	*CS*	*DS*	Mean stated imp. (*SD*)
Made of recycled (or bio-based) material	Indif.	-	-	5.64 (1.52)	**Attr.**	.60	-.37	5.67 (1.47)	Indif.	-	-	5.59 (1.48)
Produced at low environmental cost	Indif.	-	-	5.51 (1.52)	**One-dim.**	.46	-.53	5.64 (1.45)	**One-dim.**	.49	-.53	5.65 (1.46)
Recyclable (or compostable) material	**One-dim.**	.54	-.65	5.88 (1.44)	**One-dim.**	.58	-.61	5.82 (1.40)	**One-dim.**	.58	-.52	5.70 (1.42)
Value recovery in other ways	Indif.	-	-	4.96 (1.49)	**One-dim.**	.60	-.63	5.81 (1.38)	Indif.	-	-	5.18 (1.48)
Clear instructions for disposal	Indif.	-	-	5.42 (1.55)	Indif.	-	-	5.39 (1.53)	Indif.	-	-	5.54 (1.49)
Captured in the waste management system	**Must-be**	.23	-.59	5.46 (1.47)	Indif.	-	-	5.53 (1.44)	Indif.	-	-	5.45 (1.45)
Deposit return scheme in place	Indif.	-	-	4.98 (1.60)	Indif.	-	-	5.14 (1.60)	Indif.	-	-	4.99 (1.66)

Note: CS = Consumer satisfaction score; *DS* = Consumer dissatisfaction score. *CS* and *DS* scores are not computed for features classified as indifferent. Stated importance was measured on a scale from 1 to 7.
* Mean willingness to buy scores, measured on a scale from 1 to 7, were 4.77 (*SD* = 1.69) for conventional plastic, 5.03 (*SD* = 1.64) for glass, and 5.70 (*SD* = 1.38) for biodegradable plastic.

Consumer Segmentation. Due to missing data, responses from 1,123 participants were included in the consumer segmentation and the following Kano models. K-prototype clustering procedure based on sociodemographic and

environmental orientation variables resulted in four consumer clusters, hereafter referred to as segments. Descriptive results across these variables for each segment are presented in Table 6. Based on the within-segment characteristics and relative differences across segments, the segments were described as "*Educated environmentalists*" (segment 1), "*Older, less educated coastal dwellers*" (segment 2), "*Non-environmentalists*" (segment 3) and "*Nature-connected egocentrists*" (segment 4).

Kano Results across Consumer Segments. Results from the Kano modelling (Kano classifications) for each consumer segment are presented in Table 7. As can be seen, all packaging features and end-of-life scenarios bring satisfaction to *Educated environmentalists*. Notably, several features, including clear disposal instructions, were classified as must-be attributes for plastic packaging. In addition, use of recycled (or bio-based) materials, as well as recyclability (or compostability) of material were perceived as one-dimensional features. That is, the more these features are present in packaging, the more satisfied the consumers in this segment are. Furthermore, this segment perceived deposit return scheme as an attractive feature, regardless of packaging material type. That is, implementation of deposit return schemes would bring this consumer segment satisfaction, but its presence is not expected.

Similarly, *Older, less educated coastal dwellers* perceived deposit return schemes as attractive, although this feature was not valued for biodegradable plastic packaging. In contrast to *Educated environmentalists,* this segment perceived the use of recycled materials in glass bottles and the use of bio-based materials in biodegradable plastic packaging as attractive features, meaning that they did not expect them *per se*. Furthermore, consumers in this segment did not care about clear disposal instructions, nor were they concerned about biodegradable plastic packaging ending up in the natural environment.

Table 6

Consumer Characteristics across Four Segments.

	Consumer segment			
	Educated environmentalists (*n* = 354)	Older, less educated coastal dwellers (*n* = 300)	Non-environmentalists (*n* = 234)	Nature-connected egocentrists (*n* = 235)
Age (%)				
18 – 29	17	8	37	44
30 – 49	47	42	49	46
50 +	36	50	14	10
Gender (%)				
female	58	60	35	38
male	41	39	65	62
other	< 1	< 1	-	-
Education (%)				
no formal education	< 1	2	3	2
GCSE	17	42	21	16
A-level	24	24	23	20
undergraduate	41	22	34	42
postgraduate	16	8	14	14
doctorate	1	2	5	5
Distance from the coast (%)				
≤ 1 miles	18	12	11	6
> 1 – 5 miles	18	16	24	20
> 5 – 20 miles	19	40	22	31
> 20 – 50 miles	34	20	31	23
> 50 miles	12	12	13	20
nature connectedness[a]	5.71 (0.57)	4.56 (0.65)	3.99 (0.66)	4.95 (0.52)
ocean connectedness[a]	5.60 (0.76)	4.24 (0.75)	3.81 (0.72)	4.57 (0.60)
marine litter concern[a]	6.48 (0.51)	5.84 (0.77)	4.47 (0.86)	4.28 (1.04)
trust in the waste management system[a]	4.29 (1.46)	4.47 (1.28)	3.97 (0.99)	5.41 (0.95)
egoistic value orientation[a]	3.15 (1.18)	3.29 (1.06)	3.86 (0.98)	5.25 (0.96)
altruistic value orientation[a]	6.55 (0.62)	5.85 (0.84)	4.35 (1.03)	6.03 (0.75)
biospheric value orientation[a]	6.65 (0.50)	5.67 (0.87)	4.21 (0.92)	5.94 (0.78)
recycling behaviour[b]	4.56 (0.53)	4.52 (0.49)	3.32 (0.84)	3.99 (0.76)

Note: For environmental orientation variables group means are given with standard deviations in parentheses.

[a] Measured on a scale from 1 (low) to 7 (high).

[a] Measured on a scale from 1 (low) to 5 (high).

Table 7

Kano Classifications for Packaging Features and End-of-life Scenarios, across Three Material Types and Four Consumer Segments.

	Consumer segment											
	Educated environmentalists[a] (*n* = 354)			Older, less educated coastal dwellers[b] (*n* = 300)			Non-environmentalists[c] (*n* = 234)			Nature-connected egocentrists[d] (*n* = 235)		
Packaging feature or end-of-life scenario	Plastic	Glass	Biodeg. plastic	Plastic	Glass	Biodeg. plastic	Plastic	Glass	Biodeg. plastic	Plastic	Glass	Biodeg. plsatic
Made of recycled (or bio-based) material	O	O	O	I	A	A	I	I	I	I	A	I
Produced at low environmental cost	M	O	O	M	O	O	I	I	I	I	I	I
Recyclable (or compostable) material	O	O	O	O	O	O	I	I	I	I	I	I
Value recovery in other ways	M	O	O	M	O	I	I	I	I	I	I	I
Clear instructions for disposal	M	O	O	I	I	I	I	I	I	I	I	I
Captured in the waste management system	M	M	O	M	M	I	I	I	I	I	I	I
Deposit return scheme in place	A	A	A	A	A	I	I	I	I	I	I	I

Note: A = Attractive; O = One-dimensional; M = Must-be; I = Indifferent.

[a] Mean willingness to buy scores were 4.21 (*SD* = 1.80) for conventional plastic, 5.25 (*SD* = 1.64) for glass, and 6.14 (*SD* = 1.37) for biodegradable plastic.

[b] Mean willingness to buy scores were 4.97 (*SD* = 1.52) for conventional plastic, 4.90 (*SD* = 1.70) for glass, and 5.77 (*SD* = 1.20) for biodegradable plastic.

[c] Mean willingness to buy scores were 4.99 (*SD* = 1.60) for conventional plastic, 4.61 (*SD* = 1.65) for glass, and 5.09 (*SD* = 1.44) for biodegradable plastic.

[d] Mean willingness to buy scores were 5.11 (*SD* = 1.62) for conventional plastic, 5.33 (*SD* = 1.49) for glass, and 5.61 (*SD* = 1.27) for biodegradable plastic.

Non-environmentalists did not value any of the environmentally relevant features or end-of-life scenarios for packaging, as these were all classified as indifferent. In the *Nature-connectedness egocentrists* segment, the only valued feature was glass packaging being produced from recycled materials. This feature was classified as an attractive feature, signifying that consumers in this segment did not expect this feature to be fulfilled or experience dissatisfaction at its absence, but they were delighted when it is present.

Comparing Ocean Connectedness and Nature Connectedness.

Table 8 displays bivariate correlations between ocean connectedness and other environmentally relevant variables, and between nature connectedness and said variables. Displayed are also 95% Zou's confidence intervals (Zou, 2007) which indicate whether the variables correlate reliably differently with ocean and nature connectedness. It should be noted that ocean connectedness and nature connectedness were highly correlated (r = .70). Furthermore, the most notable difference between ocean and nature connectedness could be observed in their associations with distance from the coast: Distance from the coast had a significant negative correlation with ocean connectedness, indicating that people living closer to the coast showed higher levels of ocean connectedness. For the environmental orientation variables, although some inter-variable correlations were higher for nature connectedness (altruistic and biospheric value orientations, recycling behaviour and willingness to buy biodegradable packaging), no qualitative differences between the two connectedness constructs in how they associate with the listed variables can be observed based on these correlations. In addition, women had higher levels of ocean connectedness (M = 4.75, SD = 1.00) in comparison to men (M = 4.52, SD = .98), $t(1170) = 3.94$, $p < .001$, d = .23. Similarly,

women had higher levels of nature connectedness (M = 4.95, SD = .88) in comparison to men (M = 4.78, SD = .89), $t(1170) = 3.28$, p = .001, d = .19.

Table 8

Bivariate Correlations between Ocean Connectedness and Other Environmentally Relevant Variables, and between Nature Connectedness and Other Environmentally Relevant Variables, and Zou's 95% Confidence Intervals for Comparisons of Correlation Coefficients (n = 1,177).

	Ocean connectedness (adapted CNS)	**Nature connectedness** (CNS)	**Zou's confidence interval**[a]
Age	.15**	.11**	[-0.01, 0.08]
Level of education	.07*	.07*	[-0.04, 0.04]
Distance from the coast	-.07*	.01	**[-0.12, -0.04]**
Ocean connectedness (adapted CNS)	-	.70**	-
Nature connectedness (CNS)	.70**	-	-
Marine litter concern	.41**	.40**	[-0.03, 0.05]
Egoistic value orientation	-.05	-.05	[-0.04, 0.04]
Altruistic value orientation	.39**	.50**	**[-0.15, -0.07]**
Biospheric value orientation	.55**	.66**	**[-0.15, -0.08]**
Recycling behaviour	.33**	.38**	**[-0.09, -0.01]**
Willingness to buy a single-use bottle made of conventional plastic	-.23**	-.21**	[-0.06, 0.02]
Willingness to buy a single-use bottle made of glass	.16**	.15**	[-0.03, 0.05]
Willingness to buy a single-use bottle made of biodegradable plastic	.20**	.26**	**[-0.10, -0.02]**

Note: The reported values are Pearson correlations; for level of education and distance from the coast the reported values are Spearman correlations; CNS = 'Connectedness to Nature Scale'.

[a] Zou's 95% confidence intervals for comparing the magnitudes of correlation coefficients. Confidence intervals that do not contain zero indicate a reliable difference between the compared correlation coefficients. Reliable differences are indicated in bold.

* Correlation significant at the $p < .05$ level.

** Correlation significant at the $p < .01$ level.

3.4 General Discussion

Studies 1 and 2 demonstrated an interaction between ocean connectedness and consumers' responses to environmentally relevant attributes of packaging. In Study 3, the research focus was extended to include packaging attributes along the whole lifecycle of packaging (e.g. origin of raw materials) and possible end-of-life scenarios for packaging, as well as bio-based (and/or biodegradable) plastic as type of packaging material. The applied Kano methodology enabled the appraisal of consumer perceptions of packaging features and end-of-life scenarios both quantitatively and qualitatively, rendering a comprehensive and easily interpretable account of consumer response. Moreover, while Studies 1 and 2 considered ocean connectedness as the sole moderating variable of consumer response, Study 3 investigated the impact of ocean connectedness together with other consumer characteristics, both environmentally relevant (e.g. nature connectedness and value orientations) and sociodemographic variables (e.g. gender and proximity to the coast), on consumer responses. These characteristics were included in the study design in a consumer segmentation approach, enabling comparisons of packaging responses across different consumer profiles. In addition, this rich consumer data permitted examining the similarities and differences between ocean and nature connectedness in how they relate to other environmental orientations and consumer responses to packaging.

A number of key conclusions can be drawn from the findings in Study 3. Firstly, congruent with results from Studies 1 and 2, Kano results for the whole survey sample in Study 3 indicated that recyclability is valued by consumers. More specifically, recyclability was classified as a one-dimensional attribute, meaning that packaging recyclability brings consumers satisfaction, and they are dissatisfied if packaging is not recyclable. These findings differ from those obtained in previous studies (Kovačević & Bota, 2021; Löfgren & Witell, 2005; Williams et al., 2021) where recyclability was

classified as an attractive feature, meaning that recyclability has been previously considered a delight attribute but not essential for consumer liking. This trend in consumer response suggests that consumer expectations regarding packaging recyclability have changed over time. Löfgren et al. (2011) described this phenomenon as the '*life cycle of quality attributes'*, illustrating the dynamic nature of quality attributes over time. Furthermore, like packaging recyclability, compostability of biodegradable plastic packaging was similarly classified as a one-dimensional feature. That is, compostability is appreciated by consumers, and consumers are unhappy if biodegradable plastic packaging cannot be fully composted and ends up in landfill instead. This finding is in line with previous research demonstrating that consumers value packaging biodegradability highly (Herbes et al., 2018; Wensing et al., 2020).

Secondly, consumers were found to expect that plastic packaging stays within the waste management system. More specifically, consumers were indifferent about glass or biodegradable plastic packaging ending up in the natural environment, but they showed dissatisfaction with conventional plastic packaging realising this end-of-life scenario. Consumers expressing concerns about plastic packaging leaking into the environment is not surprising given that we are currently experiencing a global plastics crisis. Thus, consumers are likely highly motivated to ensure, through their decisions and behaviour, that plastic packaging does not end up polluting the environment. On the contrary, the findings show that consumers do not care whether conventional plastic packaging is produced from recycled materials or at a low carbon cost, signifying that consumers lack concern for the environmental burden of the beginning-of-life stage of plastic packaging, as shown previously (Herbes et al., 2018). In contrast, consumers showed appreciation for environmentally sustainable production (as well as value recovery) for glass bottles. Although consumers have been shown to overestimate the environmental sustainability of glass as a packaging material in previous research (Otto

et al., 2021), the current findings indicate that they especially value glass bottles being produced using circular strategies, in comparison to plastic bottles.

Inspection of consumer responses across the different segments revealed, as expected, that *Educated environmentalists* obtained utility from all the environmentally relevant packaging features and end-of-life scenarios of interest. This finding supports previous research linking environmental orientations, such as nature connectedness and environmental concern, as well as sociodemographic variables including gender and level of education, with pro-environmental inclinations (e.g. Barr, 2003; Huddart Kennedy et al., 2015; Madigele et al., 2017; Martin et al., 2020) and sustainable packaging preferences (e.g. Koenig-Lewis et al., 2014; Magnier & Schoormans, 2015). Notably, for this consumer segment four out of the seven attributes of interest (low environmental cost of production, value recovery, clear disposal instructions, and captured in the waste management system) were classified as must-be features for conventional plastic packaging. That is, for highly environmentally oriented consumers, low environmental impact was a requirement for plastic packaging, whereas for the other two material types it was valued but not required. Therefore, as was found in Studies 1 and 2, consumers who were highly connected with nature and the ocean were more critical about plastic packaging in particular. Furthermore, this group of consumers, as well as the segment *Older, less educated coastal dwellers*, found deposit return schemes an attractive opportunity. Such schemes do not exist in the UK yet, but it is predicted that they will be implemented UK-wide in 2024 at the earliest (Laville, 2021). A particularly positive reception to a deposit return scheme is therefore expected from a group of consumers who are highly or moderately environmentally oriented, older, and mostly women.

Responses in the consumer segment *Non-environmentalists* were somewhat as expected. This segment did not find any of the packaging attributes or end-of-life

scenarios relevant in determining their user satisfaction. In agreement with previous literature (e.g. Jaiswal & Bihari, 2020; Prakash et al., 2019), consumers (mostly male) low in nature connectedness, altruistic values and biospheric value orientation did not receive utility from environmental sustainability and optimal value recovery of single-use packaging. Meanwhile, findings on the segment *Nature-connected egocentrists* were rather surprising. This segment consisted of younger consumers (mostly male) with relatively high levels of nature and ocean connectedness, high trust in the waste management system, and an egoistic value orientation. The Kano results for this group were very similar to those for *Non-environmentalists,* except that *Nature-connected egocentrists* found recycled content in glass bottles an attractive delight attribute. Yet, the finding that almost all packaging sustainability features were irrelevant for this group of consumers warrants discussion. Notably, this group showed higher levels of nature and ocean connectedness than *Older, less educated coastal dwellers,* and yet the latter received satisfaction from almost all of the studied features. Previous research on the role of egoistic values in green purchasing behaviour has been mixed. For example, Prakash et al. (2019) found that both altruistic and egoistic values lead to positive consumer evaluations of eco-friendly food packaging. Yet, an egoistic value orientation may be a stronger motivational basis for sustainable consumer behaviour that has more direct consequences to an individual's wellbeing or health, such as buying organic food (Magnusson et al., 2003; Yadav, 2016). All in all, upon inspection of the consumer characteristics across the identified segments, it appears that even relatively high levels of nature and ocean connectedness will only predict more positive responses to packaging sustainability if the individual does not hold egoistic values.

Finally, inspection of how ocean and nature connectedness associate with sociodemographic factors and environmental orientation variables permit some conclusions to be drawn regarding the conceptual differences (and similarities) between

ocean and nature connectedness. Firstly, as expected (and as suggested by previous literature, e.g. Stoll-Kleeman, 2019), distance from the coast emerged as having a significant negative correlation with ocean connectedness, whereby larger distances from the coast were associated with lower levels of ocean connectedness. No similar association was observed for nature connectedness, indicating an intuitive and unique contribution of proximity to the coast to the human-ocean relationship. However, ocean connectedness did not differ from nature connectedness in regard to its relationship with other sociodemographic variables: Age and level of education were positively correlated with both ocean and nature connectedness. Nature connectedness has been shown to increase with age in some previous studies on the adult population (Beery, 2013; Diessner et al., 2018; Zhang et al., 2014), but a notable number of studies have concluded with null findings for the effects of age (Bruni et al., 2008; Mayer & Frantz, 2004; Unsworth et al., 2016) and, in particular, educational attainment (Beery, 2013; Cervinka et al., 2012; Dutcher et al., 2007; Mayer & Frantz, 2004; Weinstein et al., 2009). However, older and more highly educated people perceiving a stronger connection with the ocean is not surprising considering that age and level of education are often positively associated with higher levels of pro-environmental attitudes and intentions (e.g. Afroz et al., 2017; Gifford & Nilsson, 2014; Sánchez et al., 2016).

Furthermore, gender differences were observed in human-nature connection, with women having higher levels of both ocean and nature connectedness. As concluded in a review by Lengieza and Swim (2021), literature addressing gender differences in nature connectedness reports mixed findings, with both significant and null findings for the effect of gender. However, studies where gender differences are found tend to suggest that women are indeed more connected to nature than men (Anderson & Krettenauer, 2021; Cervinka et al., 2012; Hughes et al., 2019; Mayer et al., 2009; Schultz & Tabanico, 2007). Why females showed higher levels of ocean

connectedness in comparison to males warrants further discussion. Women have traditionally been shown to be more environmentally oriented in their attitudes and behaviours than men (Blok et al., 2015; Soares et al., 2021; Vicente-Molina et al., 2013). Thus, one explanation is that ocean connectedness is no different from most environmental orientation variables in this regard. Alternatively, on a conceptual level, ocean connectedness may be rather likened to place attachment: Previous research has demonstrated that women, in comparison to men, show stronger place attachment (Hidalgo & Hernandez, 2001). Similarly, in some instances women have been reported to have higher levels of ocean literacy (Lwo et al., 2013) and greater concern for the wellbeing of marine environments, specifically (European Commission, 2009; Wester & Eklund, 2011). However, conflicting and mixed findings regarding the impact of gender on place attachment and ocean literacy have been reported, too (Mesch & Manor, 1998; Steel et al., 2005), rendering the discussion on gender differences in ocean connectedness somewhat speculative in nature.

The conceptual characteristics of ocean and nature connectedness are further illustrated by inspection of their associations with value orientations. Traditionally, nature connectedness has had a negative relationship with egoistic values (Mayer & Frantz, 2004) and a positive correlation with altruistic and biospheric values (Pereira & Forster, 2015; Schultz, 2001). However, in the current study egoistic value orientation was not significantly (negatively) associated with either ocean or nature connectedness, indicating that self-enhancement attitudes do not bear relevance to perceptions of connectedness in the current sample. It is also notable that, although both ocean and nature connectedness correlated strongly with altruistic and biospheric value orientations, these correlations were stronger for nature connectedness. This trend suggests that high altruistic values and an appreciation of the biosphere more strongly co-occur with sensing a connection to and belonging with the natural environment in

general. Similarly, nature connectedness was more highly correlated with pro-environmental behaviour (recycling). One explanation is, again, that for some people ocean connectedness may be more accurately conceptualised as place attachment (Ramkissoon et al., 2012), for example connectedness to specific coastal areas, rather than a general pro-environmental attitude.

Finally, there were only small differences between ocean and nature connectedness in terms of how they associated with consumer evaluations of different types of packaging. Ocean connectedness and nature connectedness were similarly negatively associated with willingness to buy packaging made of conventional plastic, and equally positively correlated with willingness to buy packaging made of glass. However, nature connectedness was more highly correlated with willingness to buy biodegradable packaging, indicating that appreciation for biodegradability is more congruent with a general 'green' attitude. Overall, these correlations provide evidence of marginal differences between nature and ocean connectedness in how they relate to consumer responses to packaging. The theoretical implications regarding the conceptual characteristics of ocean connectedness are discussed further in Chapter 5 (section 5.3.1.).

Other implications from Study 3 include the notion that sustainable features and design of packaging, as well as environmentally desirable end-of-life scenarios for packaging, bring satisfaction to mostly female consumers who are connected with nature and the ocean, are highly concerned about marine litter, and who hold biospheric and altruistic values. Packaging targeted to these consumers may be more likely to enter favourable end-of-life scenarios, such as optimal value recovery. Therefore, communications and cues signalling packaging sustainability and appropriate disposal, such as information on the packaging label, could have an influence on consumer perceptions in this segment. For other consumers, namely males with strong egoistic

values, such communications may be insufficient. Alternative means of promoting purchasing and use of sustainable packaging in this segment could involve highlighting the functional properties of packaging or using novel, even disruptive packaging designs (Steenis et al., 2017). In addition, the results showed that recyclability is highly valued by all consumers, and today's consumers may experience dissatisfaction if packaging is not recyclable or compostable. Therefore, packaging communications that clearly signal packaging recyclability could have an impact on consumer perception and purchasing behaviour.

Furthermore, there was some evidence showing that consumers may more readily accept biodegradable plastic packaging bypassing value recovery. Even in the moderately environmentally oriented segment consumers were more relaxed about biodegradable packaging not reaching favourable end-of-life scenarios, in comparison to conventional plastic or glass. This finding is consistent with previous suggestions that biodegradability may undermine consumer willingness to ensure appropriate disposal of packaging (Haider et al., 2019). Therefore, it is desirable that the packaging sector and manufacturers accurately and clearly inform end-users about the properties of biodegradable packaging and its preferred disposal methods in order to prevent unintended consequences such as littering, as suggested previously (Hann et al., 2020). Finally, ocean connectedness (as well as general nature connectedness) was associated with higher levels of consumer satisfaction with sustainable features and favourable end-of-life scenarios for packaging, especially for conventional plastic. Therefore, current communications about the harmful impacts of plastic packaging on the marine environments have probably been effective in shaping consumer satisfaction with environmentally relevant packaging attributes and end-of-life scenarios.

Chapter 4: Does Manipulating Ocean Connectedness with a Virtual Reality Experience Shape Consumers' Packaging Preferences?

4.1 Introduction

Studies 1 and 2 demonstrated a correlational association between ocean connectedness and consumer responses to packaging recyclability and material type. Similarly, in Study 3, this relationship between connectedness to marine environments and valuation of packaging sustainability was extended to cover beginning-of-life properties and end-of-life scenarios for packaging. These findings are in line with existing literature documenting that a dispositional psychological connection with the environment predicts pro-environmental behaviour and consumer evaluations of product sustainability (Barbaro & Pickett, 2016; Kautish et al., 2021; Jaiswal & Bihari, 2020; Mackay & Schmitt, 2019; Martin et al., 2020).

Analogously, one would expect that increasing ocean connectedness would shape pro-environmental behaviour and consumer behaviour accordingly. That is, it could be anticipated that connecting individuals with the marine environment would subsequently cause them to, following from Studies 1 and 2, value packaging recyclability more and perhaps make them more wary of plastic packaging. As suggested in Chapter 1, experiences in marine and coastal environments, fostering place attachment to these locations, or promoting ocean literacy may help connect individuals with the ocean (Guest et al., 2015; Liefländer et al., 2013; Halpenny, 2010; Wyles et al.,

2017). These strategies could be implemented as long-term interventions to promote ocean connectedness and ultimately pro-environmental (or pro-marine) outcomes.

Furthermore, as discussed in Chapter 1, nature connectedness has been shown to manifest as both a dispositional trait and as a transient state concept. That is, individuals may feel more or less connected with the environment depending on the situation or immediately after exposure to natural environments (Zelenski et al., 2015). Furthermore, previous research suggests that nature connectedness, like other attitudinal orientations, is not only experienced on a conscious level, but it can also manifest as an implicit conception outside of one's awareness (Schultz, 2004; Schultz & Tabanico, 2007). To summarise, nature connectedness is malleable and can be induced momentarily, both explicitly and explicitly, with potential favourable impacts on pro-environmental behaviour. Furthermore, even with restricted or no access to real natural environments, nature experiences can be emulated using modern technologies, such as Virtual Reality (VR; Scurati et al., 2021). Chapter 4 outlines empirical work based on this rationale: In Studies 4 and 5, state ocean connectedness (both explicit and implicit) was manipulated with an oceanic VR experience, and consumer responses to packaging were assessed immediately after. Literature on the use of VR in inducing nature connection as well as previous research on implicit nature connection are presented next.

4.2 Literature Review

4.2.1. Virtual Reality, Nature Connection and Pro-Environmental Behaviour

As outlined in a review by Scurati et al. (2021), VR technologies can aid in the attainment of sustainability-related objectives in various ways. Firstly, VR experiences can address the emotional sphere of pro-environmental behaviour by altering affective states, awareness and sense of connection with nature. For example, VR technologies

enable exposure to and interaction with natural environments that are remote or otherwise difficult to reach. Secondly, VR can be used as an educational tool to shape rational beliefs including knowledge and understanding about sustainability issues, their causes and consequences. Finally, VR technologies, in particular multi-user simulations, can be helpful on the practical level, as they can facilitate the realisation of solutions. Consistent with the first objective, the potential of immersive VR experiences in reinforcing nature connection has been realised for some time (Ahn et al., 2016; Fox et al., 2020; Soliman et al., 2017; Yeo et al., 2020).

Even brief exposures to a natural environment can serve as a prime, prompting sustainable behaviour immediately after (Arendt & Matthes, 2016; Zelenski et al., 2015). However, evidence on the impacts of nature experiences mediated by VR on readiness to engage in pro-environmental behaviours is more equivocal. For example, Soliman et al. (2017) found that although a nature video experienced via immersive technology did increase sense of connectedness with nature, this connection did not translate into pro-environmental behaviour. Similarly, Klein and Hilbig (2018) note that for virtual nature experiences to promote pro-environmental behaviour, they need to incorporate conservational content, such as images of destroyed nature. Nevertheless, there are two ways in which the impact of exposure to 'undisturbed' (virtual) nature on pro-environmental behaviour or intentions can be amplified. Firstly, novel VR technologies permit fully immersive nature experiences with interactive elements and haptic feedback, enabling life-like, vivid encounters with the natural world. These features help create a heightened sense of presence and agency in the nature setting, even in environments that are otherwise impossible to reach, which can help bridge the subjective distance between humans and nature (Soliman et al., 2017). Alleviating this so-called psychological distance through realistic interactions with nature can promote motivation and efforts to protect it (Schuldt et al., 2016). That is, these immersive

experiences can facilitate one's nature connectedness further and thus operate as a more powerful prime for pro-environmental behaviour. Because VR technologies that enable such realistic encounters have only recently become available for every-day use by consumers, no studies exist yet that have looked into their potential to alter behaviour.

Secondly, the nature VR environment used and the targeted type of pro-environmental behaviour, or its consequences, should be readily and meaningfully associated. In other words, if one has 'connected the dots' between the natural environment emulated by the VR and the target behaviour, the VR exposure is likely to yield a more substantial impact on behaviour. Drawing on literature on place attachment, a construct closely related to nature connectedness (see e.g. Basu et al., 2020), a recent meta-analysis by Daryanto and Song (2021) demonstrated a stronger link between place attachment and specific behaviours towards said place than between place attachment and general pro-environmental behaviour. That is, the operationalisation of pro-environmental behaviour is non-trivial when studying the association between nature connection and behaviour. People today are likely to have formed a mental link between marine environments and plastic packaging pollution. Particularly in the Global North, this association may be partly due to the so-called "*Blue Planet effect*" which gave rise to widespread awareness and concern for plastic pollution in the world's oceans (Dunn et al.. 2020). Therefore, an oceanic VR exposure paired with assessment of a pro-marine behaviour, such as avoiding plastic packaging, is more likely to yield an observable effect on behaviour than using a VR manipulation involving 'green' nature. Therefore, life-like interaction with a virtual oceanic setting holds promise in shaping nature connectedness, and in this case ocean connectedness, in such magnitude that it primes readiness to behave in ways that can help alleviate the plastic burden of oceans.

