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Using motivations to explain pro-environmental behaviours: Leveraging psychometric approaches

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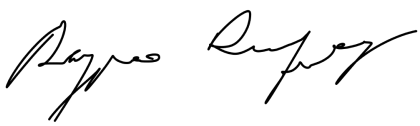
Signature: 

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Abstract

This dissertation focused on studying pro-environmental behaviours and examining the influence of motivations on such behaviours. We sought to use different psychometric approaches towards this aim, with the hope of commenting on the advantages and disadvantages of each approach and the information gained within this research context. The dissertation consists of four research projects whereby different methodological approaches were used to examine how motivations might explain variations in pro-environmental behaviours (PEBs).

In the introduction chapter, we outlined a framework for understanding PEBs. We first introduced the concept of motivations – any construct used to capture the 'why' behind behaviours – and then reviewed the background literature surrounding the influence of motivations on PEB. We then reviewed other known constructs related to the discussion of motivations and the prediction of PEBs, such as values, attitudes, goals and intentions. We conclude the introduction by justifying the adoption of a framework whereby PEBs are conceptualised as intentional goal-directed behaviours.

In a methodology chapter we provide an overview and relevant background into the methods used within the dissertation. We review the literature surrounding the use of computerised tasks and the concerns around self-report measures, statistical modelling approaches, and the development of measurement scales within psychological research. Each method is discussed in terms of its advantages and disadvantages in how it will allow us to draw conclusions about the power of motivations to help explain variations in PEBs.

In Chapter 4, the research project used an experimental approach where a computerised task was designed to capture recycling behaviour. Recycling behaviour is inherently limited in the feedback or reinforcement, and/or punishment one receives, and it is difficult to reinforce since it is not a simple behaviour but rather one that occurs in response to various cues. Using this task, we examined differences in recycling behaviour across familiar and unfamiliar contexts, considering the given goal to recycle correctly, and investigated if the use of feedback would help support behaviour maintenance towards the goal. Across three studies (N = 530), the results suggested that recycling behaviour patterns in unfamiliar contexts may be more influenced by the changes in sorting rules rather than

motivations. We discussed the conflicting results and possible challenges of weighing infrastructure demands against considerations of individuals' interaction with the sorting.

In the Chapter 5 research project, we used a time-series analysis to model longitudinal data. Using a daily diary method, we measured behaviour occurrences and goal importance daily for 3-weeks. While the literature suggests that behaviour performances may impact future mental states (i.e., goals), to our knowledge, this has not been directly tested in an applied setting, nor using multi-level data. We sought to examine a possible dynamic effect between daily goal importance ratings and daily recycling and sustainable consumption behaviours. The results (N = 144) indicated that goal ratings are only predictive of same-day behaviours. Goals and behaviours do not appear to have a dynamic relationship. The results are discussed in line with goal-systems theory with the suggest of the need for future research to replicate the results.

In Chapter 6, the study focused on examining pre-volitions and using a Structural Equation Modelling analysis to examine variations in recycling and sustainable consumption behaviour. We measured pre-volition constructs (i.e., attitudes, norms, perceived behaviour control, and behaviour desire, etc.) and perceived barriers (i.e., wealth, busyness), including a distinction between doing and not doing goals at baseline. Then, recycling and sustainable consumption behaviours were measured over a three-week period using a daily diary method. The results (N =144) suggested that the two behaviours have very different profiles despite both being considered pro-environmental behaviours. We discussed how the findings suggest that recycling may be conceptualised as an incidental behaviour and sustainable consumption may be conceptualised as deliberate, highlighting the importance of considering sustainable behaviours as overlapping yet distinct.

Lastly, in the Chapter 7 research project, the current project aimed to develop a measure of contact with nature that would capture the individual's experience and improve upon measures of exposure in explaining variations in pro-environmental behaviours. What is currently missing from the literature is support from participant data about interactions with nature that can be reliably classified according to the four typologies – intentional, incidental, direct and indirect. To this end, across three studies (N = 482), we developed a preliminary Experience with Nature scale by identifying intentional interactions with nature supported by participant data. In a fourth study (N = 301), this project then demonstrated that by capturing the individual's experience, we were able to explain more variations in PEBs compared to exposure to nature alone. The results are discussed in line with the literature about

motivations behind contact with nature and the need to capture the experience in order to improve the prediction of outcomes.

In the final discussion chapter, we combined the results across all studies, providing a nuanced discussion surrounding the power of motivations to explain PEBs. The focus of the discussion is surrounding the methodological advantages and disadvantages of each research project including a critical examination of what each method has allowed us to conclude. We discuss the external validity of the computerised task used in Chapter 4, the benefits of the time-series modelling approach used in Chapter 5, the potential limits of pre-volition models in explaining actual behaviour with respect to Chapter 6, and the limitations of the measurement scale developed in Chapter 7. Overall, this dissertation highlights the important research considerations relevant to each psychometric approach as well as an overview of the challenges related to examining pro-environmental behaviour.

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Chapter 1

Dissertation Introduction

Pro-environmental behaviour (PEB) is a vast term referring to any actions that individuals take to reduce harm to the environment or to contribute positively to environmental sustainability (Steg & Vlek, 2009). PEB includes activities such as reducing energy consumption, recycling, conserving resources, protecting wildlife, and supporting environmental policies (Li et al., 2019). Environmental sustainability is a major concern within modern society, with the need to adopt pro-environmental behaviours being increasingly recognised around the world (Klöckner, 2013). Consequently, there is an extensive amount of research surrounding PEBs and the best way to promote them.

This dissertation focused on exploring the power of motivations in explaining variations in PEB. Towards this aim, we also explored using three psychometric approaches, which we review in Chapter 3. In this introduction, we first provide a literature background on motivations, commenting on several definitions and frameworks. After reviewing the motivation literature, we expand to include additional constructs that are often discussed alongside motivations, such as values and attitudes. We include a review of the Theory of Planned Behaviour (Ajzen, 1991) and comment on ways in which the theory can be improved upon. This line of research leads into the discussion of goals and intentions which become central to this dissertation. We outline a framework for understanding PEB, which includes a focus on intentions and goals.

1.1 Motivations and Pro-Environmental Behaviours

The use of motivations to explain behaviour in research is extensive. To inquire about what motivates an individual refers to an inquiry about ‘why’ individuals act or behave in some way (Ryan & Deci, 2000). In classical theories such as Maslow’s hierarchy of needs (1943), motivations are framed as progressing from basic physiological needs to higher-order psychological desires such as self-actualization. These hierarchical motivations are suggested to influence a wide range of behaviours, such as seeking food and achieving personal fulfilment (Maslow, 1943). Motivation can also be defined as an internal process that initiates, guides and sustains goal-oriented behaviour (Deci & Ryan, 2012). Ryan and Deci (2000) further describe motivation as an energy driving individuals to act in certain ways to

meet their psychological needs