4.2.2. Implicit Connections with Nature

Self-report approaches to measuring nature connectedness assume that one's perceived connection with nature can be retrieved and expressed accurately on the conscious level. However, as noted by Schultz et al. (2004), an individual's association with the natural world may not be something that they think about unless prompted to do so. Therefore, their primitive beliefs of connection may reside below the level of explicit thought. Attempts to access such beliefs have been made using the Implicit Association Test (IAT: Greenwald et al., 1998), and reports exist of the use of the IAT to measure connection with nature (Bruni & Schultz, 2010; Geng et al., 2015; Schultz, 2004; Schultz & Tabanico, 2007). The IAT involves assorting cue words into appropriate categories as quickly, yet as accurately, as possible. Reaction times of these categorisations are then recorded, and faster reaction times denote a higher magnitude of an automatic association between the target concepts. For example, an IAT designed to assess nature connectedness measures the strength of the association between 'nature' and 'self', relative to the association between the self and non-natural environments, often conceptualised as built of urban surroundings (e.g. Schultz et al., 2004). Assessing implicit nature connectedness in this way holds an important advantage over the use of self-report instruments in that the risk of desirability bias is minimised (Menzel et al., 2021; Steffens, 2004). Whereas implicit association with nature has been studied in previous research (e.g. Schultz et al., 2004; Wang et al., 2016), there are no reports of the use of an IAT designed to gauge connectedness with marine environments.

Previous research has demonstrated that implicit evaluations, as measured with the IAT, are situationally malleable across a variety of contexts (Dasgupta, 2013). For example, short-term manipulations in field and laboratory settings have been successful in shifting implicit intergroup attitudes (Dasgupta & Greenwald, 2001; Kühnen et al., 2001) as well as implicit self-concept (Stout et al., 2011) and self-referencing

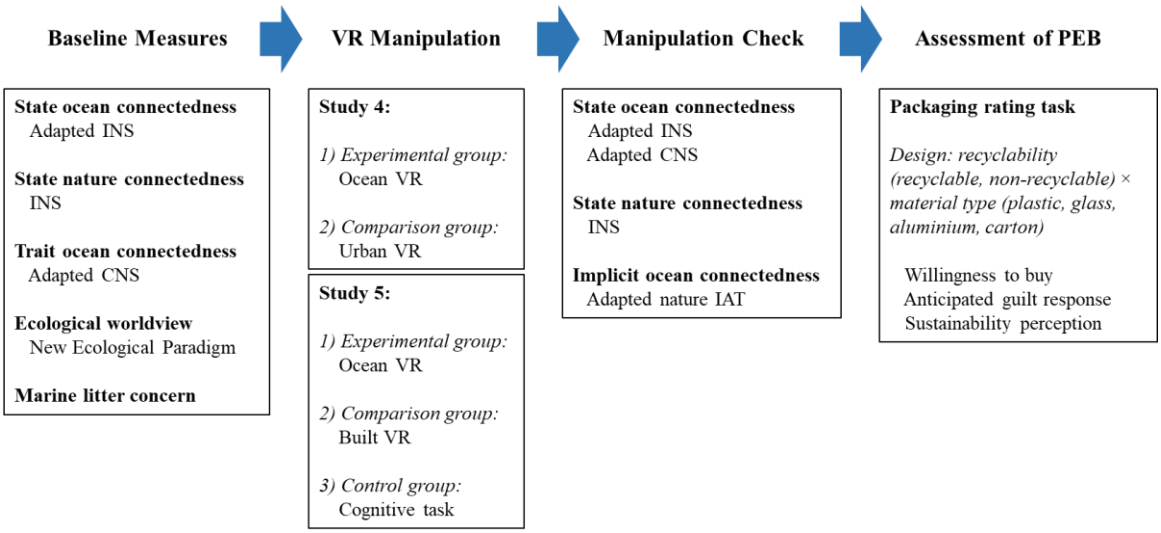
(Prestwich et al., 2010). For associations between the self and nature, Schultz and Tabanico (2007) found that a 5-minute passive immersion in a green outdoor environment did not affect implicit nature connectedness any differently than exposure to built environments, but a more active engagement of a longer duration (several hours) was sufficient in promoting nature connection. The mechanism through which simple nature exposure could change implicit connections is not yet known. As suggested by Dasgupta (2013), the local environment or context can make automatic associations more accessible, which, together with motivational and affective drivers of cognition and behaviour, may alter implicit responses. Following this premise, the current studies investigate whether making the self-ocean connection more salient by immersion can shape implicit ocean connectedness.

4.3 Studies 4 and 5: Research Aims, Experimental Paradigm and Hypotheses

The research presented here aims to uncover whether brief immersive exposure to a marine environment via VR can increase ocean connectedness, and whether this manipulation has subsequent effects on packaging preferences. The experimental paradigm applied in two studies is presented in Figure 14. Study 4 used an experimental group where participants experienced an ocean-themed VR environment, while a comparison group was exposed to a built VR environment. In Study 5, a second comparison group was included in which participants underwent a cognitive task.

Figure 14

Experimental Paradigm Used in Studies 4 and 5.



Firstly, it was hypothesised that participants in the *ocean VR* condition will show higher levels of self-reported state ocean connectedness than participants in the *built VR* condition ($H1_A$) or in the *cognitive task* condition ($H1_B$) after the VR manipulation.

Similarly, participants in the *ocean VR* condition were expected to show higher levels of implicit ocean connectedness than participants in the *built VR* condition ($H2_A$) or in the *cognitive task* condition ($H2_B$) as assessed immediately after the VR manipulation.

Additionally, in terms of impacts of the VR manipulation on pro-environmental behaviour, VR exposure was expected to modify study participants' responses to packaging attributes that are environmentally relevant. Firstly, a two-way interaction effect between manipulation condition and packaging material type was hypothesised. More specifically, in the *ocean VR* group plastic packaging was expected to be evaluated more negatively than the other material types on willingness to buy (WTB),

anticipated guilt response and sustainability perceptions, whereas no such differences were expected in the *built VR* condition ($H3_A$) or in the *cognitive task* condition ($H3_B$).

Similarly, following findings from Studies 1 and 2, a two-way interaction effect between manipulation condition and packaging recyclability was expected. More specifically, recyclable packaging was expected to be evaluated more positively than non-recyclable packaging on WTB, anticipated guilt response and sustainability perceptions, and the magnitude of this effect was expected to be larger in the *ocean VR* condition than in the *built VR* condition ($H4_A$) and in the *cognitive task* condition ($H4_B$).

4.4 Study 4: Comparing Oceanic VR with Urban VR

4.4.1. Method

Research Design and Participants. In Study 4, participants were assigned into one of two VR manipulation conditions, *ocean VR* (experimental group) or *built VR* (comparison group), and their levels of ocean connectedness were assessed before and after the manipulation. After the VR exposure they completed a packaging rating task similar to that in Studies 1 and 2 (measure of pro-environmental behaviour). Before data collection commenced, the study procedure and materials used were reviewed and approved by the University's Faculty of Science and Engineering Human Ethics Committee. Exclusion criteria for the study included history of epilepsy in response to flashing images or severe vertigo. 100 participants were recruited from the University's School of Psychology Participation Pool. They received one research participation point each which counted towards course credit. The participants were randomised into *ocean VR* and *built VR* conditions using a random sequence generator. Due to technical challenges encountered during data collection, the final study sample was 94 participants (78 female, 16 male) with a mean age of 21.61 (SD = 5.70), of which 46 were in the *ocean VR* group and 48 in the *built VR* group.

Apparatus, Measures and Materials.

VR Setting, Apparatus and Stimuli. The VR manipulation took place in a laboratory space (room measuring 4 x 5 m, see Figure 15) equipped with an HTC Vive VR system, located on the University campus. HTC Vive Pro VR headset with a picture resolution of 1,440 x 1,600 pixels per eye, 98° field of vision and built-in headphones was used in both VR conditions. External base station units confined the "play area" of the VR to approximately 3 x 3 m, providing the participants with space for exploration of the VR environment. Participants were also equipped with two wireless Vive Pro controllers, one in each hand (see Figure 15).

Figure 15

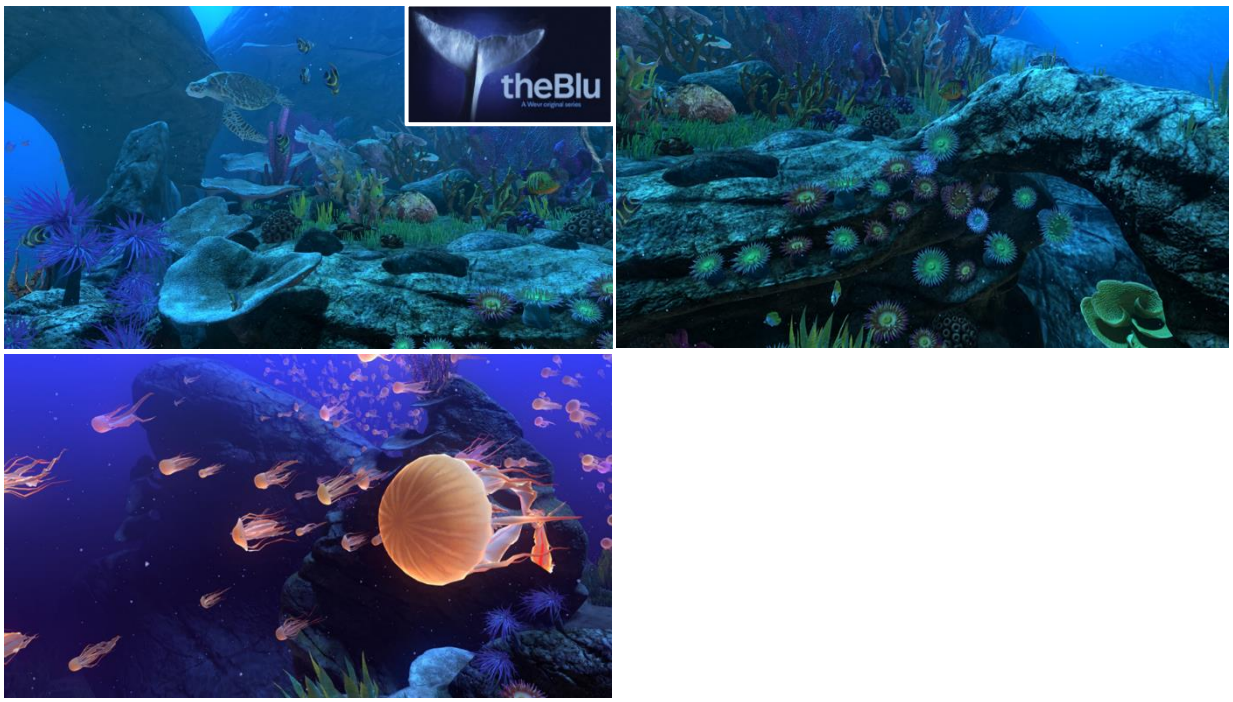
Virtual Reality Laboratory, Headset and Controllers.

VR manipulation for participants in the *ocean VR* group consisted of an immersive underwater experience (TheBlu: Reef Migration, Wevr; https://www.transportvr.com/theblu-series) featuring a coral reef ledge and various other marine organisms including anemones, fish, turtles and jellyfish (see Figure 16 for still images), as well as ambient underwater sounds played through the headphones. Participants were allowed to move around on the ledge, explore the space freely and

interact with the marine wildlife using the handheld controllers. The VR exposure lasted for around 5 minutes, during which the researcher read a script prompting the participant to pay attention to the various objects and aspects of the virtual world (see Appendix C). The purpose of the script was to promote the participant's sense of presence in the VR environment, and to prevent boredom or mind wandering.

Figure 16

Still Images of the Ocean VR Experience (TheBlu by Wevr).



VR manipulation for participants in the *built VR* condition involved a virtual tour in the busy streets of Manhattan, New York (Google Earth VR with Street View, Google; https://arvr.google.com/earth/, see Figure 17 for a still image). This VR programme allowed the participant to navigate around the city freely using the handheld controllers, therefore permitting a level of interaction similar to that in the *ocean VR* manipulation. Ambient city sounds (car and bicycle sounds, indistinct chatter) were played through the headphones during the VR exposure. The VR manipulation was

around 5 minutes in duration and involved a script guiding the participant's attention in the virtual world, read by the researcher (see Appendix C).

Figure 17

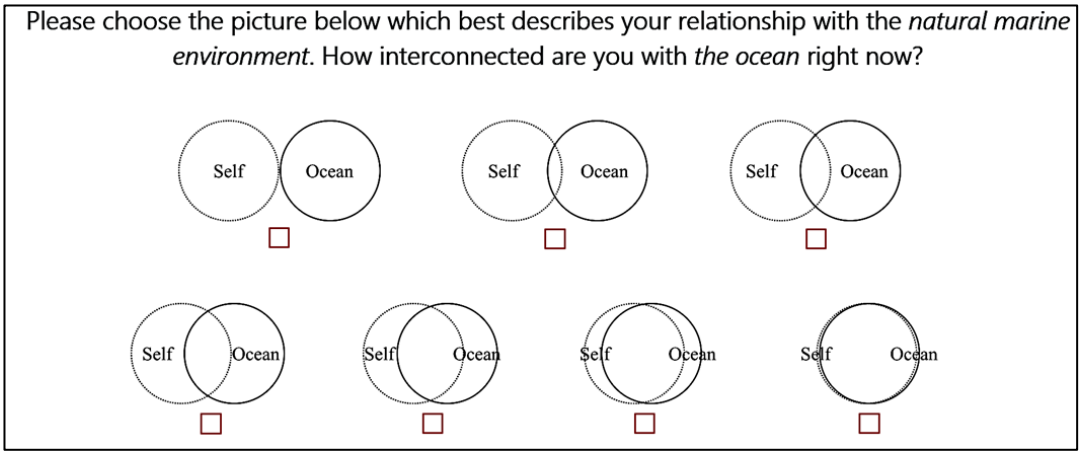
Still Image of the Built VR Experience (Google Earth VR Street View by Google).

Ocean Connectedness: Self-report Measures. Two self-report measures were developed to assess connectedness to the ocean. Firstly, an adaptation of the Inclusion of Nature in Self measure (INS; Schultz, 2001) was used as a state measure of ocean connectedness. The original INS measure consists of seven pictures, each depicting two circles named 'Self' and 'Nature'. The pictures differ in the level of overlap between the two circles: The first picture presents the 'Self' and 'Nature' circles next to each other with no overlap between them, whereas in the last picture the two circles overlap completely. The participant is asked to select the picture that most accurately represents their relationship with the natural environment. Although the single-item INS measure has been criticised for its limited psychometric properties (Martin & Czellar, 2016), avoiding participant overload was a matter of priority in the present research, and therefore this easy-to-administer measure was deemed appropriate. Furthermore, the INS has seen extensive use as a state measure of nature connectedness in previous work (e.g. Arendt & Matthes, 2016; Wang et al., 2016; Yeo et al., 2020), often with the

question wording changed to reflect the participant's perception of connectedness in the moment. In the adapted state ocean connectedness measure (see Figure 18), the 'Nature' circle was renamed 'Ocean', and the wording was revised to reflect state-level connectedness.

Figure 18

State Ocean Connectedness Measure Used in Studies 4 and 5 (Adapted from Schultz, 2001).



In order to gain a more comprehensive assessment of ocean connectedness, a six-item measure adapted from the Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004) was used as a trait measure of ocean connectedness. Designed to measure the strength of perceived affinity towards the oceans, the ocean connectedness scale includes items modified from the original CNS (e.g. *"I often feel a sense of oneness with the natural world around me."* changed into *"I often feel a sense of oneness with the ocean around me."*). Each statement is scored on a 7-point Likert-scale with a range from "strongly disagree" (1) to "strongly agree" (7). The ocean connectedness scale showed good reliability previously (Studies 1 and 2), and in the current sample reliability was high (McDonald's omega ω = .83). The previously developed ocean connectedness scale, like the CNS, is a trait measure, which is reflected in the wordings

of the items (e.g. “often”, “usually”). The ocean connectedness scale was administered in this original trait form to all participants before the VR manipulation, in order to account for any baseline differences in ocean connectedness. In addition, a state version of the scale was administered after the manipulation, with words such as “usually” omitted from the scale items (McDonald’s omega ω = .76). Therefore, the applicability of the scale in assessment of transient ocean connectedness was trialled, too.

Implicit Ocean Connectedness: Adapted Nature IAT. An adaptation of the IAT (Greenwald et al., 1998), further modified from the version used by Schultz et al. (2004) and Schultz and Tabanico (2007) to assess implicit nature connection, was used to measure implicit ocean connectedness. This computerised task involved measuring reaction times needed to categorise words related to oceanic and built environments. The words used for the *Ocean* and *Built* categories are listen in Table 9: These words were adopted from Schultz and Tabanico (2007), with the original *Nature* words modified to reflect the ocean and marine life. These newly developed words were similar to the original *Nature* words in terms of valence and word length. Two additional word categories, *Me* and *Not Me*, were used to measure self-concept (Schultz & Tabanico, 2007; see Table 9). In the IAT, the participant is instructed to categorise words appearing in the centre of the computer screen to its relevant category. The categories are presented on the left and right side of the screen, and the participant presses the corresponding key (‘left’ or ‘right’) on the keyboard to make the categorisation. The participant is instructed to categorise the appearing words as quickly yet as accurately as possible. In case of an error, the participant is notified of the incorrect categorisation and must make the correct categorisation before moving on. After example trials, the participant completes seven blocks of 24 trials (24 words). The categories used in each block, presented on opposing sides of the computer screen, are listed in Table 10.

Table 9

Categories and Words Used to Measure Implicit Ocean Connectedness.

Category			
OCEAN	BUILT	ME	NOT ME
Water	Building	I	It
Whales	Car	Me	Other
Waves	City	Mine	Their
Sea	Factory	Myself	Them
Coral	Street	Self	They
Fish	Computer	My	Theirs

Table 10

Categories Used in Each Block of the Implicit Association Test.

Block	Categories
1	Me – Not me
2	Ocean – Built
3	Me/Ocean – Not me/Built
4	Me/Ocean – Not me/Built
5	Built – Ocean
6	Built/Me – Ocean/Not me
7	Built/Me – Ocean/Not me

The words for each category in the block are chosen at random from the pool of words shown in Table 9. Blocks 1, 2 and 5 are practice trials, and the result of the IAT is computed from performance in the remaining four test trial blocks. In the test trial blocks 3, 4, 6 and 7 there are two categories on each side, and the appearing words can be from any of the four categories. Blocks 3 and 4 are called ‘compatible’ category pairings, and blocks 6 and 7 ‘incompatible’ pairings. These test blocks assess the strength of one’s association between ‘self’ and ‘ocean’ by calculating how quickly the participant completes the compatible trials in comparison to the incompatible trials (i.e., how much more easily one makes the association between ‘self’ and ‘ocean’ than

between ‘self’ and ‘built’). If the participant completes the compatible trials more quickly than the incompatible trials, they associate themselves more with the ocean than with the built environment. On the contrary, completing the incompatible trials more quickly signifies a stronger association between the self and the built environment. As the ordering of the compatible and incompatible blocks can have an impact on performance on the IAT (Greenwald et al., 1998), it was necessary to counterbalance for this order effect. Therefore, two versions of the IAT were created: One with block ordering as shown in Table 10 (compatible trials first), and a second one with blocks 6 and 7 shown as the first test trials (incompatible trials first). Study participants were randomly assigned to one of these two IAT conditions.

IAT scores, also called *D*-scores, for each participant were then calculated using the improved IAT scoring algorithm by Greenwald et al. (2003). In principle, the mean reaction time difference between test blocks 3 (compatible trials) and 6 (incompatible trials) is calculated first and then divided by their pooled standard deviation. The same is then done for blocks 4 and 7. These calculations produce two *D*-scores, one for each pair of blocks, and the average of the two is the participant’s final *D*-score. The score typically ranges from -2 to 2: A positive *D*-score indicates faster responses for the compatible trials (‘Me’ paired with ‘Ocean’), signifying stronger association between ocean and the self and, therefore, higher ocean connectedness. Analogously, a negative *D*-score means stronger association of the self with the built environment.

State Nature Connectedness: The INS. Impacts of the (VR) manipulation on overall state nature connectedness were also explored using the original measure of INS (Schultz, 2001) with the question wording changed to reflect state-level nature connectedness ("*Please choose the picture below which best describes your relationship with the natural environment. How interconnected are you with nature right now?*”).

These results on state nature connectedness are reported later alongside the state and trait ocean connectedness measures.

Assessing Pro-Environmental Behaviour: Packaging rating task.

Stimulus Material. Assessment of pro-environmental behaviour was done using a packaging rating task similar to that used in Studies 1 and 2: The stimulus material used in the experiment consisted of digital images of single-use water containers (see Figure 5 in Chapter 2), varying in type of packaging material (4 levels: plastic, glass, aluminium or carton) and recyclability (2 levels: recyclable or non-recyclable). Therefore, eight products each displaying a unique combination of type of material and recyclability, were presented to the participants. To make these products seem as real as possible, they were labelled with an existing, albeit foreign, bottled water brand name. Material type and recyclability were indicated on the packaging with stereotypical container designs (shape and transparency of packaging) and recycling labels (see Figure 5). In order to ensure that participants based their recyclability judgments on the given labels, and not on previous knowledge of packaging recyclability in their own area, participants were presented with a hypothetical shopping scenario and instructions for the task (see Appendix C).

Dependent Variables. Each of the eight products were rated on WTB, anticipated guilt response and sustainability perception. For WTB and anticipated guilt response, the items “How likely would you be to buy this product?” and “Buying this product would make me feel guilty.” were presented and answered a 7-point scale from “not at all” to “extremely” (following Studies 1 and 2). In addition, the question “How sustainable do you think this type of packaging is?”, with similar answer options from 1 “not at all” to 7 “extremely”, was asked to assess sustainability perceptions (see e.g. Boesen et al., 2019). Single items were chosen for each of these dependent variables in order to avoid excessive repetition.

Additional Measures. Additional items measuring ecological world view (revised New Ecological Paradigm scale; Dunlap et al., 2000) and marine litter concern (scale used in Studies 1 and 2) were included to assess baseline differences in environmental orientations, as well as in an attempt to mask the focus on ocean connectedness. Finally, the level of immersion in the VR environment was assessed with three items modified from Tanja-Dijkstra et al. (2014; "*To what extent did you feel like you went inside the virtual world?*", "*How real did the virtual world seem to you?*" and "*How aware were you of your real-world surroundings while in the virtual world (i.e. sounds, other people, etc.?*").

Experimental Procedure. After arriving at the testing laboratory the participant answered a computerised baseline survey with self-report measures for trait ocean connectedness and additional exploratory constructs. Once the survey was completed, the experimenter launched the appropriate VR program on the computer. The participant was then instructed to put on the VR headset and given the handheld controllers. Head straps and lenses on the headset were adjusted if necessary in order to make sure that the participant had a clear view of the VR environment. Similarly, the headphones and volume were adjusted so that the participant was able to hear the sounds displaying in the VR as well as the experimenter's voice. The computer screen displayed what was seen by the participant, enabling the experimenter to follow the participants' progression. Once clear visibility and audio were ensured, the experimenter started a stopwatch and proceeded to read a script which included instructions and prompts for the VR experience. After around 5 minutes the VR program was turned off and the participant was instructed to take off the headset.

After the VR exposure, the participant completed the IAT. Once the IAT finished, a post-manipulation survey measuring state ocean and nature connectedness

was administered, followed by the packaging rating task. This task began with an introduction to a hypothetical shopping setting (see Appendix C), and participants were also instructed to assume that all of the displayed products were priced the same. Following the instructions, the products were presented in a randomised order and rated by the participant for WTB, anticipated guilt response and perceived sustainability. The whole testing procedure lasted for less than 30 minutes per participant.

Data Analysis. All statistical analyses were conducted within the R environment (R Core Team, 2017). Analyses of covariance (ANCOVA) were used to test the effectiveness of the ocean connectedness manipulation ($H1_{A\text{-}B}$ and $H2_{A\text{-}B}$) in the presence of control variables, while linear mixed effects models were used to assess the impacts of the VR manipulation on evaluations of single-use packaging ($H3_{A\text{-}B}$ and $H4_{A\text{-}B}$). The linear mixed effects models were specified using the 'lmerTest'-package (Kuznetsova et al., 2017) which uses the Satterthwaite's approximation to derive ANOVAs for the included effects. Participant was treated as a random variable across all computed models, with only random intercepts specified in order to enable model convergence (Barr et al., 2013). Therefore, baseline differences in packaging responses were assumed between participants. Manipulation condition, packaging material and recyclability, along with possible control variables, were included in the models as fixed effects. Interactions were specified between manipulation condition and packaging material, as well as between manipulation condition and packaging recyclability in order to address hypotheses $H3_{A\text{-}B}$ and $H4_{A\text{-}B}$. Sizes of the observed interaction effects are included in the results as parameter estimates of the fixed effects (β) when appropriate. These estimates were derived using orthogonal contrast coding. If significant interactions were found in the ANOVA results, estimated marginal mean (EMM) differences between plastic and other material types ($H3_{A\text{-}B}$) and between

recyclable and non-recyclable packaging ($H4_{A\text{-}B}$) were computed and contrasted across manipulation conditions.

Preliminary checks of the data were performed first, in order to ensure that there were no differences between the two manipulation groups in terms of sociodemographic variables (assessed with chi-square tests). Baseline differences between the groups in trait and state ocean connectedness, additional environmental orientation variables, as well as differences in the level of immersion in the VR environment, were also examined (assessed with independent samples *t*-tests or equivalent non-parametric tests[14]). Furthermore, following Schultz and Tabanico (2007), participants' IAT results were screened for categorisation errors, using a 30% error rate cut-off. No participant in the current sample had an error rate higher than 30%, meaning that all participants' IAT data were included in the analyses.

4.4.2. Results

Descriptive Analyses and Baseline Differences. No differences were found between the *ocean VR* and *built VR* groups in terms of age[15] ($X^2(3) = 1.50$, $p = .682$) or gender ($X^2(1) = 3.03$, $p = .082$), and therefore these variables were excluded from subsequent analyses. There were no differences between the two groups in baseline state ocean connectedness (adapted INS measure; $t(92) = 0.28$, $p = .778$) or baseline state nature connectedness (INS measure; $t(79.83) = 1.64$, $p = .106$). Similarly, the two groups did not differ in trait ocean connectedness (adapted CNS measure; $t(92) = 0.15$, $p = .881$), ecological world view ($t(92) = 0.54$, $p = .592$) or marine litter concern ($t(92) = 0.24$, $p = .812$; see Table 11 for participant demographics and baseline survey means).

[14] Results for the parametric tests are reported here, unless parametric and non-parametric tests produced different outcomes.
[15] Participants were categorised into age groups for the chi-square analysis.

Table 11

Participant Demographics and Group Means for Baseline Survey Measures (Study 4).

	Ocean VR group (n = 46)	Built VR group (n = 48)
Gender distribution	25 female, 11 male	43 female, 5 male
Age (years)	21.98 (6.45)	21.25 (4.92)
State ocean connectedness		
Adapted INS[a]	2.65 (1.34)	2.73 (1.30)
State nature connectedness		
INS[a]	3.80 (1.26)	3.44 (0.87)
Trait ocean connectedness		
Adapted CNS[b]	4.91 (1.10)	4.94 (0.94)
Ecological world view (NEP)[c]	5.56 (0.65)	5.63 (0.58)
Marine litter concern[d]	6.26 (0.54)	6.29 (0.53)

Note: Standard deviations are in parentheses.
[a]INS = 'Inclusion of Nature in Self'; measured on a 7-point pictorial scale.
[b]CNS = 'Connectedness to Nature Scale'; 6-item scale (reliability ω = .83); items answered on a 7-point Likert scale.
[c]NEP = 'New Ecological Paradigm'; 10-item scale (reliability ω = .65); items answered on a 7-point Likert scale.
[d]9-item scale (reliability ω = .68); items answered on a 7-point Likert scale.

Manipulation Checks for Ocean Connectedness (Hypotheses $H1_A$ and $H2_A$). Experienced level of immersion in the virtual world was significantly higher in the *ocean VR* group (M = 5.44, SD = 0.78) than in the *built VR* group (M = 4.60, SD = 0.97; $t(92) = 4.65$, $p < .001$), and therefore level of immersion was included as a control variable in the following analyses.

Means and standard errors for the post-manipulation measures used, with means adjusted for the effect of level of immersion, are shown in Table 12. After the VR manipulation, participants in the *ocean VR* group reported significantly higher levels of state ocean connectedness than the *built VR* group, as measured with the adapted INS ($F(1,91) = 18.56$, $p < .001$, partial $\eta^2 = .17$). Participants in the *ocean VR* group also showed higher scores on the state ocean connectedness scale, as measured with the adapted CNS, but this difference was not significant ($F(1,91) = 2.07$, $p = .154$, partial $\eta^2 = .02$). Therefore, in terms of between-group differences in self-reported state ocean

connectedness, only partial support was found for hypothesis $H1_A$. Results for implicit ocean connectedness from the adapted nature IAT showed a global positive IAT effect, meaning that study participants had stronger associations between self and the ocean than between self and the built environment, on average. However, there were no differences between the two groups in implicit ocean connectedness ($F(1,91) = 1.36$, $p = .246$, partial $\eta^2 = .01$), meaning that no support was found for hypothesis $H2_A$. As an additional finding, the *ocean VR* group showed significantly higher levels of state nature connectedness, as measured with the INS ($F(1,91) = 24.68$, $p < .001$, partial $\eta^2 = .21$) post-manipulation. Pearson correlations across the post-manipulation measures and trait ocean connectedness are reported in Table 13.

Table 12

Group Means for Post-Manipulation State Ocean and Nature Connectedness Measures and Implicit Ocean Connectedness (Study 4).

	Ocean VR group (n = 46)	Built VR group (n = 48)
State ocean connectedness		
Adapted INS[a]*	4.75 (0.22)	3.37 (0.21)
Adapted CNS[b]	5.69 (0.13)	5.42 (0.13)
State nature connectedness		
INS[a]*	5.05 (0.18)	3.77 (0.17)
Implicit ocean connectedness		
Adapted nature IAT[c]	0.54 (0.05)	0.63 (0.05)

Note: Means are adjusted for the effect of level of immersion in the VR environment; standard errors are in parentheses.
[a]INS = 'Inclusion of Nature in Self'; measured on a 7-point pictorial scale.
[b]CNS = 'Connectedness to Nature Scale'; 6-item scale (reliability ω = .76); items answered on a 7-point Likert scale.
[c]IAT = 'Implicit Association Test'; implicit attitude expressed as a *D*-score.
* Ocean and nature connectedness, as measured with the INS measures, increased from pre- to post-manipulation in both *ocean VR* group (paired samples *t*-tests: $t(45) = -10.40$, $p < .001$; $t(45) = -6.84$, $p < .001$, respectively) and *built VR* group ($t(47) = -4.80$, $p < .001$; $t(47) = -2.44$, $p = .018$, respectively).

Table 13

Pearson Correlations across Post-Manipulation State Measures and Trait Ocean Connectedness (Study 4).

Measure	1.	2.	3.	4.	5.
State ocean connectedness					
1. Adapted INS	-				
2. Adapted CNS	.66**	-			
Implicit ocean connectedness					
3. Adapted nature IAT	.19	.25*	-		
State nature connectedness					
4. INS	.66**	.48**	.06	-	
Trait ocean connectedness					
5. Adapted CNS	.50**	.73**	.18	.37**	-

Note: INS = 'Inclusion of Nature in Self'; CNS = 'Connectedness to Nature Scale'; IAT = 'Implicit Association Test'.

* Correlation significant at the $p < .05$ level.

** Correlation significant at the $p < .01$ level.

Impact of VR Manipulation on Evaluations of Packaging Material

(Hypothesis H3$_A$). The ANOVA results with degrees of freedom obtained using the Satterthwaite method showed a non-significant two-way interaction between manipulation condition and packaging material on WTB ($F(3,658) = 0.09$, $p = .966$[16]). Similarly, no significant two-way interactions were found between manipulation condition and packaging material on anticipated guilt response ($F(3,658) = 0.47$, $p = .700$) or sustainability perceptions ($F(3,658) = 0.74$, $p = .529$). Therefore, the two groups did not differ in how plastic was evaluated for WTB, anticipated guilt response or perceived sustainability in comparison to the other material types, meaning that hypothesis *H3$_A$* was not supported.

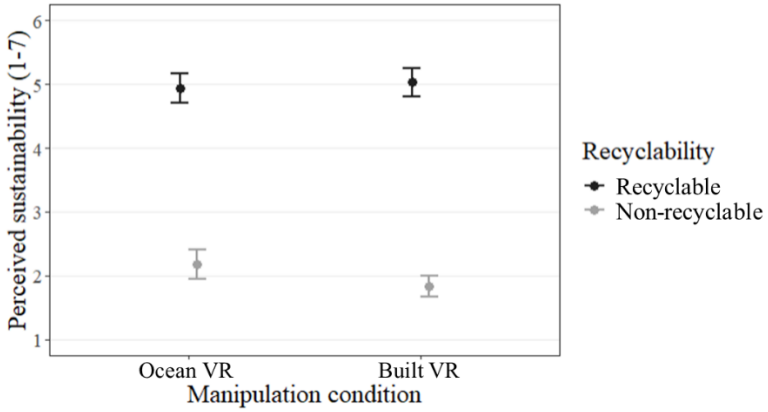
[16] No omnibus effect sizes for multilevel model effects including factor variables with more than two levels are reported, as for all such variables of interest there is notable variance across factor levels (e.g. across the different material types), rendering an 'overall' effect size lacking in interpretable value. Instead, if the omnibus effects are significant, estimated mean differences (β) are reported for individual comparisons across factor levels.

Impact of VR Manipulation on Evaluations of Packaging Recyclability

(Hypothesis H4$_A$). There were no significant two-way interactions between manipulation condition and packaging recyclability on WTB (F(1,658) = 0.36, p = .548, β = .03) or anticipated guilt response (F(1,658) = 0.61, p = .436, β = .04). However, a significant two-way interaction was found between manipulation condition and packaging recyclability on sustainability perceptions (F(1,658) = 5.13, p = .024, β = .11). This interaction is illustrated in Figure 19. According to Tukey-corrected post-hoc interaction comparisons there were no significant differences, however, between the two groups in how recyclable packaging was rated for perceived sustainability (t(210) = 0.58, p = .939, estimated marginal mean (EMM) difference: 0.10) or in how non-recyclable packaging was rated for perceived sustainability (t(210) = 2.07, p = .165, EMM difference: 0.35). Therefore, no support was found for hypothesis $H4_A$ in terms of between-group differences in evaluations of packaging recyclability.

Figure 19

Two-Way Interaction Effect between Manipulation Condition and Packaging Recyclability on Perceived Sustainability of Single-use Packaging.



Note: Error bars represent 95% confidence intervals.

4.4.3. Discussion

The purpose of Study 4 was to test the effect of an immersive VR manipulation on ocean connectedness and subsequently on pro-environmental behaviour. Overall, limited evidence was found to support the study hypotheses. Firstly, the ocean connectedness manipulation was successful in producing higher levels of self-reported ocean connectedness in the *ocean VR* group in comparison to the *built VR* group. However, this was only true for the adapted INS, as no significant differences were found in state ocean connectedness scale scores between the two groups, while controlling for level of immersion in the VR. Changes in the INS as a result of (virtual) nature exposure have been documented previously (Ahn et al., 2016; Liefländer et al., 2013; Nisbet & Zelenski, 2011), and the brief VR manipulation in Study 4 replicated these findings. Given that the current study was the first to use the ocean connectedness scale as a state measure, more research is needed for its validation as an instrument for assessing transient ocean connectedness. Furthermore, implicit ocean connectedness did not differ between the two VR groups. In fact, participants in the *built VR* group showed higher scores in the IAT, although this difference was not significant. While previous research has demonstrated the malleability of implicit associations (e.g. Dasgupta & Greenwald, 2001; Wang et al., 2016), it is possible that a 5-minute immersive VR experience in an oceanic environment was not sufficient in duration to alter implicit self-nature associations. Furthermore, it may be that the *built VR* experience caused a benign 'boomerang effect' wherein exposure to a busy urban setting resulted in a yearning for natural spaces, especially since the study participants were students living in a coastal city. Moreover, given that the ocean VR was experienced as more immersive and 'real' than the urban VR, the two conditions were not fully comparable, and thus no firm conclusions regarding manipulation of ocean connectedness can be

drawn from the between-group comparisons. In addition, as no differences were found between the two groups in terms of evaluations of single-use packaging, there was no evidence that the oceanic VR manipulation primed pro-environmental behaviour any differently than the built VR exposure.

4.5 Study 5: Comparing Oceanic VR, Built VR and a Cognitive Task

Study 5 was conducted to address some of the aforementioned issues in the VR manipulation. More specifically, Study 5 used a virtual tour in a cathedral as the *built VR* experience, in an attempt to allow a similar level of immersion, interaction and sense of presence in the virtual environment as in the *ocean VR* condition. Moreover, this built environment was less extreme (i.e. less congested), and therefore was thought to be less likely to cause a boomerang effect as suggested earlier. In addition, as the experimental design in Study 4 only allowed for comparisons between groups of individuals who were prompted to pay attention to their surroundings, Study 5 employed a third experimental condition: The *cognitive task* condition was designed to keep the participants engaged in an unrelated, non-complex task and to disallow for mind wandering (Macaulay et al., 2022).

4.5.1. Method

Research Design and Participants. In Study 5, participants were assigned into one of three VR manipulation conditions, *ocean VR* (experimental group), *built VR* (comparison group) or *cognitive task* (second comparison group). 120 participants were recruited from the University's School of Psychology Participation Pool. They received one research participation point each which counted towards course credit. The participants were randomised into *ocean VR, built VR* and *cognitive task* conditions using a random sequence generator. Due to technical challenges encountered during

data collection, the final study sample was 118 participants (92 female, 26 male) with a mean age of 21.15 (*SD* = 5.73), of which 40 were in the *ocean VR* group, 40 in the *built VR* group and 38 in the *cognitive task* group.

Apparatus, Measures and Materials.

VR Setting, Apparatus and Stimuli. The VR manipulation set-up was identical to that of Study 4, but this time the *built VR* condition involved a virtual tour of the Cologne cathedral (Realities – Cologne Cathedral on Steam; https://www.realities.io/; see Figure 20 for a still image). Participants started the virtual tour by the chancel and were permitted to explore the space as well as other rooms in the cathedral freely. Entering new rooms or picking up information 'leaflets' with the hand-held controllers triggered a speech by a virtual tour guide, which was played through the built-in headphones. As the speeches directed the participant's attention towards specific features in the built space, the researcher provided prompts to guide the participant's attention (see Appendix C) only if the participant did not trigger tour guide speeches spontaneously. The VR exposure lasted for around 5 minutes. Participants in the *cognitive task* condition completed math problems (simple addition and subtraction) for 5 minutes.

Measures. Same measures (baseline survey, manipulation check and outcome measures) were used here as in Study 4.

Experimental Procedure. The experimental procedure for the *ocean VR* and *built VR* groups followed that of Study 4. Participants in the *cognitive task* condition firstly completed the pre-manipulation measures, after which they were provided with a pencil and a sheet of math problems, of which they were instructed to complete as many as possible within 5 minutes. After the cognitive task they completed the post-manipulation measures.

Figure 20

Still Image of the Built VR Experience in Study 5 (Cologne Cathedral by Realities on Steam).

Data Analysis. The obtained data were analysed as in Study 4. Preliminary checks of the data were performed first, in order to ensure that there were no differences across the three manipulation groups in terms of sociodemographic variables (assessed with chi-square tests). Baseline differences across the groups in ocean connectedness and additional environmental orientation variables, as well as differences in level of immersion in the VR environment (for *ocean VR* and *built VR* groups), were also examined (assessed with analyses of variance or equivalent non-parametric tests). No participant in Study 5 had an error rate higher than 30% in the IAT, meaning that all participants' IAT data were included in the analyses.

4.5.2. Results

Descriptive Analyses and Baseline Differences. No differences were found across the *ocean VR, built VR* and *cognitive task* groups in terms of age[17] ($X^2(6) = 8.23$, $p = .221$). The groups were significantly different in terms of gender distribution ($X^2(2)$

[17] Participants were categorised into age groups for the chi-square analysis.

= 7.87, p = .020), and therefore gender was included as a control variable in all subsequent analyses. There were no differences across the three groups in baseline state ocean connectedness (adapted INS measure; $F(2,114) = 0.29$, p = .749) or baseline state nature connectedness (INS measure; $F(2,114) = 0.17$, p = .845). Similarly, the three groups did not differ in trait ocean connectedness (adapted CNS measure; $F(2,114)$ = 0.17, p = .845), ecological world view ($F(2,114) = 1.14$, p = .323) or marine litter concern ($F(2,114) = 1.45$, p = .239; see Table 14 for participant demographics and baseline survey means adjusted for the effect of gender).

Table 14

Participant Demographics and Group Means for Baseline Survey Measures (Study 5).

	Ocean VR group (n = 40)	Built VR group (n = 40)	Cognitive task group (n = 38)
Gender distribution	27 female, 13 male	37 female, 3 male	28 female, 10 male
Age (years)	21.58 (6.52)	22.35 (7.06)	19.45 (1.37)
State ocean connectedness			
Adapted INS[a]	3.12 (0.23)	2.93 (0.23)	3.18 (0.23)
State nature connectedness			
INS[a]	3.75 (0.18)	3.70 (0.18)	3.61 (0.18)
Trait ocean connectedness			
Adapted CNS[b]	4.88 (0.15)	4.78 (0.15)	4.77 (0.15)
Ecological world view (NEP)[c]	5.56 (0.09)	5.43 (0.09)	5.62 (0.09)
Marine litter concern[d]	5.98 (0.09)	6.16 (0.09)	6.17 (0.09)

Note: Baseline survey means are adjusted for the effect of gender; Numbers in parentheses are standard deviations for mean age, and standard errors for adjusted baseline survey means.
[a]INS = 'Inclusion of Nature in Self'; measured on a 7-point pictorial scale.
[b]CNS = 'Connectedness to Nature Scale'; 6-item scale (reliability ω = .79); items answered on a 7-point Likert scale.
[c]NEP = 'New Ecological Paradigm'; 10-item scale (reliability ω = .63); items answered on a 7-point Likert scale.
[d]9-item scale (reliability ω = .68); items answered on a 7-point Likert scale.

Manipulation Checks for Ocean Connectedness (Hypotheses $H1_{A-B}$ and $H2_{A-B}$). No differences were found between the *ocean VR* and *built VR* group in

experienced level of immersion in the virtual environment (M = 5.37, SD = 0.75 and M = 5.09, SD = 0.77, respectively; $t(78) = 1.66$, $p = .101$).

Means and standard errors for the post-manipulation measures used, adjusted for the effect of gender, are displayed in Table 15. Manipulation condition had a significant effect on state ocean connectedness, as measured with the adapted INS ($F(2,114) = 6.00$, $p = .003$, partial $\eta^2 = .10$). According to Tukey-corrected post-hoc comparisons, the *ocean VR* group showed higher levels of state ocean connectedness on the adapted INS than the *built VR* group ($\beta = 1.03$, $p = .004$) and the *cognitive task* group ($\beta = 0.81$, $p = .026$). For state ocean connectedness measured with the adapted CNS scale, there were no differences across the three groups ($F(2,114) = 2.66$, $p = .074$, partial $\eta^2 = .04$). Therefore, for between-group differences in self-reported state ocean connectedness, only partial support was found for hypotheses $H1_{A\text{-}B}$.

Table 15

Adjusted Group Means for Post-Manipulation State Ocean and Nature Connectedness Measures and Implicit Ocean Connectedness (Study 5).

	Ocean VR group (n = 40)	Built VR group (n = 40)	Cognitive task group (n = 38)
State ocean connectedness			
Adapted INS[a]*	4.57 (0.22)	3.54 (0.22)	3.75 (0.22)
Adapted CNS[b]	5.59 (0.14)	5.16 (0.14)	5.28 (0.14)
State nature connectedness			
INS[a]*	4.75 (0.19)	3.80 (0.19)	3.98 (0.19)
Implicit ocean connectedness			
Adapted nature IAT[c]	0.64 (0.06)	0.49 (0.06)	0.52 (0.06)

Note: Means are adjusted for the effect of gender; standard errors are in parentheses.
[a]INS = 'Inclusion of Nature in Self'; measured on a 7-point pictorial scale.
[b]CNS = 'Connectedness to Nature Scale'; 6-item scale (reliability ω = .79); items answered on a 7-point Likert scale.
[c]IAT = 'Implicit Association Test'; implicit attitude expressed as a *D*-score.
* Ocean and nature connectedness, as measured with the INS, increased from pre- to post-manipulation in the *ocean VR* group (paired samples *t*-tests: $t(39) = -7.28$, $p < .001$; $t(39) = -6.71$, $p < .001$, respectively) and in the *cognitive task* group ($t(37) = -5.23$, $p < .001$; $t(37) = -3.37$, $p = .002$, respectively). In the *built VR* group ocean connectedness increased but nature connectedness did not ($t(39) = -4.36$, $p < .001$; $t(39) = -0.93$, $p = .360$, respectively).

Results for implicit ocean connectedness as measured with the adapted nature IAT showed a global positive IAT effect, whereby study participants associated themselves more with the ocean than with the built environment on average. There were no differences across the three groups in implicit ocean connectedness ($F(2,114) = 1.90$, $p = .154$, partial $\eta^2 = .03$), meaning that no support was found for hypotheses $H2_{A\text{-}B}$. In terms of state nature connectedness, manipulation condition had a significant effect on the INS ($F(2,114) = 6.94$, $p = .001$, partial $\eta^2 = .11$). Tukey-corrected post-hoc comparisons showed that participants in the *ocean VR* group were significantly more connected with nature than participants in the *built VR* group ($\beta = 0.95$, $p = .002$) and those in the *cognitive task* group ($\beta = 0.76$, $p = .014$) post-manipulation. Pearson correlations across the post-manipulation measures and trait ocean connectedness are reported in Table 16.

Table 16

Pearson Correlations across Post-Manipulation State Measures and Trait Ocean Connectedness (Study 5).

Measure	1.	2.	3.	4.	5.
State ocean connectedness					
1. Adapted INS	-				
2. Adapted CNS	.71**	-			
Implicit ocean connectedness					
3. Adapted nature IAT	.23*	.21*	-		
State nature connectedness					
4. INS	.75**	.61**	.14	-	
Trait ocean connectedness					
5. Adapted CNS	.56**	.71**	.30**	.44**	-

Note: INS = 'Inclusion of Nature in Self'; CNS = 'Connectedness to Nature Scale'; IAT = 'Implicit Association Test'.

* Correlation significant at the $p < .05$ level.

** Correlation significant at the $p < .01$ level.

Impact of VR Manipulation on Evaluations of Packaging Material (Hypotheses H3$_{A\text{-}B}$). The ANOVA results showed a non-significant two-way interaction between manipulation condition and packaging material on WTB (F(6,826) = 2.08, p = .053). Similarly, no significant two-way interactions were found between manipulation condition and packaging material on anticipated guilt response (F(6,826) = 1.40, p = .210) or sustainability perceptions (F(6,826) = 1.85, p = .087). Therefore, the three groups did not differ in how they evaluated different packaging material types, meaning that hypotheses $H3_{A\text{-}B}$ were not supported.

Impact of VR Manipulation on Evaluations of Packaging Recyclability (Hypotheses H4$_{A\text{-}B}$). There were no significant two-way interactions between manipulation condition and packaging recyclability on WTB (F(2,826) = 1.84, p = .160), anticipated guilt response (F(2,826) = 0.42, p = .656) or on perceptions of packaging sustainability (F(2,826) = 0.41, p = .664). Therefore, the three groups did not differ in how they evaluated packaging recyclability, indicating that no support was found for hypotheses $H4_{A\text{-}B}$.

Post-hoc Analyses: Main Effect of Manipulation Condition. Although not hypothesised, significant main effects of manipulation condition on packaging evaluations were found and explored further. More specifically, manipulation condition had a significant effect on WTB (F(2,118) = 4.24, p = .017) and perceived sustainability (F(2,118) = 4.24, p = .017), but not on anticipated guilt (F(2,118) = 0.22, p = .807). That is, the three groups differed in how they evaluated single-use packaging for WTB and sustainability overall (i.e. regardless of material type or recyclability). Post-hoc Tukey-corrected pairwise comparisons showed that WTB ratings for packaging were significantly lower in the *ocean VR* group (estimated adjusted M = 2.96, SE = 0.18) than

in the *built VR* group (M = 3.68, SE = 0.20; p = .014). However, WTB ratings in the *ocean VR* group were not different from those in the *cognitive task* group (M = 3.31, SE = 0.19; p = .335). Similarly, perceived packaging sustainability was significantly lower in the *ocean VR* group (M = 3.32, SE = 0.11) than in the *built VR* group (M = 3.75, SE = 0.12; p = .014), but not different from perceived sustainability in the *cognitive task* group (M = 3.55, SE = 0.11; p = .285).

4.6 General Discussion

Following from the correlational findings reported in Studies 1 and 2, investigating the potential causal relationship between ocean connectedness and packaging preferences was of interest. Studies 4 and 5 were laboratory experiments which aimed to demonstrate the impacts of an oceanic nature exposure, mediated by immersive VR technology, on ocean connectedness and pro-environmental behaviour. Study 4 compared a 5-minute ocean VR experience with a non-natural, built VR exposure (5-minute tour around a busy city centre). Study 5 was conducted as a partial replication of Study 4, with revisions made to the experimental design: Study 5 used a different virtual setting for the built VR exposure (5-minute cathedral tour), in order to allow for more comparability across the VR conditions in terms of immersion and sense of presence. In addition, Study 5 employed an additional experimental group, a cognitive task with no VR exposure, in order to allow for a wider understanding of ocean connectedness manipulation as a potential driver for pro-environmental behaviour. In both studies, self-reported (explicit) ocean connectedness was assessed before and after the experimental manipulation, and implicit ocean connectedness was assessed post-manipulation only. Finally, pro-environmental behaviour was measured in a packaging rating task, where participants' evaluations of environmentally relevant features of single-use packaging were of interest. This work supplements existing research

evidence on the effectiveness of short-term manipulations of nature connectedness on pro-environmental behaviour, findings from which have been mostly mixed (Mackay & Schmitt, 2019).

In both studies, based on earlier findings on the malleability of nature connection (e.g. Coughlan et al., 2022; Wang et al., 2016; Yeo et al., 2020), inter-group differences in both explicit and implicit ocean connectedness were expected after the experimental manipulation. The immersive and interactive nature of the VR manipulations was believed to amplify experienced connections with the depicted environment (Soliman et al., 2017). Across the two studies, inter-group differences in ocean connectedness following the VR manipulation were observed only for the adapted graphical INS measure, and no such effects were found for the survey-type scale measure of state ocean connectedness. These findings indicate that the scale measure, much like the CNS in its original form (Mayer & Frantz, 2004), may not be suitable for assessment of transient ocean connectedness. Given that the INS was originally conceptualised as a cognitive measure of self-nature associations (Schultz, 2001), it seems that the VR manipulation employed here was successful in modifying the cognitive schemata of the self-ocean association. However, this cognitive association did not extend to connectedness on the implicit level, as no significant differences were found in the IAT measure across the experimental groups. Overall, these findings indicate that a short-term oceanic exposure via VR is not enough to significantly shape implicit ocean connectedness any differently than a built VR environment or no VR exposure. These conclusions are in line with previous findings where a 5-minute exposure to a natural setting (Schultz & Tabanico, 2007) or viewing a short nature documentary (Arendt & Matthes, 2016) were not successful in altering implicit nature connection. Therefore, it is probable that in order to strengthen implicit

ocean connection, longer-term or repeated exposures to marine environments would be required (Schultz & Tabanico, 2007).

However, given that Studies 4 and 5 were the first to use a modified version of the IAT developed by Schultz et al. (2004) to measure implicit ocean connectedness, wider use of the measure is needed before firm conclusions can be drawn regarding its performance as well as its sensitivity to brief manipulations of the self-ocean association. Furthermore, correlations across the various ocean (and nature) connectedness measures used in Studies 4 and 5 provide evidence of convergent validity of the IAT as a measure of ocean connectivity: In Study 4, results on the IAT only correlated weakly with scores on the state ocean connectedness scale, whereas in Study 5 small-to-moderate correlations were found between the IAT and all other ocean connectedness measures. The observed correlations were similar in magnitude to those reported previously between the nature connectedness IAT and self-report measures of nature connectedness (Schultz & Tabanico, 2007). In addition, in both studies IAT scores did not correlate with nature connectedness (as measured with the INS), indicating discriminant validity and providing evidence of the conceptual disparity between implicit ocean connectedness and explicit nature connectedness.

It should be noted that based on the adapted INS scores for ocean connectedness measured both before and after the VR manipulation, ocean connectedness increased across all groups in Studies 4 and 5 (although it was always highest in the *ocean VR* group). It is likely that this effect occurred because the IAT was administered before assessment of self-reported ocean connectedness. As the IAT involved assigning ocean-themed words into categories, as well as pairing these words with words related to the self, it is possible that the testing process primed participants' responses in the self-report ocean connectedness measures administered immediately after. However, the IAT procedure equally incorporated words related to the built environment and 'not

me', meaning that automatic pairings between the self and ocean were as likely to occur as automatic pairings between 'not me' and ocean, or between self and the built environment, as a result of completing the IAT. All in all, had such effect of the IAT testing procedure on subsequent self-report measures occurred, it would have likely affected all study groups equally. In future, and as advised by Schultz and Tabanico (2007), randomisation of the study participants into an 'IAT first' and 'IAT last' procedures can help control for potential order effects.

In order to examine the impacts of the VR manipulation on pro-environmental behaviour, Studies 4 and 5 used a packaging rating task similar to that used in Studies 1 and 2. This time study participants rated eight different single-use packaging options, each with a unique combination of packaging material type (plastic, glass, aluminium or carton) and recyclability (recyclable or non-recyclable). Following from the findings in Studies 1 and 2, the VR exposure was expected to shape participants' evaluations of packaging material types, in that participants in the *ocean VR* group were expected to rate plastic packaging as more negatively than the other material types. For packaging recyclability, recyclable packaging was expected to be evaluated more positively than non-recyclable packaging, and this difference was expected to be more pronounced in the *ocean VR* group than in the other conditions.

These differences across study groups were not observed in Studies 4 and 5, meaning that an oceanic experience in immersive VR, designed to promote ocean connectedness, was not successful in shaping evaluations of environmentally relevant attributes of SUP. Given the correlational association between ocean connectedness and preferences for packaging recyclability and material documented in Studies 1 and 2, it is possible that this association does not apply to state ocean connectedness. Alternatively, it is probable that the VR manipulation was not a powerful enough prime to shape consumer preferences in such magnitude or quality. As suggested by Lange and

Truyens (2022), effects of VR exposure on pro-environmental behaviour are likely small, and it is possible that the sample sizes used in Studies 4 and 5 were not large enough to detect such effects. Nevertheless, although not hypothesised, Study 5 found differences between the two VR groups in how single-use packaging were perceived in general: The *ocean VR* group evaluated pakaging more negatively for WTB and perceived sustainability than the *built VR* group. That is, although effects on the level of recyclability and material of single-use packaging were not observed, brief exposure to an oceanic VR environment (when compared with exposure to a built VR environment) made the study participants more critical about SUP. An interactive experience in (oceanic) nature, therefore, has the potential to shift the likelihood of single-use packaging consumption, but more research is needed to establish such a link.

Furthermore, as noted by Mackay and Schmitt (2019), experimental manipulations of nature connectedness might prove more successful if they manipulated nature identity, too. While participants were prompted to pay attention to various features of the VR environment in Studies 4 and 5, in an attempt to increase immersion, the experimental manipulation was not designed to induce or directly manipulate identification with the environment per se. Framing nature connection as an identity, for example by having participants explicitly categorise themselves as part of nature or reflect on their identity, could promote nature connection further. After all, the ocean connectedness measures used in Studies 4 and 5 could, in fact, be perceived as measuring ocean identity following some previous conceptualisations (Diessner et al., 2018; Schultz & Tabanico, 2007). While it is beyond the scope of the current research to discuss the conceptual similarities and disparities between identity and connectedness, it is likely that promoting one would shape the other, too.

While the findings of Studies 4 and 5 were not entirely what was expected, the implications of this work should be recognised. More specifically, VR technologies, as

increasingly accurate renderings of the real world, can be useful in promoting perceived connection with the marine environment. Although the present research did not demonstrate a causal impact of said connectedness on pro-environmental behaviour, inducing nature connection via virtual means has other benefits, including increased levels of positive affect (Yeo et al., 2020) and prosocial behaviour (Zelenski et al., 2015). Furthermore, previous research has identified ‘blue space’ as particularly restorative (White et al., 2010), especially when abundant in biodiversity (Cracknell et al., 2017; Cracknell et al., 2018), indicating that exposure to virtual oceanic scenes with diverse marine biota can have various positive impacts on the human psyche. Moreover, VR exposure of this kind holds promise in helping people develop a ‘marine mindset’ and subsequently shaping pro-marine intentions, especially if paired with informational strategies (Wyles et al., 2013). Therefore, the oceanic VR exposure used in the current studies would likely be more potent in promoting pro-environmental behaviour if it was paired with informational or conservational messaging, or if visible pollution was present in the VR environment. This postulation warrants more research in future.

Chapter 5: General Discussion

Parts of this chapter are extracts from a published peer-reviewed paper:
Nuojua, S., Pahl, S., & Thompson, R. C. (2022). Ocean connectedness and consumer responses to single-use packaging. *Journal of Environmental Psychology, 81*, 101814.

5.1 Introduction

The vital role of psychology and the behavioural sciences in tackling marine plastic pollution has been recognised for some time (Pahl et al., 2017). Even before global awareness about plastic pollution reached its current proportions, research on human behaviour and perceptions has directed efforts to promote sustainable consumption and waste management behaviours (Heidbreder et al., 2019; Schultz et al., 2013; Thomas & Sharp, 2013). Earlier work on the human dimension of plastic pollution, more specifically literature on the psychological determinants of behaviour that may contribute to marine plastic pollution (consumer and waste management behaviours), were reviewed in Chapter 1. The work reported in this thesis addressed the issue of marine plastic pollution from a consumer behaviour perspective and focused on one of the key pollutants of the natural marine environment: single-use packaging. It is apparent that today's end-users of plastic readily make the link between plastic packaging and its impact on the marine environment (Trivium Packaging, 2020). Following the trends found in previous literature on the relationship between nature connectedness and pro-environmental behaviour, and based on the recently proposed "*Blue Planet effect"* (Hunt, 2017), this thesis postulated an association between

psychological connectedness with the ocean, here termed *ocean connectedness*, and consumer behaviour in regard to single-use packaging.

Studies 1 and **2** investigated consumer responses to single-use packaging and its environmentally relevant properties. Using an experimental design, these studies assessed how consumers, namely students in a coastal city (Study 1) and the UK general public (Study 2), responded to two key environmentally relevant attributes of packaging: recyclability and type of raw material (e.g. plastic or glass). In addition, affinity towards the oceans, or *ocean connectedness*, was assessed with a survey, and its interactions with consumer responses to packaging were further examined.

Study 3 used a large-scale online survey to investigate consumer responses to a variety of environmentally relevant attributes of packaging beyond recyclability and raw material. Responses to the environmental cost of packaging manufacture and circular design were investigated across three types of packaging materials: conventional plastic, biodegradable plastic, and glass. In addition, consumer responses to various end-of-life scenarios for packaging (e.g. packaging ending up recovered in the waste management system or escaping into the environment) were studied. These responses were further explored across different consumer profiles, created based on environmentally relevant consumer characteristics (e.g. ocean connectedness) and sociodemographic variables (e.g. gender and level of education). In addition, Study 3 involved investigating the characteristics of both ocean and nature connectedness, in terms of how they associate with the aforementioned consumer characteristics, thus providing insight into whether ocean connectedness is conceptually unique and different from nature connectedness.

Finally, **Studies 4** and **5** were designed to explore whether the previously found association between consumer response to packaging and ocean connectedness would extend to a causal relationship between the two. As such, these studies explored whether consumer responses to packaging could be changed by increasing consumers'

connectivity with the ocean momentarily. In an experimental design involving a test condition and a comparison condition (Study 4) and a further control condition (Study 5), participants were exposed to a natural marine environment using immersive Virtual Reality (VR) technology. Following this ocean connectedness manipulation, participants' explicit and implicit ocean connectedness were firstly assessed. Subsequently, their responses to single-use packaging and its environmentally relevant attributes were measured using the same testing paradigm as in Studies 1 and 2.

The following section summarises the key findings of the work presented in this thesis. The wider implications of the findings are then discussed in the following section, and the chapter concludes with an overview of methodological limitations and suggestions for future research.

5.2 Summary of Results

Results from the respective studies are reviewed and discussed next, structured according to the research question(s) that each chapter set out to address.

> **RQ1)** How do consumers respond to environmentally relevant attributes of single-use packaging, and what is the role of ocean connectedness in shaping these views?

Chapter 2 **(Studies 1** and **2)** showed that consumers in general preferred recyclable single-use packaging, supporting previous findings (Rokka & Uusitalo, 2008; Klaiman et al., 2016). That is, consumers responded to recyclable packaging with higher willingness to buy, more positive affective reaction, as well as higher ratings of product attractiveness in comparison to non-recyclable packaging. These findings indicate that recyclability cues on single-use packaging labels could influence consumer opinion

substantially, at least for fast-moving consumer goods for which packaging usually forms a considerable part of the presentation and ecological footprint of the product (Ibrahim et al., 2022; Underwood, 2003; van Herpen et al., 2016). Furthermore, the observed preference for recyclability was shown to be moderated by ocean connectedness: Consumers higher in ocean connectedness rated recyclable packaging more positively than those lower in ocean connectedness, and non-recyclable packaging was rated more negatively at higher levels of ocean connectedness. Psychological connection with the ocean was thus shown to shape the utility that consumers gain from packaging circularity. These findings enrich the existing evidence base on the role of environmental orientations in shaping the demand for packaging sustainability (e.g. Magnier & Schoormans, 2015; Rhein & Schmid, 2020; Thøgersen, 1999).

Furthermore, in Studies 1 and 2, packaging made of plastic (in comparison to that made of glass, carton or aluminium) was viewed as more benign by those low in ocean connectedness, demonstrating that ocean connectedness moderated responses to packaging raw material, too. Although the hypothesised effect of sensitisation towards plastic was only observed in the larger online sample, and only for anticipated positive affect and guilt responses, overall these findings signify that consumers who feel a *lesser* connection with the marine environment view plastic packaging as a viable, if not better, alternative to packaging made of other material types such as glass. Therefore, in addition to modifying preferences for packaging sustainability (here conceptualised as circularity), ocean connectedness is also associated with selective responses to packaging material. These findings align with the postulation that a pro-marine mindset may motivate intentions to limit plastic packaging waste (Pahl et al., 2017; Wyles et al., 2013).

RQ2) Does the human-nature relationship amongst other environmental orientations impact consumer responses to the circular design and end-of-life scenarios of packaging?

Chapter 3 **(Study 3**) firstly extended the findings from Studies 1 and 2: Study 3 demonstrated that consumers' valuation of packaging recyclability has, when contrasting with previous studies (Kovačević & Bota, 2021; Löfgren & Witell, 2005; Williams et al., 2021), evolved. Previously, recyclability has been viewed by consumers as a delight attribute that is not essential for consumer satisfaction. In the large UK survey sample in Study 3, respondents in general found packaging recyclability, as well as compostability of biodegradable packaging, an attribute that brings great consumer satisfaction, while packaging that cannot be recycled or composted caused dissatisfaction. In addition, consensus from the study sample was that plastic packaging escaping into the natural environment was considered an unfavourable end-of-life scenario, but not for packaging made of glass or biodegradable plastic, suggesting that consumers are especially wary of plastic packaging polluting the environment. Moreover, and further illustrating that consumer opinion around packaging sustainability is contingent on the type of packaging raw material, consumers valued circular origin of glass packaging and were especially concerned about glass ending up in landfill. On the contrary, for both conventional and biodegradable plastic packaging, recycled origin and value recovery via incineration (instead of landfill) were perceived as indifferent attributes for consumer satisfaction. Although consumers have been previously shown to overestimate the environmental sustainability of glass as packaging material (Otto et al., 2021), the aggregate findings from Study 3 suggest that UK

consumers are more critical about the sustainability of containers made of glass than those made of plastic.

Furthermore, to address RQ2, Study 3 shed light on packaging preferences across different consumer segments formulated on the basis of environmental orientation variables and sociodemographic characteristics. In summary, the identified four segments had distinct profiles in terms of their responses to packaging sustainability attributes and end-of-life scenarios. For example, the consumer segment that reported the highest levels of connectedness with nature and the ocean (as well as the highest levels of biospheric and altruistic value orientations) received utility from all the studied environmentally relevant features of packaging. Conversely, the segment with the lowest levels of nature and ocean connectedness, consisting mostly of male participants, received no utility from any of the sustainability attributes. These findings support previous research on the associations between nature connectedness, values and packaging preferences (Khachatryan et al., 2014; Jaiswal & Bihari, 2020; Prakash et al., 2019). Furthermore, egoistic value orientation had a somewhat surprising function in packaging preferences: The consumer segment with high levels of connectedness *and* an egoistic value orientation showed low demand for all of the sustainability features in question. Egoistic value orientation has been previously associated with preferences for sustainable packaging (Prakash et al., 2019), but results from Study 3 suggest an opposite effect.

> **RQ3**) Does ocean connectedness with its role in shaping environmental intentions differ from overall nature connectedness, and how?

Inspection of how ocean and nature connectedness associate with sociodemographic variables and environmental orientations in **Study 3** permits a number of conclusions

regarding the conceptual differences and similarities between the two variables. Firstly, ocean connectedness and nature connectedness were highly correlated. It is expected that a strong nature connection also extends to connectivity with the natural marine environment. Secondly, the most notable disparity between the two connectedness variables was in their associations with distance from the coast. The observed negative correlation between distance from the coast and ocean connectedness makes intuitive sense, and no such correlation was found for nature connectedness, implying that the two connectedness variables have differing profiles. However, no other qualitative differences were found between the two connectedness variables: Firstly, both ocean and nature connectedness were positively associated with being older, female and more highly educated, demonstrating consistency with the generally accepted profile of an environmentally conscious person (Barr, 2003; Gifford & Nilsson, 2014). Similarly, in terms of their associations with value orientations and other environmentally relevant variables, ocean and nature connectedness behaved very similarly. That is, both ocean and nature connectedness correlated positively with altruistic and biospheric values, marine litter concern and recycling behaviour, albeit these correlations were mostly higher for nature connectedness. It can be tentatively suggested that nature connectedness may be conceptually closer to a general pro-environmental attitude, whereas ocean connectedness likely encompasses a stronger place attachment component, such as attachment to specific coastal and marine areas.

Finally, in regard to environmental intentions, ocean and nature connectedness differed from one another only slightly in terms of correlations with consumer evaluations of different types of packaging. That is, nature connectedness was more highly associated with willingness to buy biodegradable plastic packaging. This correlational evidence indicates only marginal differences between ocean and nature

connectedness in terms of their roles in shaping packaging-related environmental intentions.

> **RQ4)** Can state ocean connectedness be induced using Virtual Reality technologies, and does this subsequently alter consumer responses to the environmentally relevant attributes of packaging?

Chapter 4 (**Studies 4** and **5**) summarised findings across two studies showing that ocean connectedness can be promoted momentarily with a brief exposure to an oceanic VR environment, at least when measured with a graphical scale depicting inclusion of ocean in one's state self-concept (Schultz, 2001). However, the VR manipulation was not sufficient in inducing implicit ocean connectedness, as measured using a modified implicit association test (IAT; Greenwald et al., 1998; Schultz, 2004). Although the oceanic VR experience, due to its immersive nature, was hypothesised to shift implicit connections, previous research on the malleability of implicit nature connectedness accords with this null finding (Arendt & Matthes, 2016; Schultz & Tabanico, 2007). Furthermore, consumer responses to packaging recyclability and material were not impacted by the VR manipulation across the two studies, suggesting that the ocean connectedness manipulation was not sufficient in priming pro-environmental (or 'anti-plastic') packaging preferences, or that its effect was too small to be detected with the sample sizes used. However, in Study 5, aggregate packaging ratings showed that participants exposed to the oceanic VR experience showed significantly lower levels of willingness to buy single-use packaging than participants in the built VR condition. Similarly, the ocean VR participants rated single-use packaging as less sustainable overall than the built VR participants. Therefore, the ocean connectedness manipulation seemed to have an impact on general liking of single-use

packaging, suggesting that a brief exposure to a virtually mediated natural marine setting may make consumers more critical about single-use packaging overall. Similar findings connecting nature exposure and subsequent pro-environmental inclinations have been documented previously (Arendt & Matthes, 2016; Zelenski et al., 2015).

5.3 Theoretical Implications

Theoretical implications of the work presented in this thesis are discussed extensively in the respective empirical chapters, and some of the key implications are noted here. Implications concerning the theoretical value of the novel ocean connectedness construct are discussed in section 5.3.1.

Firstly, findings from **Studies 1**, **2,** as well as those observed in **Study 3,** suggest that consumers value the opportunity for circular value recovery (i.e. recycling) for single-use packaging, as an attribute that increases purchase intent and positive anticipated emotions, as well as brings user satisfaction. Furthermore, consumers even found recyclable packaging more attractive than non-recyclable packaging. Therefore, packaging recyclability that is signalled with on-packaging graphical and informational cues (Magnier & Crié, 2015; see Figure 5) can impact consumer evaluation substantially. While this preference for recyclability is not a novel finding (see e.g. Heiniö et al., 2017; Songa et al., 2019; Venter et al., 2011), findings from Study 3 indicate that packaging recyclability is now more important to consumers than before. That is, today's consumers are likely to be dissatisfied if packaging is not recyclable, whereas traditionally recyclability has been considered a delight or 'surprise' attribute that consumers do not expect *per se* (Kovačević & Bota, 2021; Löfgren & Witell, 2005; Williams et al., 2021).

Similarly, findings from **Study 3** contest previous findings regarding consumers being generally apathetic about environmentally sustainable (i.e. carbon efficient)

manufacturing process for packaging (Herbes et al.,2018). In Study 3, consumers, even those with relatively low levels of pro-environmental orientations, found utility in glass bottles being made from recycled materials, while expressing mostly indifferent views regarding its value recovery post-use. While consumers cannot be expected to fully grasp the intricacies of the circular economy for packaging, an appreciation for environmentally sustainable production of glass, a relatively carbon-intense packaging raw material (Otto et al., 2021), is a welcome development. Further regarding differences across packaging raw material types, findings from **Study 3** indicate that consumers are not very concerned about biodegradable packaging ending up polluting the environment, whereas for general plastic this end-of-life scenario was regarded as unacceptable. As suggested previously (Taufik et al., 2020), consumers may not be sufficiently informed about the appropriate disposal and value recovery for biodegradable packaging, and ensuring consumer understanding around this issue can help align packaging disposal accordingly, thus ensuring optimal value recovery of packaging materials.

Furthermore, a correlational association between ocean connectedness and sustainable packaging choice was demonstrated in **Studies 1** and **2**, and further in **Study 3** in a consumer segmentation approach. More specifically, highly connected consumers valued recyclability more than those with low levels of ocean connectedness, and they were similarly shown to obtain more satisfaction from other environmentally relevant attributes and end-of-life scenarios of packaging. A close psychological connection with the ocean (as well as with the environment generally, as shown in Study 3) can therefore aid at minimising packaging waste, and especially that made of plastic (as suggested by Study 2, specifically). It is worth noting that, according to findings on packaging evaluations across different consumer segments in Study 3, even relatively high levels of ocean and nature connectedness did not ensure favourable views on packaging

sustainability in the presence of an egoistic value orientation. No consensus has been reached to date regarding the relationship between egoistic values and green purchasing, as egoistic values are traditionally thought to inhibit pro-environmental action except when such action can aid self-preservation (Prakash et al., 2019; Sivapalan et al., 2021; Yadav, 2016). It is likely that a preference for packaging sustainability holds little relevance for self-enhancement motivations which are important to those holding egoistic values (Schwartz, 1992). Therefore, consumers with egoistic value orientations are likely not persuaded by packaging sustainability in their product evaluations, even if they are relatively environmentally oriented.

In **Studies 4** and **5**, designed to explore a potential causal link between ocean connectedness and packaging responses, the ocean connectedness manipulation via VR was only partly successful. More specifically, on the ocean connectedness self-report scale, conceptualised primarily as an assessment of affective connectedness (Mayer & Frantz, 2004; but see Perrin & Benassi, 2009) and adapted to measure transient (i.e. state) connectedness, no significant differences were observed across the experimental groups. But, participants in the oceanic VR condition indicated higher levels of inclusion of ocean in their self-concept (measured with the adapted INS; Schultz, 2001) following the VR manipulation. These results indicate the possibility that the brief oceanic VR exposure successfully modified only cognitive perceptions of connection with the ocean, (e.g. immersion of self in the ocean) but was not sufficient in duration or intensity to modify affective connection. Literature on the situational malleability of an emotional attachment to nature is virtually non-existent (see review by Mackay & Smith, 2019), and the current research indicates that inducing such connection with a brief exposure to a natural setting may not be a realistic objective. Furthermore, the INS measure has been used widely in assessment of state nature connectedness (Arendt & Matthes, 2016; Wang et al., 2016; Yeo et al., 2020), but an instrument for assessing

affective state nature connectedness is currently lacking, and it is possible that the modified state CNS scale used in Studies 4 and 5 was not fit for purpose.

Theoretical implications regarding the conceptualisation and measurement of implicit ocean connectedness should be noted, too. In Studies 4 and 5, implicit ocean connection was measured with an IAT paradigm modified further from Schultz's (2004) nature IAT measure, and this novel measure showed the expected patterns in associations with other measures (e.g. state ocean connectedness and nature connectedness). However, deviating from the experimental hypothesis, there was no evidence of the ocean VR manipulation having produced increased implicit ocean connectedness in participants (and, in Study 4, the opposite pattern was observed). Implicit ocean connectedness may thus not be malleable (as suggested by Arendt & Matthes, 2016; Schultz & Tabanico, 2007), even when a highly marine-specific, immersive experimental manipulation is used. Yet, inspection of the correlations between the ocean IAT and other ocean connectedness measures, both trait and state, does not point towards any clear pattern that would suggest implicit ocean connectedness to correlate more highly with trait than state measures of ocean connectedness.

Finally, findings from Studies 4 and 5 indicate that an oceanic experience via VR did not sufficiently prime consumers to respond to packaging recyclability and material as expected based on the correlational findings in Studies 1 and 2. It is possible that the mechanisms through which trait ocean connectedness may have developed to motivate packaging-related consumer responses cannot be activated with a brief oceanic exposure, at least in the magnitude that would cause a consumer to differentiate across levels of packaging recyclability and material. For example, an individual having frequently associated plastic packaging or litter with marine environments through media exposure or personal experiences in coastal areas may have shifted their

packaging-related intentions and behaviours over time (e.g. Hartley et al., 2018), but such motivations may not be adequately accessed as a result of a brief virtual ocean connectedness manipulation. Therefore, as suggested previously by Klein and Hilbig (2018), virtual nature experiences may have to contain conservational messaging (e.g. informational content or polluted nature) to be successful in promoting pro-environmental behaviour.

5.3.1. Ocean Connectedness: Conceptualisation, Value and Future Directions

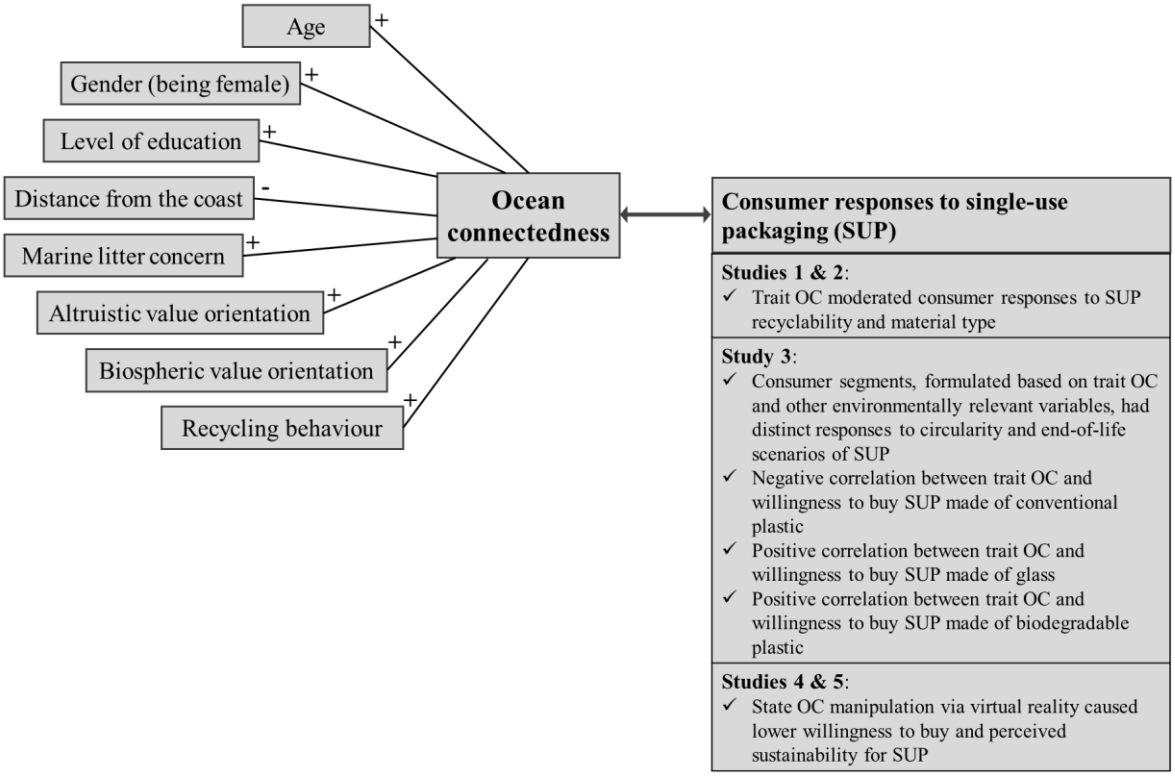
Figure 21 summarises the observed associations between ocean connectedness and other assessed variables of interest (sociodemographic factors and environmental orientations), as well as the observed links between ocean connectedness and consumer responses to single-use packaging.

According to the bivariate correlations reported in Chapter 3, ocean connectedness is, as expected, positively associated with several environmental orientation variables including marine litter concern, biospheric and altruistic value orientations, and recycling behaviour. That is, individuals with high levels of ocean connectedness manifest concern for the marine environment and appreciation for the natural world and others, and they frequently engage in pro-environmental behaviour. In that sense, ocean connectedness can be conceptualised as an environmental orientation variable that shares many similarities with nature connectedness (Dong et al., 2020; Gkargkavouzi et al., 2019; Martin & Czellar, 2017). Another intuitive finding is that people who are strongly connected with the ocean live closer to the coast. People residing nearer to the coast have been shown to spend more leisure time in coastal environments (Schipperijn et al., 2010; White et al., 2013a). Although the correlational evidence from Study 3 does not permit causal inferences, it is likely that people with a

strong connection with the ocean have developed this connection through frequent visits to marine and coastal areas (White et al., 2014; Elliot et al., 2018).

Figure 21

Determinants of Ocean Connectedness (Study 3) and a Summary of Its Associations with Consumer Responses to Single-Use Packaging across Studies 1 – 5.



Note: "+" = significant positive correlation coefficient; "-" = significant negative correlation coefficient; OC = ocean connectedness.

Furthermore, strongly connected individuals are more likely to be older, female and highly educated. As such, the sociodemographic profile of those with a strong connection to the ocean is very similar to that of individuals with high levels of environmental concern and behaviour in general (Barr, 2003; Chen et al., 2011; Gifford & Nilsson, 2014; Soares et al., 2021; Vicente-Molina et al., 2013). Yet, it should be noted that conclusions from previous evidence regarding sociodemographic determinants of nature connectedness have been very mixed: Some research indicates

that women are more connected than men (Cervinka et al., 2012; Hughes et al., 2019; Mayer et al., 2009), while other studies have found no gender differences (Di Fabio & Rosen, 2019; Mayer & Frantz, 2004; Weinstein et al., 2009). Similarly, age has been found to positively correlate with levels of nature connectedness (Beery et al., 2013; Diessner et al., 2018; Sanguinetti, 2014), but not consistently (Mayer & Frantz, 2004; Unsworth et al., 2016; Weinstein et al., 2009). For the impact of educational attainment on nature connectedness, mostly null findings have been reported to date (Beery et al., 2013; Dutcher et al., 2007; Whitburn et al., 2019), and nature connectedness has even been shown to correlate negatively with income level (Richardson et al., 2022). Therefore, the observed significant impacts of gender, age and educational attainment on ocean connectedness merit further discussion.

As suggested in Chapter 3, the observed gender difference in ocean connectedness may stem from women being more environmentally oriented or more concerned and literate about marine issues, as some prior evidence suggests (Lwo et al., 2013; Soares et al., 2021; Wester & Eklund, 2011). Similarly, women may be more attached to specific coastal and marine areas, as according to some reports women tend to have stronger place attachment than men (Hidalgo & Hernandez, 2001; Rollero & De Piccoli, 2010). Moreover, Elliot et al. (2018) report that women and older adults are more likely to participate in coastal walks. If ocean connectedness is to a large extent cultivated by frequent (recreational) visits to marine and coastal areas, as suggested above, then women and older people may show stronger ocean connectedness because they make more such visits. Moreover, why ocean connectedness increases with age may be explained by generational differences in lifestyle and leisure, or by the so-called coastal retirement effect (White et al., 2013b). Finally, one possible explanation for the observed association between ocean connectedness and educational level is that more highly educated people may have more means and opportunities to visit the coast.

Indeed, Elliot et al. (2018) demonstrate that people from more socioeconomically deprived groups are less likely to engage in recreational coastal activities, although beaches are visited equally often by people in lower and higher socioeconomic classifications.

The associations between ocean connectedness and consumer responses to single-use packaging summarised in Figure 21 suggest that connectivity with the ocean shapes people's likelihood of purchasing single-use packaging. Furthermore, the observed moderating impacts of ocean connectedness on how much emphasis consumers place on packaging recyclability, material type and its end-of-life scenarios suggest an interplay between ocean connectedness and responses to environmentally relevant features of packaging. Although the experimental evidence from Studies 4 and 5 showed mixed findings in terms of a short-term manipulation of ocean connectedness and subsequent impacts on packaging preferences, overall the evidence presented in this thesis implies that promoting ocean connectedness holds promise in motivating pro-environmental interactions with single-use packaging. The value and relevance of ocean connectedness is likely to extend to other behaviours that have consequences to the marine environment, such as supporting sustainable fishing and personal actions that can help mitigate ocean acidification (Spence et al., 2018; White et al., 2016; Wyles et al., 2013). In general, a disconnection from marine environments is associated with low awareness and concern of marine issues (Spence et al., 2018), and connecting individuals with the ocean may provide a particularly powerful impetus to marine conservation efforts.

It should be noted that the evidence from Studies 1 – 5 is only a starting point to establishing ocean connectedness as a robust construct with clear theoretical and practical implications. Firstly, the reviewed findings, including the provided evidence on convergent and discriminant validity, only hold for the specific measures used. That

is, an alternative operationalisation of ocean connectedness, such as a survey measure based on the Nature Relatedness scale (NR; Nisbet et al., 2009), could produce slightly different findings in terms of associations with other environmentally relevant variables. Secondly, although Studies 4 and 5 employed a variety of ocean connectedness measures (survey, pictorial scale and implicit measure), they were the first studies to do so. Therefore, the reliability, validity and value of these measures should be established further in future research. Furthermore, as the conceptual examination of both ocean and nature connectedness revealed some discrepancies between the two constructs, ocean connectedness measures may require some unique elements not present in current operationalisations of nature connectedness. Moreover, while the current research was primarily quantitative in nature, a qualitative inquiry could provide a more in-depth understanding of the nature, composition, and genesis of ocean connectedness. Such research could survey members of the public who interact with the marine environment in different ways as consumers, recreational users, and community members. Future research could, in particular, shed light on potential ways to promote ocean connectedness in both short and long term. This type of research could trial various ways of engaging the public with the marine environment, such as coastal walks, visits to marine parks, beach cleans, or repeated exposures to virtual marine environments (Halpenny, 2010; Pittman et al., 2019; Ramkissoon et al., 2012; Wyles et al., 2017).

Finally, it should be noted that although the research rationale and work summarised in this thesis postulated that connectivity with the ocean is a motivational basis for more sustainable or selective evaluations of single-use packaging, the observed trends may have been similarly present if general nature connectedness had been investigated as a moderating variable, instead. However, it is possible and can be tentatively suggested that the moderating effects of nature connectedness on packaging evaluations would have been of a smaller magnitude than those observed in the current

work, as “a marine mindset” (Wyles et al., 2013, p. 96) is thought to shape attitudes and behaviours around issues especially relevant to marine environments, such as marine pollution (Wyles et al., 2013). Yet, based on the findings from Studies 1 – 5, investigating nature connectedness instead of ocean connectedness in shaping packaging evaluations would have likely had very similar implications in terms of real-world applications of the study findings.

5.4 Applications

A number of practical applications of the findings presented in this thesis should be acknowledged. Firstly, this research is hoped to assist in guiding consumer communication goals in regard to single-use packaging. Given that consumers were shown to value packaging recyclability and circular value recovery of packaging materials, highlighting such properties in single-use packaging may be a viable marketing strategy. However, care should be taken to avoid unintended consequences, such as incorrect or inappropriate disposal of biodegradable plastic packaging. As highlighted previously, companies can aspire to inform end-users of packaged products about the properties of and preferred disposal methods for biodegradable packaging (Hann et al., 2020). Furthermore, as highlighted in Chapter 3, different consumer segments may require tailored marketing approaches, as certain consumers (e.g. women, highly nature connected and concerned individuals) may be more likely to engage in efforts to ensure favourable end-of-life scenarios for packaging.

In addition, communications that help connect packaging consumption with marine environments, such as labelling (e.g. European Commission, 2020) are likely an effective marketing strategy. In the least, they may make consumers more critical about single-use packaging in general (as suggested by findings from Study 5). Similarly, as evidenced, VR technologies may hold promise in helping connect individuals with the

marine environment. Whilst they cannot be expected, based on the research findings reviewed here, to shape immediate pro-environmental intentions or behaviour, repeated exposures may help individuals develop a closer connection with the marine environment over time. However, the methodological limitations of the work presented in this thesis should be acknowledged prior to realising the suggested real-world applications.

5.5 Methodological Limitations and Future Research

A number of limitations in how Studies 1 – 5 were conducted should be noted. Firstly, the outcome measures used throughout the work in this thesis assessed consumer response, not actual behaviour. Assessing consumer behaviour and choice *in situ* is indubitably a challenging task, and therefore proxy measures are commonly used (see e.g. Bech-Larsen, 1996; Koenig-Lewis et al., 2014; Magnier & Schoormans, 2015). While responses measured in this way provide valuable information about consumer attitudes and trends, no firm conclusions on behaviour can be drawn. However, employing a rating-based experimental paradigm in Studies 1, 2, 4 and 5 enabled obtaining of a considerable amount of information about consumer attitude and examining ocean connectedness as a novel moderator variable. Furthermore, factorial survey experiments were used in these studies to assess consumer response. This methodological approach can help thwart efforts to answer in a socially acceptable manner: Factorial designs (e.g. recyclability × material) are considered more robust to social desirability effects than direct question formats (Cerri et al., 2019; Walzenbach, 2019).

Furthermore, Kano consumer surveys, such as the one used in Study 3, have been critiqued for requiring a lot of respondent time and effort as well as for being sensitive to how the survey questions are worded (Violante & Vezzetti, 2017). A Kano

survey was used in the current work because it bears several advantages over alternative consumer research methodologies, including assessment of consumer satisfaction with specific product attributes both quantitatively and qualitatively (Sauerwein et al., 1996). Several alternative techniques for assessing consumer behaviour in a more realistic setting can be suggested for future work. These include measuring willingness to pay, applying a choice-based conjoint analysis, or using a virtual supermarket setting (Demarque et al., 2015; Hensher et al., 2005; Klaiman et al., 2016; Rokka & Uusitalo, 2008). Moreover, the limitations of the consumer segmentation approach, as used in Study 3, should be recognised. As the consumer segments were formulated in an inductive approach on the basis of sociodemographic and environmental orientation variables that are thought to bear relevance to consumer interactions with packaging, the full segmentation model has limited applicability in other behaviour domains. However, the fact that the identified consumer segments had distinct profiles in terms of responses to the packaging-themed Kano survey, the model was evidently successful in segmenting for packaging sustainability.

As the ocean connectedness manipulation used in Studies 4 and 5 was not successful in shaping ocean connectedness and packaging responses in the anticipated fashion, several revisions to the experimental design could be suggested. Firstly, as suggested in Chapter 4 and by Mackay and Schmitt (2019), manipulation of nature connectedness may be more successful in promoting connection and pro-environmental outcomes if it directly manipulates nature identity. In Studies 4 and 5 participants were instructed to pay attention to various aspects and objects in the virtual world, in order to promote sense of presence. Similarly, participants could be prompted to ponder on their identity or identification with the depicted environment. Secondly, and as suggested previously (Klein & Hilbig, 2018; Soliman et al., 2017), embedding a conservational message or depicting an oceanic scene impacted by plastic pollution could shift pro-

environmental responses more effectively. Yet, as Studies 4 and 5 aimed at increasing ocean connectedness as a primary objective, it was a priority to use a pristine, awe-inspiring environment with high potential to induce connectedness with the surrounding environment (Soliman et al., 2017). Future research can address the aforementioned points by including a manipulation of environmental identity, as suggested, or by depicting polluted marine scenes.

Furthermore, the use of student samples (Studies 1, 4 and 5) is often met with concerns over external validity (Peterson & Merunka, 2014). Student participants were from a university located on the coast, and therefore it is possible that they were more sensitised than the average UK resident to issues such as marine pollution. Nevertheless, the main findings in Studies 1 and 2 were consistent across student and general population samples. It should be noted, however, that the study findings presented in this thesis cannot be generalised to countries beyond the UK. It is possible that consumers in an island state feel higher levels of affiliation with the ocean than people in continental nations. Similarly, the extent to which environmental cues on packaging influence consumer response may vary from country to country (even if recent research has demonstrated great consistency in concern about plastic pollution; Davison et al., 2021). Structural aspects like waste management and recycling systems, as well as psychological characteristics such as consumer empowerment (Nardo et al., 2011; Thøgersen, 2005) differ across countries. Future research can assess ocean connectedness and consumer responses to single-use packaging in other countries, including those in the Global South.

5.6 Conclusion

The findings reviewed in this thesis have shed light on the highly topical yet unexplored area of marine pollution and packaging choice. Marine plastic pollution is a key threat

to the natural environment and the economy (Beaumont et al., 2019). The global plastic crisis is a multi-faceted problem, solutions to which require wider systemic and regulatory considerations. Due to the complexities involved in this holistic approach, the importance of behaviour change in reducing plastic pollution has been questioned (e.g. Dauvergne, 2018). However, with transnational collaboration in the global governance of plastic currently underway (UNEP, 2022), behavioural changes will be enabled, facilitated and reinforced globally. Furthermore, effecting change in policy can be a lengthy process, whereas behaviour change strategies can be often implemented more promptly (SAPEA, 2019). Therefore, policies and other interventions should be complemented by targeted efforts to change the public's behaviour. Promoting sustainable lifestyles remains a prominent challenge, and the research outlined in this thesis advocates the relevance of a strong connection with the marine environment in pro-environmental consumption.

References

Abrahamse, W. & Steg, L. (2013). Social influence approaches to encourage resource conservation: a meta-analysis. *Global Environmental Change*, *23*(6), 1773–1785.

Adam, I., Walker, T. R., Clayton, C. A., & Bezerra, J. C. (2021). Attitudinal and behavioural segments on single-use plastics in Ghana: Implications for reducing marine plastic pollution. *Environmental Challenges, 4*, 100185.

Aday, M. S., & Yener, U. (2014). Understanding the buying behaviour of young consumers regarding packaging attributes and labels. *International Journal of Consumer Studies, 38*(4), 385-393.

Afroz, R., Rahman, A., Masud, M. M., & Akhtar, R. (2017). The knowledge, awareness, attitude and motivational analysis of plastic waste and household perspective in Malaysia. *Environmental Science and Pollution Research, 24*(3), 2304-2315.

Ahn, S. J., Bostick, J., Ogle, E., Nowak, K. L., McGillicuddy, K. T., & Bailenson, J. N. (2016). Experiencing nature: Embodying animals in immersive virtual environments increases inclusion of nature in self and involvement with nature. *Journal of Computer-Mediated Communication, 21*(6), 399-419.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Anable, J. (2005). 'Complacent car addicts' or 'aspiring environmentalists'? Identifying travel behaviour segments using attitude theory. *Transport Policy, 12*(1), 65-78.

Anderson, D. J., & Krettenauer, T. (2021). Connectedness to nature and pro-environmental behaviour from early adolescence to adulthood: A comparison of urban and rural Canada. *Sustainability, 13*(7), 3655.

Andrady, A. L., & Neal, M. A. (2009). Applications and societal benefits of plastics. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364*(1526), 1977-1984.

Arendt, F., & Matthes, J. (2016). Nature documentaries, connectedness to nature, and pro-environmental behavior. *Environmental Communication, 10*(4), 453-472.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*(4), 471-499.

Arulnayagam, A. (2020). Public perception towards plastic pollution in the marine ecosystems of Sri Lanka. *American Journal of Marine Science, 8*(1), 6-13.

Asioli, D., Næs, T., Øvrum, A., & Almli, V. L. (2016). Comparison of rating-based and choice-based conjoint analysis models. A case study based on preferences for iced coffee in Norway. *Food Quality and Preference, 48*, 174-184.

Atlason, R. S., & Giacalone, D. (2018). Rapid computation and visualization of data from Kano surveys in R. *BMC Research Notes, 11*(1), 1-6.

Atlason, R. S., Giacalone, D., & Parajuly, K. (2017). Product design in the circular economy: Users' perception of end-of-life scenarios for electrical and electronic appliances. *Journal of Cleaner Production, 168*, 1059-1069.

Azzi, A., Battini, D., Persona, A., & Sgarbossa, F. (2012). Packaging design: general framework and research agenda. *Packaging Technology and Science, 25*(8), 435-456.

Bamberg, S. (2003). How does environmental concern influence specific environmentally related behaviors? A new answer to an old question. *Journal of Environmental Psychology, 23*(1), 21-32.

Bamberg, S., Hunecke, M., & Blöbaum, A. (2007). Social context, personal norms and the use of public transportation: Two field studies. *Journal of Environmental Psychology, 27*(3), 190-203.

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*(1), 14-25.

Barbaro, N., & Pickett, S. M. (2016). Mindfully green: Examining the effect of connectedness to nature on the relationship between mindfulness and engagement in pro-environmental behavior. *Personality and Individual Differences, 93*, 137-142.

Barnes, D. K., Galgani, F., Thompson, R. C., & Barlaz, M. (2009). Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364*(1526), 1985-1998.

Barnes, D. K., & Milner, P. (2005). Drifting plastic and its consequences for sessile organism dispersal in the Atlantic Ocean. *Marine Biology, 146*(4), 815-825.

Barr, S. (2003). Strategies for sustainability: citizens and responsible environmental behaviour. *Area, 35*(3), 227-240.

Barr, S. (2007). Factors influencing environmental attitudes and behaviors: A UK case study of household waste management. *Environment and Behavior, 39*(4), 435-473.

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language, 68*(3), 255-278.

Barry, J. (2012). Bio-fuelling the hummer? Transdisciplinary thoughts on techno-optimism and innovation in the transition from unsustainability. In E. Byrne, G.

Mullally, & C. Sage (Eds.), *Transdisciplinary perspectives on transitions to sustainability* (pp.106-123). Abingdon, UK: Routledge

Bartels, J., & Onwezen, M. C. (2014). Consumers' willingness to buy products with environmental and ethical claims: the roles of social representations and social identity. *International Journal of Consumer Studies, 38*(1), 82-89.

Basu, M., Hashimoto, S., & Dasgupta, R. (2020). The mediating role of place attachment between nature connectedness and human well-being: Perspectives from Japan. *Sustainability Science, 15*(3), 849-862.

Batista, L., Bourlakis, M., Smart, P., & Maull, R. (2018). In search of a circular supply chain archetype–a content-analysis-based literature review. *Production Planning & Control, 29*(6), 438-451.

Baumeister, R. F. (1999). The nature and structure of the self: An overview. In R. F. Baumeister (Ed.), *The self in social psychology* (pp. 1-20). Psychology Press (Taylor & Francis).

Beacom, E., Bogue, J., & Repar, L. (2021). Market-oriented development of plant-based food and beverage products: A usage segmentation approach. *Journal of Food Products Marketing, 27*(4), 204-222.

Bech-Larsen, T. (1996). Danish consumers' attitudes to the functional and environmental characteristics of food packaging. *Journal of Consumer Policy, 19*(3), 339-363.

Beaumont, N. J., Aanesen, M., Austen, M. C., Börger, T., Clark, J. R., Cole, M., ... & Wyles, K. J. (2019). Global ecological, social and economic impacts of marine plastic. *Marine Pollution Bulletin, 142*, 189-195.

Becker-Leifhold, C. V. (2018). The role of values in collaborative fashion consumption-A critical investigation through the lenses of the theory of planned behavior. *Journal of Cleaner Production, 199*, 781-791.

Beery, T. H. (2013). Nordic in nature: friluftsliv and environmental connectedness. *Environmental Education Research, 19*(1), 94-117.

Berger, C., Blauth, R., & Boger, D. (1993). Kano's methods for understanding customer-defined quality. *The Center for Quality Management Journal, 2*(4).

Blamey, R. K., & Braithwaite, V. A. (1997). A social values segmentation of the potential ecotourism market. *Journal of Sustainable Tourism, 5*(1), 29-45.

Blok, V., Wesselink, R., Studynka, O., & Kemp, R. (2015). Encouraging sustainability in the workplace: A survey on the pro-environmental behaviour of university employees. *Journal of Cleaner Production, 106*, 55-67.

Boesen, S., Bey, N., & Niero, M. (2019). Environmental sustainability of liquid food packaging: is there a gap between Danish consumers' perception and learnings from life cycle assessment?. *Journal of Cleaner Production, 210*, 1193-1206.

Bond, T., Ferrandiz-Mas, V., Felipe-Sotelo, M., & Van Sebille, E. (2018). The occurrence and degradation of aquatic plastic litter based on polymer physicochemical properties: A review. *Critical Reviews in Environmental Science and Technology*, *48*(7-9), 685-722.

Borg, K., Curtis, J., & Lindsay, J. (2020). Social norms and plastic avoidance: Testing the theory of normative social behaviour on an environmental behaviour. *Journal of Consumer Behaviour, 19*(6), 594-607.

Borg, K., Lindsay, J., & Curtis, J. (2021). Targeted change: Using behavioral segmentation to identify and understand plastic consumers and how they respond to media communications. *Environmental Communication, 15*(8), 1109-1126.

Boz, Z., Korhonen, V., & Koelsch Sand, C. (2020). Consumer considerations for the implementation of sustainable packaging: A review. *Sustainability, 12*(6), 2192.

Breidert, C., Hahsler, M., & Reutterer, T. (2006). A review of methods for measuring willingness-to-pay. *Innovative Marketing, 2*(4), 8-32.

Breves, P., & Heber, V. (2020). Into the wild: The effects of 360 immersive nature videos on feelings of commitment to the environment. *Environmental Communication, 14*(3), 332-346.

Brown, J., & Macfadyen, G. (2007). Ghost fishing in European waters: Impacts and management responses. *Marine Policy, 31*(4), 488-504.

Bruni, C. M., Fraser, J., & Schultz, P. W. (2008). The value of zoo experiences for connecting people with nature. *Visitor Studies, 11*(2), 139-150.

Bruni, C. M., & Schultz, P. W. (2010). Implicit beliefs about self and nature: Evidence from an IAT game. *Journal of Environmental Psychology, 30*(1), 95-102.

Camacho-Otero, J., Boks, C., & Pettersen, I. N. (2018). Consumption in the circular economy: A literature review. *Sustainability, 10*(8), 2758.

Campbell, M. J., & Sumpton, W. D. (2009). Ghost fishing in the pot fishery for blue swimmer crabs Portunus pelagicus in Queensland, Australia. *Fisheries Research, 95*(2-3), 246-253.

Carmi, N., Arnon, S., & Orion, N. (2015). Transforming environmental knowledge into behavior: the mediating role of environmental emotions. *The Journal of Environmental Education, 46*(3), 183–201.

Carroll, J. D., & Green, P. E. (1995). Psychometric methods in marketing research: Part I, conjoint analysis. *Journal of Marketing Research, 32*(4), 385-391.

Carrus, G., Passafaro, P., & Bonnes, M. (2008). Emotions, habits and rational choices in ecological behaviours: The case of recycling and use of public transportation. *Journal of Environmental Psychology, 28*(1), 51-62.

Cerri, J., Testa, F., Rizzi, F., & Frey, M. (2019). Factorial surveys reveal social desirability bias over self-reported organic fruit consumption. *British Food Journal, 121*(4), 897-909.

Cervinka, R., Röderer, K., & Hefler, E. (2012). Are nature lovers happy? On various indicators of well-being and connectedness with nature. *Journal of Health Psychology, 17*(3), 379-388.

Chapman, C., & Feit, E. M. (2015). *R for marketing research and analytics*. New York, NY: Springer.

Chen, Y., Awasthi, A. K., Wei, F., Tan, Q., & Li, J. (2021). Single-use plastics: Production, usage, disposal, and adverse impacts. *Science of the Total Environment, 752*, 141772.

Chen, X., Peterson, M. N., Hull, V., Lu, C., Lee, G. D., Hong, D., & Liu, J. (2011). Effects of attitudinal and sociodemographic factors on pro-environmental behaviour in urban China. *Environmental Conservation, 38*(1), 45-52.

Chirilli, C., Molino, M., & Torri, L. (2022). Consumers' awareness, behavior and expectations for food packaging environmental sustainability: Influence of socio-demographic characteristics. *Foods, 11*(16), 2388.

Chung, J., & Monroe, G. S. (2003). Exploring social desirability bias. *Journal of Business Ethics, 44*(4), 291-302.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58*(6), 1015.

Clark, N., Trimingham, R., & Wilson, G. T. (2020). Incorporating consumer insights into the UK food packaging supply chain in the transition to a circular economy. *Sustainability, 12*(15), 6106.

Clayton, S. (2003). Environmental identity: A conceptual and an operational definition. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp. 45-65). The MIT Press.

Coe, J. M., & Rogers, D. (2012). *Marine debris: sources, impacts, and solutions*. Springer Science & Business Media.

Cole, M., Lindeque, P., Fileman, E., Halsband, C., Goodhead, R., Moger, J., & Galloway, T. S. (2013). Microplastic ingestion by zooplankton. *Environmental Science & Technology, 47*(12), 6646-6655.

College of Exploration. (2013, March). *Ocean Literacy: The Essential Principles and Fundamental Concepts of Ocean Sciences for Learners of All Ages.* https://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf

Costa, S., & Caldeira, R. (2018). Bibliometric analysis of ocean literacy: an underrated term in the scientific literature. *Marine Policy, 87*, 149-157.

Coughlan, A., Ross, E., Nikles, D., DeCesare, E., Tran, C., & Pensini, P. (2022). Nature guided imagery: An intervention to increase connectedness to nature. *Journal of Environmental Psychology, 80*, 101759.

Courtene-Jones, W., Quinn, B., Ewins, C., Gary, S. F., & Narayanaswamy, B. E. (2019). Consistent microplastic ingestion by deep-sea invertebrates over the last four decades (1976–2015), a study from the North East Atlantic. *Environmental Pollution, 244*, 503-512.

Cracknell, D. L., Pahl, S., White, M. P., & Depledge, M. H. (2018). Reviewing the role of aquaria as restorative settings: how subaquatic diversity in public aquaria can influence preferences, and human health and well-being. *Human Dimensions of Wildlife, 23*(5), 446-460.

Cracknell, D., White, M. P., Pahl, S., & Depledge, M. H. (2017). A preliminary investigation into the restorative potential of public aquaria exhibits: a UK student-based study. *Landscape Research, 42*(1), 18-32.

Dace, E., Stibe, A., & Timma, L. (2020). A holistic approach to manage environmental quality by using the Kano model and social cognitive theory. *Corporate Social Responsibility and Environmental Management, 27*(2), 430-443.

Dahl, D. W., Honea, H., & Manchanda, R. V. (2003). The nature of self-reported guilt in consumption contexts. *Marketing Letters, 14*(3), 159-171.

Dalu, M. T., Cuthbert, R. N., Muhali, H., Chari, L. D., Manyani, A., Masunungure, C., & Dalu, T. (2020). Is awareness on plastic pollution being raised in schools? Understanding perceptions of primary and secondary school educators. *Sustainability, 12*(17), 6775.

Daryanto, A., & Song, Z. (2021). A meta-analysis of the relationship between place attachment and pro-environmental behaviour. *Journal of Business Research, 123*, 208-219.

Dasgupta, N. (2013). Implicit attitudes and beliefs adapt to situations: A decade of research on the malleability of implicit prejudice, stereotypes, and the self-concept. *Advances in Experimental Social Psychology, 47*, 233-279.

Dasgupta, N., & Greenwald, A. G. (2001). On the malleability of automatic attitudes: combating automatic prejudice with images of admired and disliked individuals. *Journal of Personality and Social Psychology, 81*(5), 800.

Dash, S. K. (2021). Identifying and classifying attributes of packaging for customer satisfaction - A Kano model approach. *International Journal of Production Management and Engineering, 9*(1), 57-64.

Dauvergne, P. (2018). Why is the global governance of plastic failing the oceans?. *Global Environmental Change, 51*, 22-31.

Davis, G., & Song, J. H. (2006). Biodegradable packaging based on raw materials from crops and their impact on waste management. *Industrial Crops and Products, 23*(2), 147-161.

Davison, M.C. et al. (2021). Public concern about, and desire for research into, the human health effects of marine plastic pollution: Results from a 15-country survey across Europe and Australia. *Global Environmental Change, 69*, 102309.

De Groot, J. I., Abrahamse, W., & Jones, K. (2013). Persuasive normative messages: the influence of injunctive and personal norms on using free plastic bags. *Sustainability, 5*(5), 1829–1844.

De Groot, J. I., & Steg, L. (2008). Value orientations to explain beliefs related to environmental significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *Environment and Behavior, 40*(3), 330-354.

De Groot, J. I., & Steg, L. (2010). Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *Journal of Environmental Psychology, 30*(4), 368-378.

De Magistris, T., & Gracia, A. (2008). The decision to buy organic food products in Southern Italy. *British Food Journal, 110*(9), 929-947.

Demarque, C., Charalambides, L., Hilton, D. J., & Waroquier, L. (2015). Nudging sustainable consumption: The use of descriptive norms to promote a minority behavior in a realistic online shopping environment. *Journal of Environmental Psychology, 43*, 166-174.

Detenber, B., Rosenthal, S., Liao, Y., & Ho, S. S. (2016). Climate and sustainability | Audience segmentation for campaign design: Addressing climate change in Singapore. *International Journal of Communication, 10*, 23.

Diedenhofen, B. & Musch, J. (2015). cocor: A Comprehensive Solution for the Statistical Comparison of Correlations. *PLoS ONE, 10*(4), e0121945.

Diessner, R., Genthôs, R., Praest, K., & Pohling, R. (2018). Identifying with nature mediates the influence of valuing nature's beauty on proenvironmental behaviors. *Ecopsychology, 10*(2), 97-105.

Di Fabio, A., & Rosen, M. A. (2019). Accounting for individual differences in connectedness to nature: Personality and gender differences. *Sustainability, 11*(6), 1693.

Dilkes-Hoffman, L., Ashworth, P., Laycock, B., Pratt, S., & Lant, P. (2019). Public attitudes towards bioplastics–knowledge, perception and end-of-life management. *Resources, Conservation and Recycling, 151,* 104479.

Dong, X., Liu, S., Li, H., Yang, Z., Liang, S., & Deng, N. (2020). Love of nature as a mediator between connectedness to nature and sustainable consumption behavior. *Journal of Cleaner Production, 242,* 118451.

Do Paco, A., & Raposo, M. (2009). "Green" segmentation: an application to the Portuguese consumer market. *Marketing Intelligence & Planning, 27*(3), 364-379.

dos Reis, R. A., Grant-Muller, S., Lovelace, R., & Hodgson, F. (2022). Different people, different incentives? Examining the public acceptance of smartphone-based persuasive strategies for sustainable travel using psychographic segmentation. *International Journal of Sustainable Transportation, 16*(1), 1-21.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New trends in measuring environmental attitudes: Measuring endorsement of the new ecological paradigm: a revised NEP scale. *Journal of Social Issues, 56*(3), 425-442.

Dunn, M. E., Mills, M., & Veríssimo, D. (2020). Evaluating the impact of the documentary series Blue Planet II on viewers' plastic consumption behaviors. *Conservation Science and Practice, 2*(10), e280.

Dutcher, D. D., Finley, J. C., Luloff, A. E., & Johnson, J. B. (2007). Connectivity with nature as a measure of environmental values. *Environment and Behavior, 39*(4), 474-493.

Elgaaïed-Gambier, L. (2016). Who buys overpackaged grocery products and why? Understanding consumers' reactions to overpackaging in the food sector. *Journal of Business Ethics, 135*(4), 683–698.

Elliott, L. R., White, M. P., Grellier, J., Rees, S. E., Waters, R. D., & Fleming, L. E. (2018). Recreational visits to marine and coastal environments in England: Where, what, who, why, and when?. *Marine Policy, 97*, 305-314.

European Commission. (2009). *Europeans' attitudes towards climate change.* Available online at https://www.europarl.europa.eu/pdf/eurobarometre/12_07/report_eb711_climat_change_en.pdf

European Commission. (2018). *A European strategy for plastics in a circular economy.* Available online at https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1516265440535&uri=COM:2018:28:FIN.

European Commission. (2020). *Commission Implementing Regulation (EU) 2020/2151 of 17 December 2020 laying down rules on harmonised marking specifications on single-use plastic products listed in Part D of the Annex to Directive (EU) 2019/904 of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment.* Official Journal of the European Union.

Farrow, K., Grolleau, G., & Ibanez, L. (2017). Social norms and pro-environmental behavior: A review of the evidence. *Ecological Economics, 140*, 1-13.

Filho, W. L., Barbir, J., Abubakar, I. R., Paço, A., Stasiskiene, Z., Hornbogen, M., ... & Klõga, M. (2022). Consumer attitudes and concerns with bioplastics use: An international study. *PLOS ONE, 17*(4), e0266918.Forleo, M. B., & Romagnoli,

L. (2021). Marine plastic litter: public perceptions and opinions in Italy. *Marine Pollution Bulletin, 165*, 112160.

Fox, J., McKnight, J., Sun, Y., Maung, D., & Crawfis, R. (2020). Using a serious game to communicate risk and minimize psychological distance regarding environmental pollution. *Telematics and Informatics, 46*, 101320.

Fox, J., Weisberg, S., Price, B., Friendly, M., & Hong, J. (2019). *Package 'effects': Effect Displays for Linear, Generalized Linear, and Other Models*. Retrieved from: https://cran.r-project.org/web/packages/effects/

Frick, J., Kaiser, F. G., & Wilson, M. (2004). Environmental knowledge and conservation behavior: Exploring prevalence and structure in a representative sample. *Personality and Individual differences, 37*(8), 1597-1613.

Gall, S. C., & Thompson, R. C. (2015). The impact of debris on marine life. *Marine Pollution Bulletin, 92*(1-2), 170-179.

Geng, L., Xu, J., Ye, L., Zhou, W., & Zhou, K. (2015). Connections with nature and environmental behaviors. *PloS ONE, 10*(5), e0127247.

GESAMP (2015). *Sources, fate and effects of microplastics in the marine environment: a global assessment.* (P. J. Kershaw, Ed.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). *Rep. Stud. GESAMP, 90*, 96.

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances, 3*(7), e1700782.

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology, 49*(3), 141-157.

Gkargkavouzi, A., Halkos, G., & Matsiori, S. (2019). A multi-dimensional measure of environmental behavior: Exploring the predictive power of connectedness to nature, ecological worldview and environmental concern. *Social Indicators Research, 143,* 859-879.

Golob, U., & Kronegger, L. (2019). Environmental consciousness of European consumers: A segmentation-based study. *Journal of Cleaner Production, 221*, 1-9.

González, E. M., Felix, R., Carrete, L., Centeno, E., & Castaño, R. (2015). Green shades: a segmentation approach based on ecological consumer behavior in an emerging economy. *Journal of Marketing Theory and Practice, 23*(3), 287-302.

Gordon, R., Butler, K. A., Magee, C. A., Waitt, G. R., & Cooper, P. (2015). Using value theory for segmentation in social marketing. *Faculty of Social Sciences – Papers, 1782.*

Gosling, E., & Williams, K. J. (2010). Connectedness to nature, place attachment and conservation behaviour: Testing connectedness theory among farmers. *Journal of Environmental Psychology*, *30*(3), 298-304.

GreenBlue. (2011, August). *Sustainable Packaging Coalition – A Project of GreenBlue: Definition of Sustainable Packaging.* https://sustainablepackaging.org/wp-content/uploads/2017/09/Definition-of-Sustainable-Packaging.pdf

Green, P., & MacLeod, C. (2019). *Package 'simr': Power Analysis for Generalised Linear Mixed Method Models by Simulation*. Retrieved from: https://cran.r-project.org/web/packages/simr/simr.pdf

Green, P. E., & Srinivasan, V. (1990). Conjoint analysis in marketing: new developments with implications for research and practice. *Journal of Marketing*, *54*(4), 3-19.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: the implicit association test. *Journal of Personality and Social Psychology, 74*(6), 1464.

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the implicit association test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology, 85*(2), 197.

Grewal, D., Monroe, K. B., & Krishnan, R. (1998). The effects of price-comparison advertising on buyers' perceptions of acquisition value, transaction value, and behavioral intentions. *The Journal of Marketing, 46-59.*

Grunert, K. G., Hieke, S., & Wills, J. (2014). Sustainability labels on food products: Consumer motivation, understanding and use. *Food Policy, 44*, 177-189.

Grönman, K., Soukka, R., Järvi-Kääriäinen, T., Katajajuuri, J. M., Kuisma, M., Koivupuro, H. K., ... & Thun, R. (2013). Framework for sustainable food packaging design. *Packaging Technology and Science, 26*(4), 187-200.

Guest, H., Lotze, H. K., & Wallace, D. (2015). Youth and the sea: Ocean literacy in Nova Scotia, Canada. *Marine Policy, 58*, 98-107.

Guillard, V., Gaucel, S., Fornaciari, C., Angellier-Coussy, H., Buche, P., & Gontard, N. (2018). The next generation of sustainable food packaging to preserve our environment in a circular economy context. *Frontiers in Nutrition, 5*, 121.

Gwozdz, W., Steensen Nielsen, K., & Müller, T. (2017). An environmental perspective on clothing consumption: Consumer segments and their behavioral patterns. *Sustainability, 9*(5), 762.

Hahladakis, J. N., & Iacovidou, E. (2018). Closing the loop on plastic packaging materials: What is quality and how does it affect their circularity?. *Science of the Total Environment, 630*, 1394-1400.

Haider, T. P., Völker, C., Kramm, J., Landfester, K., & Wurm, F. R. (2019). Plastics of the future? The impact of biodegradable polymers on the environment and on society. *Angewandte Chemie International Edition, 58*(1), 50-62.

Halonen, N., Pálvölgyi, P. S., Bassani, A., Fiorentini, C., Nair, R., Spigno, G., & Kordas, K. (2020). Bio-based smart materials for food packaging and sensors – a review. *Frontiers in Materials, 7*, 82.

Halpenny, E. A. (2010). Pro-environmental behaviours and park visitors: The effect of place attachment. *Journal of Environmental Psychology*, *30*(4), 409-421.

Hann, S., Scholes, R., Molteno, S., Hilton, M., Favoino, E., & Jakobsen, L. G. (2020). *Relevance of Biodegradable and Compostable Consumer Plastic Products and Packaging in a Circular Economy*. European Commission.

Han, J. W., Ruiz-Garcia, L., Qian, J. P., & Yang, X. T. (2018). Food packaging: A comprehensive review and future trends. *Comprehensive Reviews in Food Science and Food Safety*, *17*(4), 860-877.

Hartley, B. L., Pahl, S., Veiga, J., Vlachogianni, T., Vasconcelos, L., Maes, T., ... & Thompson, R. C. (2018). Exploring public views on marine litter in Europe: Perceived causes, consequences and pathways to change. *Marine Pollution Bulletin, 133*, 945-955.

Haward, M. (2018). Plastic pollution of the world's seas and oceans as a contemporary challenge in ocean governance. *Nature Communications, 9*(1), 667.

Heidbreder, L. M., Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of the Total Environment*, *668*, 1077-1093.

Heiniö, R. L., Arvola, A., Rusko, E., Maaskant, A., & Kremer, S. (2017). Ready-made meal packaging–A survey of needs and wants among Finnish and Dutch 'current'and 'future'seniors. *LWT-Food Science and Technology*, *79*, 579-585.

Hensher, D. A., Rose, J., & Greene, W. H. (2005). The implications on willingness to pay of respondents ignoring specific attributes. *Transportation, 32*(3), 203-222.

Herbes, C., Beuthner, C., & Ramme, I. (2018). Consumer attitudes towards biobased packaging – A cross-cultural comparative study. *Journal of Cleaner Production, 194*, 203-218.

Herbes, C., Beuthner, C., & Ramme, I. (2020). How green is your packaging — A comparative international study of cues consumers use to recognize environmentally friendly packaging. *International Journal of Consumer Studies, 44*(3), 258-271.

Herrmann, C., Rhein, S., & Sträter, K. F. (2022). Consumers' sustainability-related perception of and willingness-to-pay for food packaging alternatives. *Resources, Conservation and Recycling, 181*, 106219.

Hidalgo, M. C., & Hernandez, B. (2001). Place attachment: Conceptual and empirical questions. *Journal of Environmental Psychology, 21*(3), 273-281.

Horne, R. E. (2009). Limits to labels: The role of eco-labels in the assessment of product sustainability and routes to sustainable consumption. *International Journal of Consumer Studies, 33*(2), 175-182.

Hoot, R. E., & Friedman, H. (2010). Connectedness and environmental behavior: Sense of interconnectedness and pro-environmental behavior. *Transpersonal Studies, 30*(1-2), 89-100.

Hottle, T. A., Bilec, M. M., & Landis, A. E. (2013). Sustainability assessments of bio-based polymers. *Polymer Degradation and Stability, 98*(9), 1898-1907.

Huang, Z. (1998). Extensions to the k-means algorithm for clustering large data sets with categorical values. *Data Mining and Knowledge Discovery, 2*(3), 283-304.

Huang, W., Song, B., Liang, J., Niu, Q., Zeng, G., Shen, M., ... & Zhang, Y. (2021). Microplastics and associated contaminants in the aquatic environment: A review

on their ecotoxicological effects, trophic transfer, and potential impacts to human health. *Journal of Hazardous Materials, 405*, 124187.

Huddart Kennedy, E., Krahn, H., & Krogman, N. T. (2015). Are we counting what counts? A closer look at environmental concern, pro-environmental behaviour, and carbon footprint. *Local Environment, 20*(2), 220-236.

Hughes, J., Rogerson, M., Barton, J., & Bragg, R. (2019). Age and connection to nature: when is engagement critical?. *Frontiers in Ecology and the Environment, 17*(5), 265-269.

Hungerford, H. R., & Volk, T. L. (1990). Changing learner behavior through environmental education. *The Journal of Environmental Education, 21*(3), 8-21.

Hunt, E. (2017, December 10). Blue Planet II: From octopus v shark to fish that crawl, the series's biggest discoveries. *The Guardian*. https://www.theguardian.com/tv-and-radio/2017/nov/20/blue-planet-ii-what-have-we-learned-so-far().

Ibrahim, I. D., Hamam, Y., Sadiku, E. R., Ndambuki, J. M., Kupolati, W. K., Jamiru, T., ... & Snyman, J. (2022). Need for sustainable packaging: An overview. *Polymers, 14*(20), 4430.

Irwin, J. R., & McClelland, G. (2001). Misleading heuristics for moderated multiple regression models. *Journal of Marketing, 38*, 100-109.

Iwata, T. (2015). Biodegradable and bio-based polymers: Future prospects of eco-friendly plastics. *Angewandte Chemie International Edition, 54*(11), 3210-3215.

Jain, S. K., & Kaur, G. (2006). Role of socio-demographics in segmenting and profiling green consumers: an exploratory study of consumers in India. *Journal of International Consumer Marketing, 18*(3), 107-146.

Jaiswal, J., & Bihari, S. (2020). Role of connectedness to nature and perceived environmental responsibility on green purchase behaviour. Asian Journal of Business Research, 10(3), 65-84.

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., ... & Law, K. L. (2015). Plastic waste inputs from land into the ocean. *Science, 347*(6223), 768-771.

Jang, Y. C., Hong, S., Lee, J., Lee, M. J., & Shim, W. J. (2014). Estimation of lost tourism revenue in Geoje Island from the 2011 marine debris pollution event in South Korea. *Marine Pollution Bulletin, 81*(1), 49-54.

Kabadayı, E. T., Dursun, İ., Alan, A. K., & Tuğer, A. T. (2015). Green purchase intention of young Turkish consumers: Effects of consumer's guilt, self-monitoring and perceived consumer effectiveness. *Procedia - Social and Behavioral Sciences, 207,* 165-174.

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology, 19*(1), 1-19.

Kalafatis, S. P., Pollard, M., East, R., & Tsogas, M. H. (1999). Green marketing and Ajzen's theory of planned behaviour: a cross-market examination. *Journal of Consumer Marketing, 16*(5), 441-460.

Kals, E., Schumacher, D., & Montada, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environment and Behavior, 31*(2), 178-202.

Kang, D., Auras, R., & Singh, J. (2017). Life cycle assessment of non-alcoholic single-serve polyethylene terephthalate beverage bottles in the state of California. *Resources, Conservation and Recycling, 116*, 45-52.

Kano, N. (1984). Attractive quality and must-be quality. *Hinshitsu (Quality, The Journal of Japanese Society for Quality Control), 14*, 39-48.

Kastenholz, E., Eusébio, C., & Carneiro, M. J. (2018). Segmenting the rural tourist market by sustainable travel behaviour: Insights from village visitors in Portugal. *Journal of Destination Marketing & Management, 10*, 132-142.

Kautish, P., Sharma, R., Mangla, S. K., Jabeen, F., & Awan, U. (2021). Understanding choice behavior towards plastic consumption: an emerging market investigation. *Resources, Conservation and Recycling, 174*, 105828.

Ketelsen, M., Janssen, M., & Hamm, U. (2020). Consumers' response to environmentally-friendly food packaging - A systematic review. *Journal of Cleaner Production, 254*, 120123.

Khachatryan, H., Campbell, B., Hall, C., Behe, B., Yue, C., & Dennis, J. (2014). The effects of individual environmental concerns on willingness to pay for sustainable plant attributes. *HortScience, 49*(1), 69-75.

Kim, Y. J., Njite, D., & Hancer, M. (2013). Anticipated emotion in consumers' intentions to select eco-friendly restaurants: Augmenting the theory of planned behavior. *International Journal of Hospitality Management, 34*, 255-262.

Klaiman, K., Ortega, D. L., & Garnache, C. (2016). Consumer preferences and demand for packaging material and recyclability. *Resources, Conservation and Recycling, 115*, 1-8.

Klaiman, K., Ortega, D. L., & Garnache, C. (2017). Perceived barriers to food packaging recycling: Evidence from a choice experiment of US consumers. *Food Control, 73*, 291-299.

Klein, S. A., & Hilbig, B. E. (2018). How virtual nature experiences can promote pro-environmental behavior. *Journal of Environmental Psychology, 60*, 41-47.

Koenig-Lewis, N., Palmer, A., Dermody, J., & Urbye, A. (2014). Consumers' evaluations of ecological packaging – Rational and emotional approaches. *Journal of Environmental Psychology, 37*, 94-105.

Kossack, A., & Bogner, F. X. (2012). How does a one-day environmental education programme support individual connectedness with nature?. *Journal of Biological Education, 46*(3), 180-187.

Kovačević, D., & Bota, J. (2021). Consumer satisfaction with packaging materials: Kano model analysis approach. *Tehnički Vjesnik, 28*(4), 1203-1210.

Kühnen, U., Schießl, M., Bauer, N., Paulig, N., Pöhlmann, C., & Schmidthals, K. (2001). How robust is the IAT? Measuring and manipulating implicit attitudes of East-and West-Germans. *Zeitschrift für Experimentelle Psychologie, 48*(2), 135–144.

Kurisu, K. H., & Bortoleto, A. P. (2011). Comparison of waste prevention behaviors among three Japanese megacity regions in the context of local measures and socio-demographics. *Waste Management, 31*(7), 1441-1449.

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software, 82*(13), 1-26.

Kuznetsova, A., Christensen, R. H., Bavay, C., & Brockhoff, P. B. (2015). Automated mixed ANOVA modeling of sensory and consumer data. *Food Quality and Preference, 40*, 31-38.

Lacerda, A. L. D. F., Rodrigues, L. D. S., Van Sebille, E., Rodrigues, F. L., Ribeiro, L., Secchi, E. R., ... & Proietti, M. C. (2019). Plastics in sea surface waters around the Antarctic Peninsula. *Scientific Reports, 9*(1), 1-12.

Lange, F., & Truyens, M. (2022). Mixed evidence for the effect of virtual nature exposure on effortful pro-environmental behavior. *Journal of Environmental Psychology, 81*, 101803.

Lapinski, M. K., & Rimal, R. N. (2005). An explication of social norms. *Communication Theory, 15*(2), 127-147.

Lau, W. W., Shiran, Y., Bailey, R. M., Cook, E., Stuchtey, M. R., Koskella, J., ... & Palardy, J. E. (2020). Evaluating scenarios toward zero plastic pollution. *Science, 369*(6510), 1455-1461.

Laville, S. (2021, March 24). No bottle deposit return scheme for most of UK until 2024 at earliest. *The Guardian.* https://www.theguardian.com/environment/2021/mar/24/no-bottle-deposit-return-scheme-for-most-of-uk-until-2024-at-earliest

Law, K. L. (2017). Plastics in the marine environment. *Annual Review of Marine Science, 9*, 205-229.

Lebreton, L., Van Der Zwet, J., Damsteeg, J. W., Slat, B., Andrady, A., & Reisser, J. (2017). River plastic emissions to the world's oceans. *Nature Communications, 8*(1), 1-10.

Lee, J., & Haley, E. (2022). Green consumer segmentation: consumer motivations for purchasing pro-environmental products. *International Journal of Advertising, 41*(8), 1477-1501.

Lee, N. R., & Kotler, P. (2015). Social marketing: Changing behaviors for good (5th ed.). SAGE Publications.

Lengieza, M. L., & Swim, J. K. (2021). The paths to connectedness: A review of the antecedents of connectedness to nature. *Frontiers in Psychology, 12*, 763231.

Lenth, R. (2019). *Package 'emmeans': Estimated Marginal Means, aka Least-Squares Means.* Retrieved from https://cran.r-project.org/web/packages/emmeans/

Liefländer, A. K., Fröhlich, G., Bogner, F. X., & Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research, 19*(3), 370-384.

Lin, F. H., Tsai, S. B., Lee, Y. C., Hsiao, C. F., Zhou, J., Wang, J., & Shang, Z. (2017). Empirical research on Kano's model and customer satisfaction. *PloS ONE, 12*(9), e0183888.

Lindh, H., Olsson, A., & Williams, H. (2016). Consumer perceptions of food packaging: contributing to or counteracting environmentally sustainable development? *Packaging Technology and Science, 29*(1), 3-23.

Luo, Y., Douglas, J., Pahl, S., & Zhao, J. (2022). Reducing plastic waste by visualizing marine consequences. *Environment and Behavior*, *54*(4), 809-832.

Lusher, A. L., Mchugh, M., & Thompson, R. C. (2013). Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel. *Marine Pollution Bulletin, 67*(1-2), 94-99.

Lwo, L. S., Cheng-Chieh, C., Yuan-Ping, T., & Wen-Cheng, Y. (2013). Marine science literacy and misconceptions among senior high school students. *Journal of Research in Education Sciences, 58*(3), 51.

Löfgren, M., & Witell, L. (2005). Kano's theory of attractive quality and packaging. *Quality Management Journal, 12*(3), 7-20.

Löfgren, M., Witell, L., & Gustafsson, A. (2011). Theory of attractive quality and life cycles of quality attributes. *The TQM Journal*, *23*(2), 235-246.

Löhr, A., Savelli, H., Beunen, R., Kalz, M., Ragas, A., & Van Belleghem, F. (2017). Solutions for global marine litter pollution. *Current Opinion in Environmental Sustainability, 28*, 90-99.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental Education Research, 8*(3), 239-260.

Macaulay, R., Johnson, K., Lee, K., & Williams, K. (2022). Comparing the effect of mindful and other engagement interventions in nature on attention restoration, nature connection, and mood. *Journal of Environmental Psychology, 81*, 101813.

Mackay, C. M., & Schmitt, M. T. (2019). Do people who feel connected to nature do more to protect it? A meta-analysis. *Journal of Environmental Psychology, 65*, 101323.

Madigele, P. K., Mogomotsi, G. E. J., & Kolobe, M. (2017). Consumer willingness to pay for plastic bags levy and willingness to accept eco-friendly alternatives in Botswana. *Chinese Journal of Population Resources and Environment, 15*(3), 255-261.

Maga, D., Hiebel, M., & Aryan, V. (2019). A comparative life cycle assessment of meat trays made of various packaging materials. *Sustainability, 11*(19), 5324.

Magnier, L., & Crié, D. (2015). Communicating packaging eco-friendliness: An exploration of consumers' perceptions of eco-designed packaging. *International Journal of Retail & Distribution Management, 43*(4/5), 350-366.

Magnier, L., & Schoormans, J. (2015). Consumer reactions to sustainable packaging: The interplay of visual appearance, verbal claim and environmental concern. *Journal of Environmental Psychology, 44*, 53-62.

Magnier, L., Schoormans, J., & Mugge, R. (2016). Judging a product by its cover: Packaging sustainability and perceptions of quality in food products. *Food Quality and Preference, 53*, 132-142.

Magnusson, M. K., Arvola, A., Hursti, U. K. K., Åberg, L., & Sjödén, P. O. (2003). Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour. *Appetite, 40*(2), 109-117.

Maibach, E. W., Leiserowitz, A., Roser-Renouf, C., & Mertz, C. K. (2011). Identifying like-minded audiences for global warming public engagement campaigns: An audience segmentation analysis and tool development. *PloS One, 6*(3), e17571.

Marconi, M., & Germani, M. (2017). An end of life oriented framework to support the transition toward circular economy. In *DS 87-5 Proceedings of the 21st*

International Conference on Engineering Design (ICED 17) Vol 5: Design for X, Design to X, Vancouver, Canada, 21-25.08. 2017 (pp. 199-208).

Marsh, K., & Bugusu, B. (2007). Food packaging — roles, materials, and environmental issues. *Journal of Food Science, 72*(3), 39-55.

Martel-Morin, M., & Lachapelle, E. (2022). The Five Canadas of Climate Change: Using audience segmentation to inform communication on climate policy. *Plos One, 17*(11), e0273977.

Martin, C., & Czellar, S. (2016). The extended inclusion of nature in self scale. *Journal of Environmental Psychology, 47,* 181-194.

Martin, C., & Czellar, S. (2017). Where do biospheric values come from? A connectedness to nature perspective. *Journal of Environmental Psychology, 52*, 56-68.

Martin, L., White, M. P., Hunt, A., Richardson, M., Pahl, S., & Burt, J. (2020). Nature contact, nature connectedness and associations with health, wellbeing and pro-environmental behaviours. *Journal of Environmental Psychology, 68,* 101389.

Martinho, G., Pires, A., Portela, G., & Fonseca, M. (2015). Factors affecting consumers' choices concerning sustainable packaging during product purchase and recycling. *Resources, Conservation and Recycling, 103*, 58-68.

Mathis, J. E., Gillet, M. C., Disselkoen, H., & Jambeck, J. R. (2022). Reducing ocean plastic pollution: Locally led initiatives catalyzing change in South and Southeast Asia. *Marine Policy, 143*, 105127.

Mato, Y., Isobe, T., Takada, H., Kanehiro, H., Ohtake, C., & Kaminuma, T. (2001). Plastic resin pellets as a transport medium for toxic chemicals in the marine environment. *Environmental Science & Technology, 35*(2), 318-324.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology, 24*(4), 503-515.

Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior, 41*(5), 607-643.

Mccallum, M. L., & Bury, G. W. (2013). Google search patterns suggest declining interest in the environment. *Biodiversity and Conservation, 22*(6-7), 1355-1367.

McCarthy, B., & Wang, P. (2022). Shades of Sustainability: Who are the Buyers and Non-buyers of Sustainable Packaging?. *Journal of Food Products Marketing, 28*(4), 153-178.

McGowan, F., Thorndyke, M., Solo-Gabriele, H., & Fleming, L. E. (2016). Oceans and human health. *Journal of the Marine Biological Association of the United Kingdom, 96*(1), 1-3.

McIlgorm, A., Campbell, H. F., & Rule, M. J. (2011). The economic cost and control of marine debris damage in the Asia-Pacific region. *Ocean & Coastal Management, 54*(9), 643-651.

McKinley, E., & Burdon, D. (2020). Understanding ocean literacy and ocean climate-related behaviour change in the UK - Work Package 1: Evidence Synthesis. *Hull: Daryl Burdon Ltd*. Available online at: https://darylburdon.co.uk.

Mehta, N., Cunningham, E., Roy, D., Cathcart, A., Dempster, M., Berry, E., & Smyth, B. M. (2021). Exploring perceptions of environmental professionals, plastic processors, students and consumers of bio-based plastics: Informing the development of the sector. *Sustainable Production and Consumption, 26*, 574-587.

Meneses, G. D. (2010). Refuting fear in heuristics and in recycling promotion. *Journal of Business Research, 63*(2), 104-110.

Menzel, C., Brom, J., & Heidbreder, L. M. (2021). Explicitly and implicitly measured valence and risk attitudes towards plastic packaging, plastic waste, and microplastic in a German sample. *Sustainable Production and Consumption, 28*, 1422-1432.

Mesch, G. S., & Manor, O. (1998). Social ties, environmental perception, and local attachment. *Environment and Behavior, 30*(4), 504-519.

Mohanty, A. K., Vivekanandhan, S., Pin, J. M., & Misra, M. (2018). Composites from renewable and sustainable resources: Challenges and innovations. *Science, 362*(6414), 536-542.

Morales-Caselles, C., Viejo, J., Martí, E., González-Fernández, D., Pragnell-Raasch, H., González-Gordillo, J. I., ... & Cózar, A. (2021). An inshore–offshore sorting system revealed from global classification of ocean litter. *Nature Sustainability, 4*(6), 484-493.

Morris, J. D., Woo, C., Geason, J. A., & Kim, J. (2002). The power of affect: Predicting intention. *Journal of Advertising Research, 42*(3), 7-17.

Mouat, J., Lozano, R., & Bateson, H. (2010). *Economic impacts of marine litter*. Shetland, Scotland, UK: KIMO.

Napper, I. E., & Thompson, R. C. (2019). Environmental deterioration of biodegradable, oxo-biodegradable, compostable, and conventional plastic carrier bags in the sea, soil, and open-air over a 3-year period. *Environmental Science & Technology, 53*(9), 4775-4783.

Nardo, M., Loi, M., Rosati, R., & Manca, A. R. (2011). *The consumer empowerment index. A measure of skills, awareness and engagement of European consumers.* Munich Personal RePEc Archive.

Næs, T., Lengard, V., Johansen, S. B., & Hersleth, M. (2010). Alternative methods for combining design variables and consumer preference with information about attitudes and demographics in conjoint analysis. *Food Quality and Preference, 21*(4), 368-378.

Nelms, S. E., Barnett, J., Brownlow, A., Davison, N. J., Deaville, R., Galloway, T. S., ... & Godley, B. J. (2019). Microplastics in marine mammals stranded around the British coast: ubiquitous but transitory?. *Scientific Reports, 9*(1), 1-8.

Newman, S., Watkins, E., Farmer, A., ten Brink, P., & Schweitzer, J.-P. (2015). The economics of marine litter. In M. Bergmann, L. Gutow, & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 371–398). Berlin: Springer.

Newton, P., & Meyer, D. (2013). Exploring the attitudes-action gap in household resource consumption: does "environmental lifestyle" segmentation align with consumer behaviour?. *Sustainability, 5*(3), 1211-1233.

Newton, J. D., Tsarenko, Y., Ferraro, C., & Sands, S. (2015). Environmental concern and environmental purchase intentions: The mediating role of learning strategy. *Journal of Business Research, 68*(9), 1974-1981.

Nguyen, A. T., Parker, L., Brennan, L., & Lockrey, S. (2020). A consumer definition of eco-friendly packaging. *Journal of Cleaner Production, 252*, 119792.

Nisbet, E. K., & Zelenski, J. M. (2011). Underestimating nearby nature: Affective forecasting errors obscure the happy path to sustainability. *Psychological Science, 22*(9), 1101-1106.

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature relatedness scale: Linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior, 41*(5), 715-740.

Ngo, P. L., Pramanik, B. K., Shah, K., & Roychand, R. (2019). Pathway, classification and removal efficiency of microplastics in wastewater treatment plants. *Environmental Pollution, 255*, 113326.

Nguyen, T. N., Lobo, A., & Greenland, S. (2016). Pro-environmental purchase behaviour: The role of consumers' biospheric values. *Journal of Retailing and Consumer Services, 33*, 98-108.

Nordin, N., & Selke, S. (2010). Social aspect of sustainable packaging. *Packaging Technology and Science, 23*(6), 317-326.

Nuojua, S., Cracknell, D., & Pahl, S. (2022). Human behavior and marine plastic pollution. In A. L. Andrady (Ed.), *Plastics and the Ocean: Origin, Characterization, Fate, and Impacts* (pp. 429-454). Wiley.

Obbard, R. W., Sadri, S., Wong, Y. Q., Khitun, A. A., Baker, I., & Thompson, R. C. (2014). Global warming releases microplastic legacy frozen in Arctic Sea ice. *Earth's Future, 2*(6), 315-320.

Olivos, P., Aragonés, J. I., & Amérigo, M. (2011). The connectedness to nature scale and its relationship with environmental beliefs and identity. *International Journal of Hispanic Psychology, 4*(1), 5-19.

Olson, J. C. (1978). Inferential belief formation in the cue utilization process. *Advances in Consumer Research, 5,* 706–713.

Onwezen, M. C., Antonides, G., & Bartels, J. (2013). The Norm Activation Model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology, 39*, 141-153.

Onwezen, M. C., Reinders, M. J., & Sijtsema, S. J. (2017). Understanding intentions to purchase bio-based products: The role of subjective ambivalence. *Journal of Environmental Psychology, 52*, 26-36.

Otto, S., Strenger, M., Maier-Nöth, A., & Schmid, M. (2021). Food packaging and sustainability – Consumer perception vs. correlated scientific facts: A review. *Journal of Cleaner Production, 298*, 126733.

Oxford English Dictionary (n.d.). Greenwashing. In *OED Online*, Oxford University Press. Retrieved June 13, 2022, from https://www.oed.com/viewdictionaryentry/Entry/249122

Pahl, S., Wyles, K. J., & Thompson, R. C. (2017). Channelling passion for the ocean towards plastic pollution. *Nature Human Behaviour, 1*(10), 697.

Pan, Y., Farmahini-Farahani, M., O'Hearn, P., Xiao, H., & Ocampo, H. (2016). An overview of bio-based polymers for packaging materials. *J. Bioresour. Bioprod, 1*(3), 106-113.

Pasqualino, J., Meneses, M., & Castells, F. (2011). The carbon footprint and energy consumption of beverage packaging selection and disposal. *Journal of Food Engineering, 103*(4), 357-365.

Pauer, E., Wohner, B., Heinrich, V., & Tacker, M. (2019). Assessing the environmental sustainability of food packaging: An extended life cycle assessment including packaging-related food losses and waste and circularity assessment. *Sustainability, 11*(3), 925.

Peloza, J., White, K., & Shang, J. (2013). Good and guilt-free: The role of self-accountability in influencing preferences for products with ethical attributes. *Journal of Marketing, 77*(1), 104-119.

Pereira, M., & Forster, P. (2015). The relationship between connectedness to nature, environmental values, and pro-environmental behaviours. *Reinvention: An International Journal of Undergraduate Research, 8*(2).

Perrin, J. L., & Benassi, V. A. (2009). The connectedness to nature scale: A measure of emotional connection to nature?. *Journal of Environmental Psychology, 29*(4), 434-440.

Perugini, M., & Bagozzi, R. P. (2001). The role of desires and anticipated emotions in goal-directed behaviours: Broadening and deepening the theory of planned behaviour. *British Journal of Social Psychology, 40*(1), 79-98.

Peterson, R. A., & Merunka, D. R. (2014). Convenience samples of college students and research reproducibility. *Journal of Business Research, 67*(5), 1035-1041.

Pham, C. K., Pereira, J. M., Frias, J. P., Ríos, N., Carriço, R., Juliano, M., & Rodríguez, Y. (2020). Beaches of the Azores archipelago as transitory repositories for small plastic fragments floating in the North-East Atlantic. *Environmental Pollution, 263*, 114494.

Phelan, A. A., Meissner, K., Humphrey, J., & Ross, H. (2022). Plastic pollution and packaging: Corporate commitments and actions from the food and beverage sector. *Journal of Cleaner Production, 331*, 129827.

Pittman, S. J., Rodwell, L. D., Shellock, R. J., Williams, M., Attrill, M. J., Bedford, J., ... & Rees, S. E. (2019). Marine parks for coastal cities: A concept for enhanced community well-being, prosperity and sustainable city living. *Marine Policy, 103*, 160-171.

PlasticsEurope (2021). *Plastics—The Facts 2021. An Analysis of European Plastics Production, Demand and Waste Data*. Available online at https://plasticseurope.org/knowledge-hub/plastics-the-facts-2021/

Poortinga, W., & Darnton, A. (2016). Segmenting for sustainability: The development of a sustainability segmentation model from a Welsh sample. *Journal of Environmental Psychology, 45*, 221-232.

Poortinga, W., Steg, L., & Vlek, C. (2004). Values, environmental concern, and environmental behavior: A study into household energy use. *Environment and Behavior, 36*(1), 70-93.

Popovic, I., Bossink, B. A., van der Sijde, P. C., & Fong, C. Y. (2020). Why are consumers willing to pay more for liquid foods in environmentally friendly packaging? A dual attitudes perspective. *Sustainability, 12*(7), 2812.

Prakash, G., Choudhary, S., Kumar, A., Garza-Reyes, J. A., Khan, S. A. R., & Panda, T. K. (2019). Do altruistic and egoistic values influence consumers' attitudes and purchase intentions towards eco-friendly packaged products? An empirical investigation. *Journal of Retailing and Consumer Services, 50*, 163-169.

Prakash, G., & Pathak, P. (2017). Intention to buy eco-friendly packaged products among young consumers of India: A study on developing nation. *Journal of Cleaner Production, 141*, 385-393.

Prestwich, A., Perugini, M., Hurling, R., & Richetin, J. (2010). Using the self to change implicit attitudes. *European Journal of Social Psychology, 40*(1), 61-71.

Pritchard, A., Richardson, M., Sheffield, D., & McEwan, K. (2019). The relationship between nature connectedness and eudaimonic well-being: A meta-analysis. *Journal of Happiness Studies*, 1-23.

Rai, P., Mehrotra, S., Priya, S., Gnansounou, E., & Sharma, S. K. (2021). Recent advances in the sustainable design and applications of biodegradable polymers. *Bioresource Technology, 325*, 124739.

Ramkissoon, H., Weiler, B., & Smith, L. D. G. (2012). Place attachment and pro-environmental behaviour in national parks: The development of a conceptual framework. *Journal of Sustainable Tourism, 20*(2), 257-276.

R Core Team (2017). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Reinders, M. J., Onwezen, M. C., & Meeusen, M. J. (2017). Can bio-based attributes upgrade a brand? How partial and full use of bio-based materials affects the purchase intention of brands. *Journal of Cleaner Production, 162*, 1169-1179.

Rezvani, Z., Jansson, J., & Bengtsson, M. (2017). Cause I'll feel good! An investigation into the effects of anticipated emotions and personal moral norms on consumer pro-environmental behavior. *Journal of Promotion Management, 23*(1), 163-183.

Rhein, S., & Schmid, M. (2020). Consumers' awareness of plastic packaging: More than just environmental concerns. *Resources, Conservation and Recycling, 162*, 105063.

Richardson, M., Hamlin, I., Elliott, L. R., & White, M. P. (2022). Country-level factors in a failing relationship with nature: Nature connectedness as a key metric for a sustainable future. *Ambio, 51*(11), 2201-2213.

Rokka, J., & Uusitalo, L. (2008). Preference for green packaging in consumer product choices – do consumers care?. *International Journal of Consumer Studies, 32*(5), 516-525.

Rollero, C., & De Piccoli, N. (2010). Place attachment, identification and environment perception: An empirical study. *Journal of Environmental Psychology, 30*(2), 198-205.

Rompf, S. A. (2014). *System trust and cooperation: the case of recycling behavior. (MPRA Paper No. 60279).* University of Cologne.

Rosa, C. D., Profice, C. C., & Collado, S. (2018). Nature experiences and adults' self-reported pro-environmental behaviors: The role of connectedness to nature and childhood nature experiences. *Frontiers in Psychology, 9*, 1055.

Rosenboom, J. G., Langer, R., & Traverso, G. (2022). Bioplastics for a circular economy. *Nature Reviews Materials, 7*(2), 117-137.

Ryan, P. G., Swanepoel, D., Rice, N., & Preston, G. R. (1996). The 'free' shopping-bag debate: costs and attitudes. *South African Journal of Science, 92*, 163-164.

Salazar, G., Neves, J., Alves, V., Silva, B., Giger, J. C., & Veríssimo, D. (2021). The effectiveness and efficiency of using normative messages to reduce waste: A real world experiment. *PLOS One, 16*(12), e0261734.

Sánchez, M., López-Mosquera, N., & Lera-López, F. (2016). Improving pro-environmental behaviours in Spain. The role of attitudes and socio-demographic and political factors. *Journal of Environmental Policy & Planning, 18*(1), 47-66.

Sanguinetti, A. (2014). Transformational practices in cohousing: Enhancing residents' connection to community and nature. *Journal of Environmental Psychology, 40*, 86-96.

Santos, I. R., Friedrich, A. C., Wallner-Kersanach, M., & Fillmann, G. (2005). Influence of socio-economic characteristics of beach users on litter generation. *Ocean & Coastal Management, 48*(9-10), 742-752.

SAPEA (Science Advice for Policy by European Academies). (2019). *A Scientific Perspective on Microplastics in Nature and Society*. Berlin: SAPEA.

Sargisson, R. J., De Groot, J. I., & Steg, L. (2020). The relationship between sociodemographics and environmental values across seven European countries. *Frontiers in Psychology, 11*, 2253.

Sauerwein, E., Bailom, F., Matzler, K., & Hinterhuber, H. H. (1996). The Kano model: How to delight your customers. *International Working Seminar on Production Economics, 1*(4), 313-327.

Schipperijn, J., Ekholm, O., Stigsdotter, U. K., Toftager, M., Bentsen, P., Kamper-Jørgensen, F., & Randrup, T. B. (2010). Factors influencing the use of green space: Results from a Danish national representative survey. *Landscape and Urban Planning, 95*(3), 130-137.

Schmitt, M. T., Aknin, L. B., Axsen, J., & Shwom, R. L. (2018). Unpacking the relationships between pro-environmental behavior, life satisfaction, and perceived ecological threat. *Ecological Economics, 143*, 130-140.

Schmitt, M. T., Mackay, C. M., Droogendyk, L. M., & Payne, D. (2019). What predicts environmental activism? The roles of identification with nature and politicized environmental identity. *Journal of Environmental Psychology, 61*, 20-29.

Schnurr, R. E., Alboiu, V., Chaudhary, M., Corbett, R. A., Quanz, M. E., Sankar, K., ... & Walker, T. R. (2018). Reducing marine pollution from single-use plastics (SUPs): A review. *Marine Pollution Bulletin, 137*, 157-171.

Schuldt, J. P., McComas, K. A., & Byrne, S. E. (2016). Communicating about ocean health: Theoretical and practical considerations. *Philosophical Transactions of the Royal Society B, 371*(1689), 20150214.

Schultz, P. W. (1999). Changing behavior with normative feedback interventions: A field experiment on curbside recycling. *Basic and Applied Social Psychology, 21*(1), 25-36.

Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, *21*(4), 327-339.

Schultz, P. (2002). Inclusion with nature: The psychology of human-nature relations. In P. Schmuck & W.P. Schultz (Eds.) *Psychology of sustainable development* (pp. 61-78). Kluwer Academic Publishers, Dordrecht.

Schultz, P. W., Bator, R. J., Large, L. B., Bruni, C. M., & Tabanico, J. J. (2013). Littering in context: Personal and environmental predictors of littering behavior. *Environment and Behavior, 45*(1), 35-59.

Schultz, P. W., Gouveia, V. V., Cameron, L. D., Tankha, G., Schmuck, P., & Franěk, M. (2005). Values and their relationship to environmental concern and conservation behavior. *Journal of Cross-cultural Psychology, 36*(4), 457-475.

Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology, 24*(1), 31-42.

Schultz, P. W., & Tabanico, J. (2007). Self, identity, and the natural environment: exploring implicit connections with nature. *Journal of Applied Social Psychology, 37*(6), 1219-1247.

Schuyler, Q., Hardesty, B. D., Wilcox, C., & Townsend, K. (2014). Global analysis of anthropogenic debris ingestion by sea turtles. *Conservation Biology, 28*(1), 129-139.

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In M. Zanna (Ed.), *Advances in experimental social psychology* (pp. 1-65). Orlando, FL: Academic Press.

Schwartz, S. H., & Howard, J. A. (1981). A normative decision-making model of altruism. *Altruism and Helping Behavior*, 189-211.

Scott, L., & Vigar-Ellis, D. (2014). Consumer understanding, perceptions and behaviours with regard to environmentally friendly packaging in a developing nation. *International Journal of Consumer Studies, 38*(6), 642-649.

Scurati, G. W., Bertoni, M., Graziosi, S., & Ferrise, F. (2021). Exploring the use of Virtual Reality to support environmentally sustainable behavior: a framework to design experiences. *Sustainability, 13*(2), 943.

Sheavly, S., & Register, K. (2007). Marine debris & plastics: environmental concerns, sources, impacts and solutions. *Journal of Polymers and the Environment, 15*(4), 301-305.

Sheeran, P. (2002). Intention—behavior relations: a conceptual and empirical review. *European Review of Social Psychology, 12*(1), 1-36.

Sheeran, P., & Webb, T. L. (2016). The intention–behavior gap. *Social and Personality Psychology Compass, 10*(9), 503-518.

Shen, M., Song, B., Zeng, G., Zhang, Y., Huang, W., Wen, X., & Tang, W. (2020). Are biodegradable plastics a promising solution to solve the global plastic pollution?. *Environmental Pollution, 263*, 114469.

Silayoi, P., & Speece, M. (2004). Packaging and purchase decisions: An exploratory study on the impact of involvement level and time pressure. *British Food Journal, 106*(8), 607-628.

Simon, B., Amor, M. B., & Földényi, R. (2016). Life cycle impact assessment of beverage packaging systems: focus on the collection of post-consumer bottles. *Journal of Cleaner Production, 112*, 238-248.

Singmann, H., & Kellen, D. (2019). An introduction to mixed models for experimental psychology. *New Methods in Cognitive Psychology, 28*, 4-31.

Siracusa, V., Ingrao, C., Giudice, A. L., Mbohwa, C., & Dalla Rosa, M. (2014). Environmental assessment of a multilayer polymer bag for food packaging and preservation: An LCA approach. *Food Research International, 62*, 151-161.

Sivapalan, A., von der Heidt, T., Scherrer, P., & Sorwar, G. (2021). A consumer values-based approach to enhancing green consumption. *Sustainable Production and Consumption, 28*, 699-715.

Soares, J., Miguel, I., Venâncio, C., Lopes, I., & Oliveira, M. (2021). Public views on plastic pollution: Knowledge, perceived impacts, and pro-environmental behaviours. *Journal of Hazardous Materials, 412*, 125227.

Soliman, M., Peetz, J., & Davydenko, M. (2017). The impact of immersive technology on nature relatedness and pro-environmental behavior. *Journal of Media Psychology, 29*(1), 8-17.

Songa, G., Slabbinck, H., Vermeir, I., & Russo, V. (2019). How do implicit/explicit attitudes and emotional reactions to sustainable logo relate? A neurophysiological study. *Food Quality and Preference, 71*, 485-496.

Spence, E., Pidgeon, N., & Pearson, P. (2018). UK public perceptions of Ocean Acidification – The importance of place and environmental identity. *Marine Policy, 97*, 287-293.

Steel, B. S., Smith, C., Opsommer, L., Curiel, S., & Warner-Steel, R. (2005). Public ocean literacy in the United States. *Ocean & Coastal Management, 48*(2), 97-114.

Steenis, N. D., van der Lans, I. A., van Herpen, E., & van Trijp, H. C. (2018). Effects of sustainable design strategies on consumer preferences for redesigned packaging. *Journal of Cleaner Production, 205*, 854-865.

Steenis, N. D., Van Herpen, E., Van Der Lans, I. A., Ligthart, T. N., & Van Trijp, H. C. (2017). Consumer response to packaging design: The role of packaging materials and graphics in sustainability perceptions and product evaluations. *Journal of Cleaner Production, 162*, 286-298.

Steffens, M. C. (2004). Is the implicit association test immune to faking?. *Experimental Psychology, 51*(3), 165-179.

Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors and goals. *Journal of Environmental Psychology, 38*, 104-115.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology, 29*(3), 309-317.

Stern, P. C. (2000). New environmental theories: toward a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*(3), 407-424.

Stern, P. C., & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues, 50*, 65-84.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 81-97.

Stoll-Kleemann, S. (2019). Feasible options for behavior change toward more effective ocean literacy: a systematic review. *Frontiers in Marine Science, 6*, 273.

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the tide: using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology, 100*(2), 255.

Sundqvist-Andberg, H., & Åkerman, M. (2021). Sustainability governance and contested plastic food packaging – An integrative review. *Journal of Cleaner Production, 306*, 127111.

Su, C. H., Tsai, C. H., Chen, M. H., & Lv, W. Q. (2019). US sustainable food market generation Z consumer segments. *Sustainability, 11*(13), 3607.

Sütterlin, B., Brunner, T. A., & Siegrist, M. (2011). Who puts the most energy into energy conservation? A segmentation of energy consumers based on energy-related behavioral characteristics. *Energy Policy, 39*(12), 8137-8152.

Sweeney, J. C., & Soutar, G. N. (2001). Consumer perceived value: the development of a multiple item scale. *Journal of Retailing, 77,* 203-220.

Syakur, M. A., Khotimah, B. K., Rochman, E. M. S., & Satoto, B. D. (2018). Integration k-means clustering method and elbow method for identification of the best customer profile cluster. *IOP Conference Series: Materials Science and Engineering, 336*(1), 012017.

Syberg, K., Hansen, S. F., Christensen, T. B. et al. (2018). Risk perception of plastic pollution: importance of stakeholder involvement and citizen science. In M. Wagner, & S. Lambert (Eds.). *Freshwater Microplastics* (pp. 203–221). Cham: Springer.

Szabo, S., & Webster, J. (2020). Perceived greenwashing: the effects of green marketing on environmental and product perceptions. *Journal of Business Ethics, 171*(4), 719-739.

Szepannek, G. (2018). clustMixType: User-Friendly Clustering of Mixed-Type Data in R. *R J., 10*(2), 200.

Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. In M. J. Hatch & M. Schultz (Eds.), *Organizational identity: A reader* (pp. 56–65). OUP Oxford.

Tangney, J. P. (1999). The self-conscious emotions: Shame, guilt, embarrassment and pride. In T. Dalgleish & M. J. Power (Eds.), *Handbook of cognition and emotion* (pp. 541–568). John Wiley & Sons Ltd.

Tanja-Dijkstra, K., Pahl, S., P. White, M., Andrade, J., Qian, C., Bruce, M., ... & Moles, D. R. (2014). Improving dental experiences by using virtual reality distraction: a simulation study. *PLoS One, 9*(3), e91276.

Tanner, C. (1999). Constraints on environmental behaviour. *Journal of Environmental Psychology, 19*(2), 145-157.

Taufik, D., Reinders, M. J., Molenveld, K., & Onwezen, M. C. (2020). The paradox between the environmental appeal of bio-based plastic packaging for consumers and their disposal behaviour. *Science of the Total Environment, 705*, 135820.

Thøgersen, J. (1999). The ethical consumer. Moral norms and packaging choice. *Journal of Consumer Policy, 22*(4), 439-460.

Thøgersen, J. (2005). How may consumer policy empower consumers for sustainable lifestyles?. *Journal of Consumer Policy, 28*(2), 143-177.

Thøgersen, J., Haugaard, P., & Olesen, A. (2010). Consumer responses to ecolabels. *European Journal of Marketing, 44*(11/12), 1787-1810.

Thomas, C. & Sharp, V. (2013). Understanding the normalisation of recycling behaviour and its implications for other pro-environmental behaviours: a review of social norms and recycling. *Resources, Conservation and Recycling, 79*, 11–20.

Thompson, R.C. (2019). *Has Blue Planet II had an impact on plastic pollution?* Science Focus (12 April). https://www.sciencefocus.com/nature/has-blue-planet-ii-had-an-impact-on-plastic-pollution/().

Thompson, R. C., Olsen, Y., Mitchell, R. P., Davis, A., Rowland, S. J., John, A. W., ... & Russell, A. E. (2004). Lost at sea: where is all the plastic?. *Science, 304*(5672), 838-838.

Tonge, J., Ryan, M. M., Moore, S. A., & Beckley, L. E. (2015). The effect of place attachment on pro-environment behavioral intentions of visitors to coastal natural area tourist destinations. *Journal of Travel Research, 54*(6), 730-743.

Trivium Packaging (2020). *Executive Summary – 2020 Global Buying Green Report: Momentum build for sustainable packaging.* https://www.triviumpackaging.com/media/01bfokre/2020buyinggreenreport.pdf

Tudor, D. T., & Williams, A. T. (2006). A rationale for beach selection by the public on the coast of Wales, UK. *Area, 38*(2), 153-164.

Underwood, R. L. (2003). The communicative power of product packaging: creating brand identity via lived and mediated experience. *Journal of Marketing Theory and Practice, 11*(1), 62-76.

Unger, B., Rebolledo, E. L. B., Deaville, R., Gröne, A., IJsseldijk, L. L., Leopold, M. F., ... & Herr, H. (2016). Large amounts of marine debris found in sperm whales stranded along the North Sea coast in early 2016. *Marine Pollution Bulletin, 112*(1-2), 134-141.

United Nations Environment Programme. (2022, March 2). *Historic day in the campaign to beat plastic pollution: Nations commit to develop a legally binding agreement.* https://www.unep.org/news-and-stories/press-release/historic-day-campaign-beat-plastic-pollution-nations-commit-develop

Unsworth, S., Palicki, S. K., & Lustig, J. (2016). The impact of mindful meditation in nature on self-nature interconnectedness. *Mindfulness, 7,* 1052-1060.

Van Birgelen, M., Semeijn, J., & Keicher, M. (2009). Packaging and proenvironmental consumption behavior: Investigating purchase and disposal decisions for beverages. *Environment and Behavior, 41*(1), 125-146.

Van den Oever, M., Molenveld, K., van der Zee, M., & Bos, H. (2017). *Bio-based and biodegradable plastics: facts and figures: focus on food packaging in the Netherlands (No. 1722).* Wageningen Food & Biobased Research.

Van der Werff, E., Steg, L., & Keizer, K. (2013). The value of environmental self-identity: The relationship between biospheric values, environmental self-identity and environmental preferences, intentions and behaviour. *Journal of Environmental Psychology, 34*, 55-63.

Van Franeker, J. A., Blaize, C., Danielsen, J., Fairclough, K., Gollan, J., Guse, N., ... & Turner, D. M. (2011). Monitoring plastic ingestion by the northern fulmar Fulmarus glacialis in the North Sea. *Environmental Pollution, 159*(10), 2609-2615.

Van Herpen, E., Immink, V., & van den Puttelaar, J. (2016). Organics unpacked: The influence of packaging on the choice for organic fruits and vegetables. *Food Quality and Preference, 53*, 90-96.

Van Rensburg, M. L., S'phumelele, L. N., & Dube, T. (2020). The 'plastic waste era'; social perceptions towards single-use plastic consumption and impacts on the marine environment in Durban, South Africa. *Applied Geography, 114*, 102132.

Venter, K., Van der Merwe, D., De Beer, H., Kempen, E., & Bosman, M. (2011). Consumers' perceptions of food packaging: an exploratory investigation in Potchefstroom, South Africa. *International Journal of Consumer Studies, 35*(3), 273-281.

Verghese, K., Lewis, H., Lockrey, S., & Williams, H. (2015). Packaging's role in minimizing food loss and waste across the supply chain. *Packaging Technology and Science, 28*(7), 603-620.

Verplanken, B. (2018). Promoting sustainability: Towards a segmentation model of individual and household behaviour and behaviour change. *Sustainable Development, 26*(3), 193-205.

Vicente-Molina, M. A., Fernández-Sáinz, A., & Izagirre-Olaizola, J. (2013). Environmental knowledge and other variables affecting pro-environmental behaviour: comparison of university students from emerging and advanced countries. *Journal of Cleaner Production, 61*, 130-138.

Violante, M. G., & Vezzetti, E. (2017). Kano qualitative vs quantitative approaches: An assessment framework for products attributes analysis. *Computers in Industry, 86*, 15-25.

Von Falkenstein, E., Wellenreuther, F., & Detzel, A. (2010). LCA studies comparing beverage cartons and alternative packaging: can overall conclusions be drawn?. *The International Journal of Life Cycle Assessment, 15*(9), 938-945.

Wang, C. K., & Lamb, C. W. (1983). The impact of selected environmental forces upon consumers' willingness to buy foreign products. *Journal of the Academy of Marketing Science, 11*(1-2), 71-84.

Wang, X., Geng, L., Zhou, K., Ye, L., Ma, Y., & Zhang, S. (2016). Mindful learning can promote connectedness to nature: Implicit and explicit evidence. *Consciousness and Cognition, 44*, 1-7.

Webber, D. N., & Parker, S. J. (2012). Estimating unaccounted fishing mortality in the Ross sea region and Amundsen sea (CCAMLR subareas 88.1 and 88.2) bottom longline fisheries targeting Antarctic toothfish. *CCAMLR Science, 19*, 17-30.

Weinstein, N., Przybylski, A. K., & Ryan, R. M. (2009). Can nature make us more caring? Effects of immersion in nature on intrinsic aspirations and generosity. *Personality and Social Psychology Bulletin, 35*(10), 1315-1329.

Wensing, J., Caputo, V., Carraresi, L., & Bröring, S. (2020). The effects of green nudges on consumer valuation of bio-based plastic packaging. *Ecological Economics, 178*, 106783.

Werner, S., Budziak, A., Van Franeker, J.A., Galgani, F., Hanke, G., Maes, T., Matiddi, M.,Nilsson, P., Oosterbaan, L., Priestland, E., Thompson, R., Veiga Joana, M., & Vlachogianni, T. (2016). *Harm caused by Marine Litter - European Commission, JRC Technical Report*.

Wester, M., & Eklund, B. (2011). "My husband usually makes those decisions": Gender, behavior, and attitudes toward the marine environment. *Environmental Management, 48*, 70-80.

Wheeler, B. W., White, M., Stahl-Timmins, W., & Depledge, M. H. (2012). Does living by the coast improve health and wellbeing?. *Health & Place, 18*(5), 1198-1201.

Whitburn, J., Linklater, W. L., & Milfont, T. L. (2019). Exposure to urban nature and tree planting are related to pro-environmental behavior via connection to nature, the use of nature for psychological restoration, and environmental attitudes. *Environment and Behavior, 51*(7), 787-810.

White, M. P., Alcock, I., Wheeler, B. W., & Depledge, M. H. (2013b). Would you be happier living in a greener urban area? A fixed-effects analysis of panel data. *Psychological Science, 24*(6), 920-928.

White, M. P., Alcock, I., Wheeler, B. W., & Depledge, M. H. (2013b). Coastal proximity, health and well-being: Results from a longitudinal panel survey. *Health & Place, 23*, 97-103.

White, M. P., Elliott, L. R., Gascon, M., Roberts, B., & Fleming, L. E. (2020). Blue space, health and well-being: A narrative overview and synthesis of potential benefits. *Environmental Research, 191*, 110169.

White, M. P., Pahl, S., Wheeler, B. W., Fleming, L. E. F., & Depledge, M. H. (2016). The 'Blue Gym': What can blue space do for you and what can you do for blue space?. *Journal of the Marine Biological Association of the United Kingdom, 96*(1), 5-12.

White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology, 30*(4), 482-493.

White, M. P., Wheeler, B. W., Herbert, S., Alcock, I., & Depledge, M. H. (2014). Coastal proximity and physical activity: Is the coast an under-appreciated public health resource?. *Preventive Medicine, 69*, 135-140.

Williams, H., Wikström, F., & Löfgren, M. (2008). A life cycle perspective on environmental effects of customer focused packaging development. *Journal of Cleaner Production, 16*(7), 853-859.

Wilson, E. O. (1984). *Biophilia.* Cambridge: Harvard University Press.

Wilson, E. O. (1993). Biophilia and the conservation ethic. In S. R. Kellert, & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 31–41). Washington, DC: Island Press.

Woodall, L. C., Sanchez-Vidal, A., Canals, M., Paterson, G. L., Coppock, R., Sleight, V., ... & Thompson, R. C. (2014). The deep sea is a major sink for microplastic debris. *Royal Society Open Science, 1*(4), 140317.

Wood Mackenzie (2021, November 18). *The plastics industry must go under the knife for a more sustainable future: Tough action required to future-proof industry and safeguard further capital investment.* https://www.woodmac.com/press-releases/the-plastics-industry-must-go-under-the-knife-for-a-more-sustainable-future/#content

WRAP. (2017). *Recycling Tracking Survey 2017: Behaviours, attitudes and awareness around recycling.* https://wrap.org.uk/sites/default/files/2020-10/WRAP-Recycling-Tracker-Report-2017.pdf

WRAP. (2018). *Recycling Tracking Survey 2018: Behaviours, attitudes and awareness around recycling.* https://wrap.org.uk/sites/default/files/2020-10/WRAP-Recycling%20Tracker%20Report%202018%20-%20Final%20for%20publication_0.pdf

WRAP. (2021). *The UK Plastics Pact: Annual Report 2020/21*. https://wrap.org.uk/sites/default/files/2021-11/The%20UK%20Plastics%20Pact%20Annual%20Report%202020-21.pdf

Wyles, K. J., Pahl, S., Holland, M., & Thompson, R. C. (2017). Can beach cleans do more than clean-up litter? Comparing beach cleans to other coastal activities. *Environment and Behavior, 49*(5), 509-535.

Wyles, K. J., Pahl, S., Thomas, K., & Thompson, R. C. (2016). Factors that can undermine the psychological benefits of coastal environments: exploring the effect of tidal state, presence, and type of litter. *Environment and Behavior, 48*(9), 1095-1126.

Wyles, K. J., Pahl, S., & Thompson, R. C. (2014). Perceived risks and benefits of recreational visits to the marine environment: Integrating impacts on the environment and impacts on the visitor. *Ocean & Coastal Management, 88*, 53-63.

Wyles, K. J., Pahl, S., White, M., Morris, S., Cracknell, D., & Thompson, R. C. (2013). Towards a marine mindset: Visiting an aquarium can improve attitudes and intentions regarding marine sustainability. *Visitor Studies, 16*(1), 95-110.

Yadav, R. (2016). Altruistic or egoistic: Which value promotes organic food consumption among young consumers? A study in the context of a developing nation. *Journal of Retailing and Consumer services*, *33*, 92-97.

Yankelovich, D., & Meer, D. (2006). Rediscovering market segmentation. *Harvard Business Review*, *84*(2), 122.

Yeo, N. L., White, M. P., Alcock, I., Garside, R., Dean, S. G., Smalley, A., & Gatersleben, B. (2020). What is the best way of delivering virtual nature for improving mood?: An experimental comparison of high definition TV, 360º video, and computer generated virtual reality. *Journal of Environmental Psychology*, *72*, 101500.

Yilmazsoy, B., Schmidbauer, H., & Rösch, A. (2015). Green segmentation: a cross-national study. *Marketing Intelligence & Planning*, *33*(7), 981-1003.

Zelenski, J. M., Dopko, R. L., & Capaldi, C. A. (2015). Cooperation is in our nature: Nature exposure may promote cooperative and environmentally sustainable behavior. *Journal of Environmental Psychology, 42*, 24-31.

Zhang, J. W., Howell, R. T., & Iyer, R. (2014). Engagement with natural beauty moderates the positive relation between connectedness with nature and psychological well-being. *Journal of Environmental Psychology, 38*, 55-63.

Zou, G. Y. (2007). Toward using confidence intervals to compare correlations. *Psychological Methods, 12*(4), 399.

Zwicker, M. V., Nohlen, H. U., Dalege, J., Gruter, G. J. M., & van Harreveld, F. (2020). Applying an attitude network approach to consumer behaviour towards plastic. *Journal of Environmental Psychology, 69*, 101433.

Appendices

A. Chapter 2: Materials and Method

Alternative Moderator Variables

Study 1 (n = 60, University Students)

Alternative moderator variables measured in the survey but not reported in the main text of the thesis were marine litter concern (12 items), emotional response to marine environments and their degradation (4 items), social consumption norms (3 items), trust in the waste management system (3 items) and general waste concern (3 items). While the other moderators were explorative in nature, a moderating effect for marine litter concern was hypothesised. Therefore, a brief overview of these results for marine litter concern are presented here, whereas results on the exploratory moderators are beyond the scope of the thesis.

Study 2 (n = 512, UK Consumers)

Alternative moderator variables measured in the survey were marine litter concern (12 items), emotional response to marine environments and their degradation (4 items), social consumption norms (2 items), trust in the local waste management system (4 items), perceived consumer effectiveness (specific to marine litter; 2 items), and collective efficacy beliefs (specific to marine litter; 2 items). While the other potential moderators were explorative in nature, a moderating effect for marine litter concern was hypothesised. Therefore, a brief overview of these results for marine litter concern are presented here, whereas results on the exploratory moderators are beyond the scope of the thesis.

Marine Litter Concern

Twelve items were used to measure awareness of and concern over marine litter on a 7-point Likert-scale with a range from "strongly disagree" (1) to "strongly agree" (7). Nine of these items were adapted from the MARLISCO Perceptions about Marine Litter survey (Hartley et al., 2018). These items assessed problem awareness (e.g. "The quantity of litter on the coast and in the sea is increasing") and concern (e.g. "I am very concerned about the impacts of marine litter") as well as scepticism (e.g. "Marine litter is a problem elsewhere but not in my country"). An additional three items were developed from the environmental concern items used in Melis et al. (2014; e.g. "We should tackle the marine litter problem even if this means slower economic growth."). The 12-item scale showed high reliability in the student sample (Study 1; McDonald's omega ω = .86) as well as in the larger consumer sample (Study 2; ω = .91). Means for these samples were M = 5.94 (SD = 0.64, range from 4.58 to 7.00) and M = 5.50 (SD = 1.16, range from 2.75 to 7.00), respectively.

In Study 1 there was a strong positive correlation between ocean connectedness and marine litter concern ($r(58) = .56$, $p < .01$). In Study 2 the two were found to be moderately positively correlated ($r(510) = .37$, $p < .01$).

Psychometrics for the Ocean Connectedness Scale

Study 1 (n = 60, University Students)

Reliability of the six-item ocean connectedness scale was ω = .81. Mean ocean connectedness (as measured with the six-item scale) was M = 4.86 (SD = 0.98, range from 2.67 to 6.83).

Exploratory factor analysis was conducted in the R environment ('psych' package) on the six-item scale. Parallel analysis and the associated scree plot suggested

a one-factor solution. Results from a maximum likelihood factor analysis are displayed in Table S1. It should be noted that the sample size (n = 60) is smaller than what is generally recommended for exploratory factor analysis (Costello & Osborne, 2005), which may partly explain the poor fit indices observed in Table S1. Therefore, these results may have limited replicability.

Table S1

Maximum Likelihood Factor Analysis on the 6-item Ocean Connectedness Scale (n = 60).

	Pattern matrix loadings based on correlation matrix						Variance explained	Model fit indices		
	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	%	CFI	TLI	RMSEA
Factor 1	0.78	0.69	0.86	0.45	0.32	0.54	40	0.93	0.76	0.161

Note: Item 1 = "I feel very close to the marine environment."; Item 2 = "I have a clear understanding of how my actions affect the ocean."; Item 3 = "I often feel a sense of oneness with the ocean around me."; Item 4 = "I usually feel disconnected from the ocean." (reverse coded); Item 5 = "My personal welfare is independent of the welfare of the ocean." (reverse coded); Item 6 = "I recognise and appreciate the intelligence of living marine organisms.". CFI = comparative fit index; TLI = Tucker Lewis Index of factoring reliability; RMSEA = root mean square error of approximation.

Study 2 (n = 512, UK Consumers)

In this sample the full six-item ocean connectedness scale showed somewhat poor reliability (ω = .71). Dropping item 5 ("My personal welfare is independent of the welfare of the ocean.") improved reliability to ω = .80, and therefore this item was omitted from the final analyses. Mean ocean connectedness in the sample (as measured with the five-item scale) was M = 5.07 (SD = 1.14, range from 1.00 to 6.00).

Exploratory factor analysis was then conducted on the five-item ocean connectedness scale. Parallel analysis and the associated scree plot suggested a two-factor solution. Results from a maximum likelihood factor analysis with oblimin rotation are displayed in Table 2. As can be seen from the factor loadings, items 1-3 load onto Factor 1 ("Reciprocal closeness"), whereas only item 6 loads onto Factor 2 ("Appreciation"). Item 4 (reverse coded) does not load clearly onto either factor;

however this item was retained in the scale and analyses because including it did not compromise reliability. Furthermore, retaining this item makes the obtained results more comparable with results from Study 1.

Table S2

Maximum Likelihood Factor Analysis on the 5-item Ocean Connectedness Scale (n = 512).

	Pattern matrix loadings based on correlation matrix					Variance explained	Model fit indices		
	Item 1	Item 2	Item 3	Item 4	Item 6	%	CFI	TLI	RMSEA
Factor 1	0.87	0.69	0.85	0.25	0	41	1	0.97	0.076
Factor 2	-0.01	0.11	-0.05	0.19	1.00	65			

Note: Item 1 = "I feel very close to the marine environment."; Item 2 = "I have a clear understanding of how my actions affect the ocean."; Item 3 = "I often feel a sense of oneness with the ocean around me."; Item 4 = "I usually feel disconnected from the ocean." (reverse coded); Item 6 = "I recognise and appreciate the intelligence of living marine organisms.". Factor 1 = "Reciprocal closeness"; Factor 2 = "Appreciation". CFI = comparative fit index; TLI = Tucker Lewis Index of factoring reliability; RMSEA = root mean square error of approximation. Variance explained refers to cumulative proportion or variance.

Preface to Packaging Rating Task

The following text was displayed to participants in both studies before the packaging rating task:

"We currently live in a throw-away society in which we produce and consume a lot of disposable goods and packaging. This leads to increasing quantities of waste.

For the next part of the study, imagine that you are somewhere else and that you are thirsty. There is no water fountain or tap with drinking water available, and you want to buy a drink. You are limited to three choices: bottled water, orange juice and cola.

You will be shown pictures of different disposable drink containers shortly. The containers will vary in terms of packaging material, recyclability and content. Note that the type and recyclability of packaging as well as the local recycling system may vary

from what you are used to. You will be asked to rate each container shown in terms of how likely it would be that you would buy the product. You will also be asked additional questions about each product.

Product price is not taken into account, so assume that all containers are priced the same.

The next part will start now. Please note that you will not have the opportunity to go back and change your answers once you have proceeded to the next page. There are no right or wrong answers."

Statistical Models Specification

In order to analyse the impact of packaging recyclability on WTB ($H1_A$), the following model was used:

$$WTB_{j,k,l} = \beta_0 + Participant_0 + \beta_j\, Recyclability_{,j} + \beta_k\, Material_{,k} + \beta_l\, Drink_{,l} + e_{j,k,l}$$

Here, *WTB* is Willingness to Buy, β_0 represents the intercept, and *e* represents the residual error. $Participant_0$ refers to the random intercept, meaning the deviation of participant from the intercept β_0. Letters *j, k* and *l* represent the different product attributes with fixed effects β_j, β_k and β_l. In addition to recyclability, material and type of drink were included in the model as fixed variables in order to control for their effects on WTB. Significance of the effect of recyclability was inferred from the resulting analysis of variance table.

Equations for modelling the effect of recyclability on PAR, attractiveness and anticipated guilt ($H1_{B-D}$) were identical to the one presented above, with the outcome variable changed accordingly.

Statistical Models Including Ocean Connectedness

In order to assess the moderating effect of ocean connectedness on the relationship between recyclability and the outcome variable (WTB, PAR, attractiveness and anticipated guilt; $H2_{A-D}$), as well as on the relationship between packaging material and the outcome variables ($H3_{A-D}$), ocean connectedness was added onto the original models (see above) as a fixed effect. For example, the moderating effect of ocean connectedness on WTB ($H2_A$ and $H3_A$) was specified in the model as:

$$WTB_{j,k,l,m} = \beta_0 + Participant_0 + \beta_j\, Recyclability_j + \beta_k\, Material_k + \beta_l\, Drink_l + \beta_j\, Recyclability_j * \beta_m\, OceanConnectedness_m + \beta_k\, Material_k * \beta_m\, OceanConnectedness_m + e_{j,k,l,m}$$

Here, *WTB* is Willingness to Buy, β_0 represents the intercept, and *e* represents the residual error. $Participant_0$ refers to the random intercept, meaning the deviation of participant from the intercept β_0. Letters *j*, *k* and *l* represent the different product attributes with fixed effects β_j, β_k and β_l. Letter *m* represents ocean connectedness, with a fixed effect β_m. Interactions are specified between recyclability and ocean connectedness, as well as between material and ocean connectedness, which enables testing of the hypothesised moderating effect(s). Significance of the interaction effects were inferred from the resulting analysis of variance table.

The equations for modelling the moderating effects of ocean connectedness on PAR, attractiveness and anticipated guilt ($H2_{B-D}$ and $H3_{B-D}$) were identical to the one presented above, with the outcome variable changed accordingly.

Statistical Models Including Marine Litter Concern

Marine litter concern was an alternative moderator variable included in our research, with a hypothesised moderating effect on consumer responses (WTB, PAR, attractiveness and anticipated guilt) to packaging recyclability and material type. These hypotheses followed the same formulation as our hypotheses for ocean connectedness ($H1_{A-D}$, $H2_{A-D}$ and $H3_{A-D}$, see main text). Similarly, the statistical models followed the same specifications as models for ocean connectedness (see above), with marine litter concern added into the model as a fixed effect interacting with recyclability and material.

B. Chapter 2: Additional Results

Estimated Marginal Means for Levels of Recyclability and Material at High and Low Levels of Ocean Connectedness

For those outcome variables where significant two-way interactions were found between ocean connectedness and recyclability and/or material, estimated marginal means at high and low levels of ocean connectedness (± 1 SD from the sample mean) across levels of recyclability and/or material are shown next.

Study 1 (University Students)

Table S3

Estimated Marginal Means for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt at High and Low Levels of Ocean Connectedness across Levels of Recyclability.

Recyclability	Level of ocean connectedness	Estimated mean WTB	Lower CL	Upper CL
Recyclable	High	4.39	4.06	4.71
	Low	3.90	3.57	4.23
Non-recyclable	High	2.17	1.84	2.50
	Low	3.01	2.68	3.34

Recyclability	Level of ocean connectedness	Estimated mean PAR	Lower CL	Upper CL
Recyclable	High	3.72	3.35	4.08
	Low	3.29	2.92	3.65
Non-recyclable	High	2.16	1.79	2.52
	Low	2.55	2.19	2.92

Recyclability	Level of ocean connectedness	Estimated mean attractiveness	Lower CL	Upper CL
Recyclable	High	4.45	4.11	4.80
	Low	3.95	3.61	4.29
Non-recyclable	High	2.51	2.17	2.85
	Low	2.94	2.60	3.28

Recyclability	Level of ocean connectedness	Estimated mean anticipated guilt	Lower CL	Upper CL
Recyclable	High	1.81	1.42	2.19
	Low	1.90	1.51	2.29
Non-recyclable	High	4.13	3.74	4.52
	Low	3.09	2.70	3.48

Note: Low ocean connectedness = 3.88; High ocean connectedness = 5.84. 95% confidence level is used here.

Table S4

Estimated Marginal Means for Willingness to Buy and Attractiveness at High and Low Levels of Ocean Connectedness across Levels of Material.

Material	Level of ocean connectedness	Estimated mean WTB	Lower CL	Upper CL
Plastic	High	3.54	3.17	3.92
	Low	3.97	3.59	4.34
Glass	High	3.43	3.06	3.80
	Low	3.98	3.61	4.36
Aluminium	High	3.10	2.73	3.47
	Low	3.21	2.83	3.58
Carton	High	3.05	2.67	3.42
	Low	2.66	2.29	3.03

Material	Level of ocean connectedness	Estimated mean attractiveness	Lower CL	Upper CL
Plastic	High	3.59	3.21	3.97
	Low	3.80	3.42	4.18
Glass	High	3.95	3.57	4.33
	Low	4.09	3.71	4.47
Aluminium	High	3.29	2.91	3.67
	Low	3.23	2.85	3.61
Carton	High	3.09	2.72	3.47
	Low	2.64	2.26	3.02

Note: Low ocean connectedness = 3.88; High ocean connectedness = 5.84. 95% confidence level is used here.

Study 2 (UK Consumers)

Table S5

Estimated Marginal Means for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt at High and Low Levels of Ocean Connectedness across Levels of Recyclability.

Recyclability	Level of ocean connectedness	Estimated mean WTB	Lower CL	Upper CL
Recyclable	High	4.85	4.67	5.02
	Low	4.22	4.03	4.41
Non-recyclable	High	3.45	3.27	3.62
	Low	3.62	3.43	3.81

Recyclability	Level of ocean connectedness	Estimated mean PAR	Lower CL	Upper CL
Recyclable	High	4.30	4.13	4.46
	Low	3.61	3.43	3.79
Non-recyclable	High	3.09	2.93	3.26
	Low	3.18	3.00	3.36

Recyclability	Level of ocean connectedness	Estimated mean attractiveness	Lower CL	Upper CL
Recyclable	High	4.69	4.53	4.85
	Low	4.21	4.03	4.39
Non-recyclable	High	3.71	3.55	3.87
	Low	3.79	3.61	3.96

Recyclability	Level of ocean connectedness	Estimated mean anticipated guilt	Lower CL	Upper CL
Recyclable	High	3.25	3.07	3.42
	Low	3.05	2.86	3.24
Non-recyclable	High	4.69	4.51	4.86
	Low	3.91	3.72	4.10

Note: Low ocean connectedness = 3.93; High ocean connectedness = 6.21. 95% confidence level is used here.

Table S6

Estimated Marginal Means for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt at High and Low Levels of Ocean Connectedness across Levels of Material.

Material	Level of ocean connectedness	Estimated mean WTB	Lower CL	Upper CL
Plastic	High	3.98	3.80	4.16
	Low	4.07	3.87	4.27
Glass	High	4.44	4.25	4.62
	Low	4.04	3.84	4.23
Aluminium	High	4.11	3.93	4.29
	Low	3.84	3.65	4.04
Carton	High	4.06	3.88	4.24
	Low	3.72	3.52	3.92

Material	Level of ocean connectedness	Estimated mean PAR	Lower CL	Upper CL
Plastic	High	3.52	3.35	3.70
	Low	3.41	3.22	3.59
Glass	High	3.98	3.80	4.15
	Low	3.52	3.33	3.70
Aluminium	High	3.69	3.51	3.86
	Low	3.36	3.18	3.55
Carton	High	3.59	3.42	3.77
	Low	3.29	3.11	3.48

Material	Level of ocean connectedness	Estimated mean attractiveness	Lower CL	Upper CL
Plastic	High	4.12	3.95	4.29
	Low	4.12	3.94	4.30
Glass	High	4.60	4.43	4.76
	Low	4.27	4.08	4.45
Aluminium	High	4.17	4.00	4.34
	Low	3.93	3.75	4.11
Carton	High	3.91	3.74	4.08
	Low	3.68	3.49	3.86

Material	Level of ocean connectedness	Estimated mean anticipated guilt	Lower CL	Upper CL
Plastic	High	4.33	4.14	4.51
	Low	3.64	3.45	3.84
Glass	High	3.68	3.50	3.86
	Low	3.35	3.15	3.55
Aluminium	High	3.90	3.72	4.08
	Low	3.48	3.28	3.68
Carton	High	3.96	3.78	4.15
	Low	3.45	3.26	3.65

Note: Low ocean connectedness = 3.93; High ocean connectedness = 6.21. 95% confidence level is used here.

Moderating Effect of Marine Litter Concern: Summary of Results

Study 1 (University Students)

Moderating Effect of Marine Litter Concern: Recyclability and Consumer Response (Hypotheses $H2_{A-D}$).

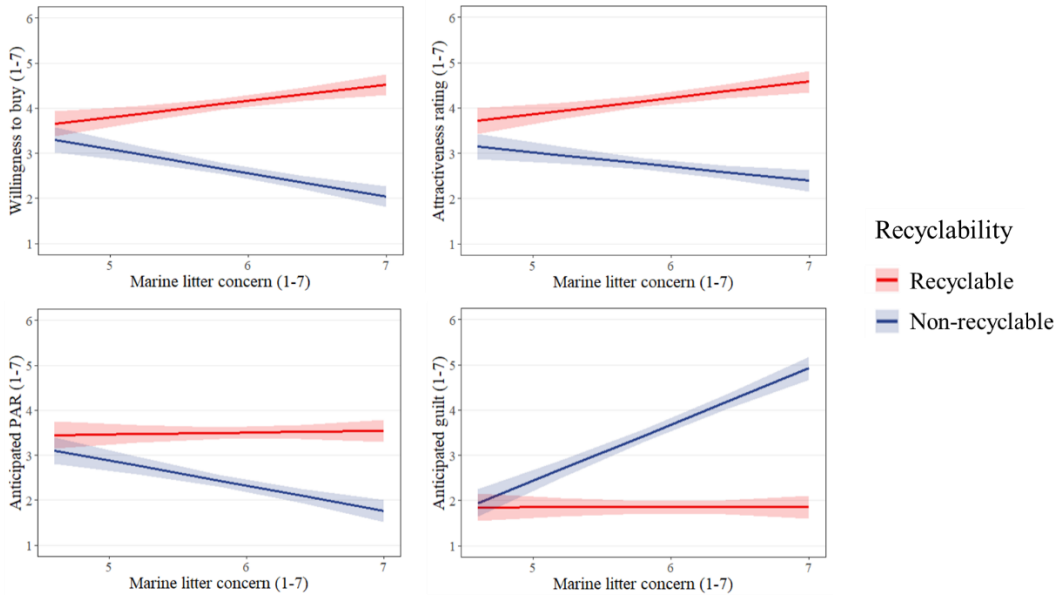
Adding marine litter concern into the original WTB, PAR, attractiveness and anticipated guilt models as a fixed effect improved model fit significantly (WTB: $\chi^2(5) = 46.91$, $p < .001$; PAR: $\chi^2(5) = 55.41$, $p < .001$; attractiveness: $\chi^2(5) = 33.09$, $p < .001$; anticipated

guilt: $\chi^2(5) = 116.64$, $p < .001$). The ANOVA results showed a significant two-way interaction between recyclability and marine litter concern on WTB ($F(1,1380) = 41.08$, $p < .001$, β = .45, 95% CI [0.31, 0.58]). A significant interaction effect was also found between recyclability and marine litter concern on PAR ($F(1,1380) = 40.51$, $p < .001$, β = .30, 95% CI [0.21, 0.39]), on attractiveness ratings ($F(1,1380) = 27.05$, $p < .001$, β = .34, 95% CI [0.21, 0.47]) as well as on anticipated guilt ($F(1,1380) = 110.85$, $p < .001$, β = -.62, 95% CI [-0.73, -0.50]). These interaction effects are illustrated in Figure S1. For brevity, further details on estimated means and post-hoc comparisons between levels of recyclability and marine litter concern are not presented here and can be obtained from the main author.

As hypothesised ($H2_{A-D}$) significant two-way interaction effects were found between recyclability and marine litter concern for WTB, PAR, attractiveness and guilt ratings. Furthermore, respondents high in marine litter concern distinguished between recyclable and non-recyclable packaging more than those low in marine litter concern.

Figure S1

Two-Way Interaction Effect of Packaging Recyclability and Marine Litter Concern on Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt



Note. Standard errors are presented as ribbons.

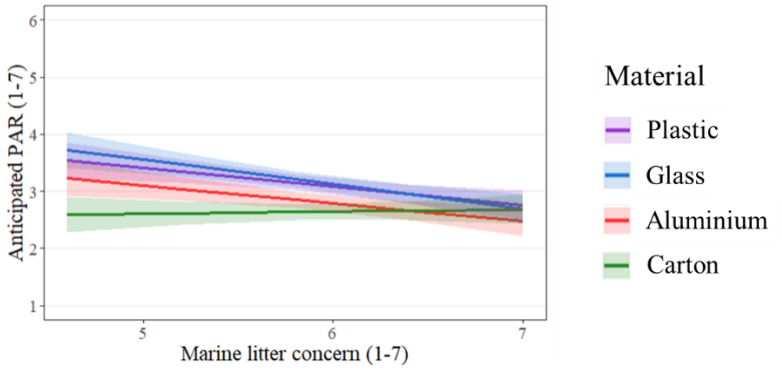
Moderating Effect of Marine Litter Concern: Material and Consumer Response (Hypotheses $H3_{A-D}$).

According to the ANOVA results there were no significant two-way interaction effects between packaging material and marine litter concern on WTB ($F(3,1380) = 2.13$, $p = 0.095$), attractiveness ($F(3,1380) = 2.14$, $p = 0.093$), or anticipated guilt ($F(3,1380) = 0.18$, $p = 0.910$) . However, a significant two-way interaction effect between packaging material and marine litter concern was found on PAR ($F(3,1380) = 4.71$, $p = 0.003$). This effect is illustrated in Figure S2. For brevity, further details on estimated means and post-hoc comparisons between levels of material and marine litter concern are not presented here and can be obtained from the main author.

These results show only very limited support for hypotheses $H3_{A-D}$ for marine litter concern: Only significant two-way interaction effects between material type and marine litter concern on PAR ratings were found. Furthermore, contrary to the hypotheses, respondents distinguished plastic less from most of the other materials at high levels of marine litter concern compared to low levels of marine litter concern. Therefore, there was limited evidence of sensitisation towards plastic packaging in those who demonstrated high concern for marine litter.

Figure S2

Two-Way Interaction Effect of Packaging Material and Marine Litter Concern on Positive Affective Response



Note. Standard errors are presented as ribbons.

Study 2 (UK Consumers)

Moderating Effect of Marine Litter Concern: Recyclability and Consumer Response (Hypotheses *H2*$_{A-D}$).

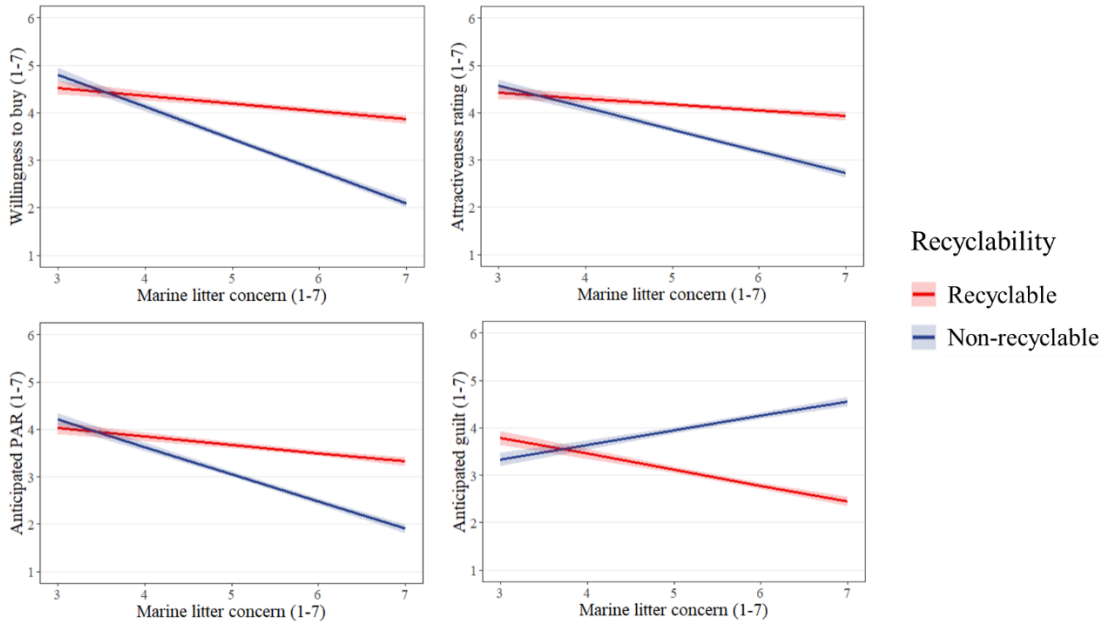
Adding marine litter concern into the original WTB, PAR, attractiveness and anticipated guilt models as a fixed effect improved model fit significantly (WTB: $\chi^2(5) = 640.19$, $p < .001$; PAR: $\chi^2(5) = 553.56$, $p < .001$; attractiveness: $\chi^2(5) = 401.28$, $p < .001$; anticipated guilt: $\chi^2(5) = 895.59$, $p < .001$). The ANOVA results showed a significant two-way interaction between recyclability and marine litter concern on WTB ($F(1,11776) = 545.14$, $p < .001$, $\beta = .26$, 95% CI [0.23, 0.28]). A significant interaction effect was also found between recyclability and marine litter concern on PAR ($F(1,11776) = 448.33$, $p < .001$, $\beta = .20$, 95% CI [0.18, 0.22]), on attractiveness ratings ($F(1,11776) = 288.64$, $p < .001$, $\beta = .17$, 95% CI [0.15, 0.19]) as well as on anticipated guilt ($F(1,11776) = 872.50$, $p < .001$, $\beta = -.32$, 95% CI [-0.34, -0.30]). These interaction

effects are illustrated in Figure S3. For brevity, further details on estimated means and post-hoc comparisons between levels of recyclability and marine litter concern are not presented here and can be obtained from the main author.

As hypothesised ($H2_{A-D}$) significant two-way interaction effects were found between recyclability and marine litter concern for WTB, PAR, attractiveness and guilt ratings. Furthermore, respondents high in marine litter concern distinguished between recyclable and non-recyclable packaging more than those low in marine litter concern.

Figure S3

Two-Way Interaction Effect of Packaging Recyclability and Marine Litter Concern on Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt



Note. Standard errors are presented as ribbons.

Moderating Effect of Marine Litter Concern: Material and Consumer Response (Hypotheses $H3_{A-D}$).

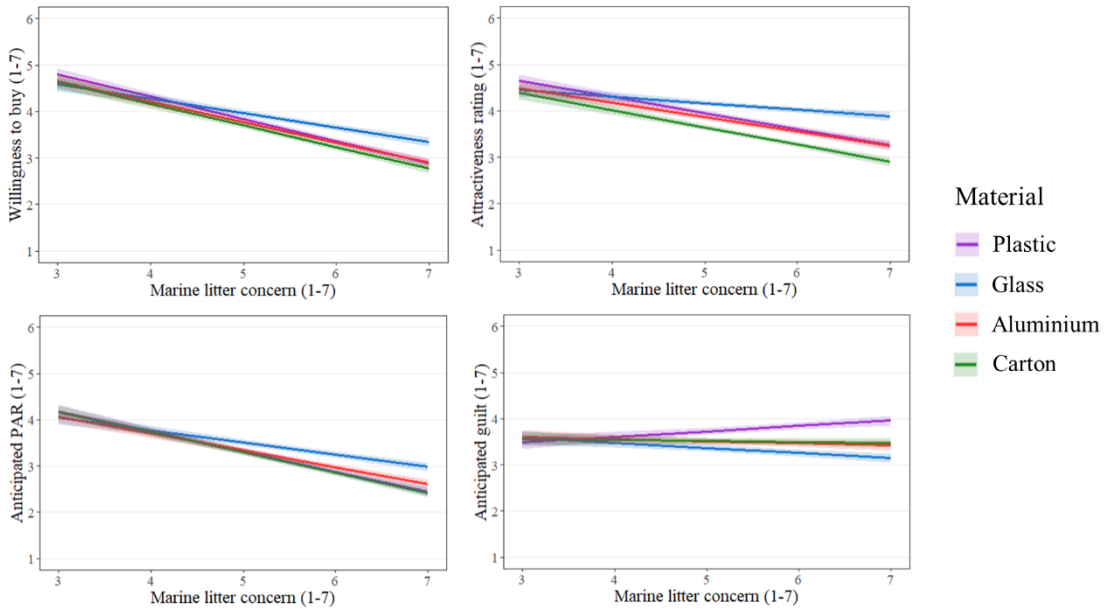
According to the ANOVA results there was a significant two-way interaction effect between packaging material and marine litter concern on WTB ($F(3,11776) = 12.63$, p

< .001). There was also a significant two-way interaction effect between packaging material and marine litter concern on PAR ($F(3,11776) = 18.31$, $p < .001$), attractiveness ($F(3,11776) = 26.42$, $p < .001$) and anticipated guilt ratings ($F(3,11776) = 19.31$, $p < .001$).

All of these effects are illustrated in Figure S4. For brevity, further details on estimated means and post-hoc comparisons between levels of material and marine litter concern are not presented here and can be obtained from the main author.

Figure S4

Two-Way Interaction Effect of Packaging Material and Marine Litter Concern on Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt



Note. Standard errors are presented as ribbons.

These results show some support for hypotheses $H3_{A-D}$ for marine litter concern: Significant interaction effects were found between packaging material and marine litter concern for all outcome variables. However, the main differences across the material types were between plastic and glass, where respondents high in marine litter concern distinguished between plastic and glass more than those low in ocean

connectedness, in their WTB, PAR, attractiveness and anticipated guilt ratings. Therefore, there was only some evidence of sensitisation towards plastic packaging in those who demonstrated high concern for marine litter.

Mean Consumer Ratings across Product Manipulations

Study 1 (University Students)

Table S7

Means and Standard Deviations for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt across Different Product Manipulations (n = 60)

Product Manipulation	WTB	PAR	Attractiveness	Anticipated Guilt
Water, recyclable, plastic	5.75 (1.49)	4.29 (1.70)	5.20 (1.70)	1.70 (1.24)
Water, recyclable, glass	4.97 (1.79)	3.95 (1.65)	5.22 (1.64)	1.78 (1.28)
Water, recyclable, aluminium	3.48 (1.96)	3.21 (1.54)	3.67 (1.95)	1.62 (1.09)
Water, recyclable, carton	3.40 (1.98)	3.24 (1.63)	3.40 (1.91)	1.68 (1.11)
Water, non-recyclable, plastic	3.93 (1.97)	2.90 (1.52)	3.85 (1.87)	3.78 (2.30)
Water, non-recyclable, glass	2.97 (1.97)	2.73 (1.38)	3.37 (1.84)	3.62 (2.17)
Water, non-recyclable, aluminium	1.93 (1.27)	2.13 (1.11)	2.17 (1.42)	3.48 (2.16)
Water, non-recyclable, carton	1.93 (1.45)	1.98 (1.16)	1.83 (1.32)	3.18 (2.22)
Orange juice, recyclable, plastic	4.08 (1.79)	3.62 (1.62)	4.02 (1.66)	2.02 (1.40)
Orange juice, recyclable, glass	4.55 (2.05)	3.81 (1.70)	4.90 (1.95)	1.53 (0.79)
Orange juice, recyclable, aluminium	3.88 (2.01)	3.45 (1.67)	4.15 (1.94)	1.80 (1.29)
Orange juice, recyclable, carton	4.95 (1.90)	3.81 (1.73)	4.68 (1.80)	1.52 (0.87)
Orange juice, non-recyclable, plastic	2.52 (1.52)	2.34 (1.19)	2.62 (1.46)	3.58 (2.20)
Orange juice, non-recyclable, glass	2.83 (1.76)	2.53 (1.31)	3.13 (1.86)	3.60 (2.12)
Orange juice, non-recyclable, aluminium	2.45 (1.52)	2.28 (1.21)	2.55 (1.62)	3.43 (2.15)
Orange juice, non-recyclable, carton	3.10 (1.95)	2.56 (1.31)	3.17 (1.77)	3.52 (2.10)
Cola, recyclable, plastic	3.75 (1.89)	3.23 (1.49)	3.88 (1.70)	2.07 (1.31)
Cola, recyclable, glass	4.18 (2.08)	3.41 (1.81)	4.38 (2.16)	2.27 (1.58)
Cola, recyclable, aluminium	4.43 (2.08)	3.45 (1.61)	4.28 (1.83)	2.18 (1.56)
Cola, recyclable, carton	2.27 (1.51)	2.55 (1.38)	2.63 (1.71)	2.07 (1.51)
Cola, non-recyclable, plastic	2.50 (1.85)	2.27 (1.29)	2.62 (1.66)	3.88 (2.23)
Cola, non-recyclable, glass	2.73 (1.82)	2.47 (1.47)	3.13 (1.89)	3.90 (2.21)
Cola, non-recyclable, aluminium	2.73 (1.86)	2.33 (1.39)	2.77 (1.71)	3.58 (2.22)
Cola, non-recyclable, carton	1.47 (1.03)	1.73 (1.05)	1.50 (1.03)	3.77 (2.21)

Note. Standard deviations are in parentheses.

Study 2 (UK Consumers)

Table S8

Means and Standard Deviations for Willingness to Buy, Positive Affective Response, Attractiveness and Anticipated Guilt across Different Product Manipulations (n = 512)

Product Manipulation	WTB	PAR	Attractiveness	Anticipated Guilt
Water, recyclable, plastic	4.46 (1.89)	3.69 (1.74)	4.35 (1.67)	3.27 (1.84)
Water, recyclable, glass	4.40 (1.96)	3.86 (1.90)	4.47 (1.82)	2.68 (1.72)
Water, recyclable, aluminium	3.97 (2.09)	3.53 (1.95)	3.95 (1.86)	2.82 (1.82)
Water, recyclable, carton	4.08 (1.97)	3.55 (1.80)	3.89 (1.77)	3.00 (1.76)
Water, non-recyclable, plastic	3.21 (2.03)	2.71 (1.79)	3.51 (1.88)	4.33 (2.15)
Water, non-recyclable, glass	3.60 (2.11)	3.16 (1.90)	4.05 (1.85)	3.70 (2.10)
Water, non-recyclable, aluminium	2.96 (2.06)	2.71 (1.83)	3.32 (1.86)	3.92 (2.16)
Water, non-recyclable, carton	2.82 (2.00)	2.53 (1.75)	2.97 (1.87)	4.11 (2.18)
Orange juice, recyclable, plastic	4.33 (1.95)	3.69 (1.80)	4.35 (1.71)	3.07 (1.81)
Orange juice, recyclable, glass	4.53 (1.90)	3.91 (1.80)	4.59 (1.70)	2.74 (1.75)
Orange juice, recyclable, aluminium	4.30 (1.97)	3.78 (1.89)	4.29 (1.81)	2.79 (1.74)
Orange juice, recyclable, carton	4.39 (1.78)	3.69 (1.69)	4.10 (1.65)	2.99 (1.66)
Orange juice, non-recyclable, plastic	3.17 (2.03)	2.75 (1.82)	3.59 (1.82)	4.34 (2.10)
Orange juice, non-recyclable, glass	3.28 (2.06)	2.89 (1.87)	3.67 (1.85)	4.09 (2.12)
Orange juice, non-recyclable, aluminium	3.10 (2.04)	2.76 (1.78)	3.29 (1.81)	4.14 (2.10)
Orange juice, non-recyclable, carton	3.58 (2.03)	3.07 (1.81)	3.64 (1.75)	3.89 (2.09)
Cola, recyclable, plastic	3.53 (2.05)	3.10 (1.78)	3.66 (1.85)	3.44 (1.92)
Cola, recyclable, glass	4.00 (2.14)	3.62 (1.95)	4.25 (1.89)	2.71 (1.73)
Cola, recyclable, aluminium	3.99 (2.06)	3.48 (1.85)	4.08 (1.79)	3.03 (1.80)
Cola, recyclable, carton	3.35 (2.10)	3.14 (1.89)	3.38 (1.96)	2.87 (1.81)
Cola, non-recyclable, plastic	2.94 (2.03)	2.64 (1.79)	3.25 (1.84)	4.26 (2.13)
Cola, non-recyclable, glass	3.06 (2.08)	2.83 (1.87)	3.54 (1.92)	3.96 (2.15)
Cola, non-recyclable, aluminium	3.01 (2.09)	2.68 (1.83)	3.34 (1.88)	4.25 (2.15)
Cola, non-recyclable, carton	2.59 (1.96)	2.47 (1.80)	2.77 (1.86)	4.21 (2.16)

Note. Standard deviations are in parentheses.

C. Chapter 3: Materials and Method

Script: Ocean VR condition (theBlu)

You are free to look around and move within the limits of the room – if you get too close to the walls you should be able to see them as grids. Make sure to avoid pressing any buttons on the remotes during this VR experience, but you can touch or prod the objects around with the remotes if you wish. As you can see you are on the edge of a coral reef. You may move around freely if you wish, but make sure that you don't go off the ledge. You may now start exploring the coral reef.

As you explore, take a good look around you. Think about what you see.

While you explore, take a closer look at the sea floor that you are standing on.

Next, look at the coral and the seagrass. Have a poke at the colourful sea anemones.

Next, look at the different fish swimming past. You'll see new ones appear every now and then.

Now, think about the sounds you are hearing.

Think about how immersed you are: You are completely surrounded by the ocean.

Script: Built environment VR condition (Google Earth VR Street View)

You are free to look around and move within the limits of the room – if you get too close to the walls you should be able to see them as grids. You will only need to use the remote that has a line pointer coming out of it, and the trigger button. As you can see you are in the centre of a big metropolitan city. Let's take a drive through the city – with the remote control and trigger, you'll be able to move to a direction, onto a new scene. Make sure that you navigate to the direction of the traffic. You may take a turn if you wish, but make sure to stay on the busy roads. You may now start exploring the city.

As you navigate your way through the city, take a moment at every scene and take good look around you. Think about what you see

While you explore, take a closer look at the road that you are on.

Next, make sure to pay attention to the buildings and shops around you.

Next, look at the vehicles and people that you pass. You'll notice how they change as you move on.

Now, think about the sounds you are hearing.

Think about how immersed you are: You are completely surrounded by the city.

Introductory preface to packaging rating task

We currently live in a throw-away society in which we produce and consume a lot of disposable goods and packaging. This leads to increasing quantities of waste.

For the next part of the study, imagine that you are somewhere else and that you are thirsty. There is no water fountain or tap with drinking water available, and you want to buy bottled water.

You will be shown pictures of different disposable water containers shortly. The containers will vary in terms of packaging material and recyclability: You will see containers made of plastic, glass, aluminium or carton; and the packaging is either recyclable or non-recyclable. Note that the type and recyclability of packaging as well as the local recycling system may vary from what you are used to. You will be asked a series of questions about each product shown, including how you feel about the product.

Product price is not taken into account, so assume that all containers are priced the same.

The next part will start now. Please note that you will not have the opportunity to go back and change your answers once you have proceeded to the next page. There are no right or wrong answers.

Script: Built environment VR condition in Study 5 (Cologne Cathedral by Realities on Steam)

As you can see you're in a cathedral. You are free to look around and move within the limits of this room – if you get too close to the walls they will appear in the VR. In order to jump to a direction keep your thumb on the large round button on the remote, point towards the floor in front of you and click. You can also interact with the environment, and you might even find a way to access other parts of the cathedral. You can now start exploring.

As you explore, take good look around you. Think about what you see.

While you explore, take a closer look at the floor of the cathedral.

Next, look at the walls and the ceiling of the cathedral. Notice the different shapes.

Next, pay attention to the objects around you.

Now, think about the sounds you are hearing.

Think about how immersed you are in this environment.

References for Appendices

Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research, and Evaluation,* 10(1), 7.

Hartley, B. L., Pahl, S., Veiga, J., Vlachogianni, T., Vasconcelos, L., Maes, T., ... & Thompson, R. C. (2018). Exploring public views on marine litter in Europe: Perceived causes, consequences and pathways to change. *Marine Pollution Bulletin, 133,* 945-955.

Melis, G., Elliot, M., & Shryane, N. (2014). Environmental concern over time: Evidence from the longitudinal analysis of a British cohort study from 1991 to 2008. *Social Science Quarterly, 95*(4), 905-919.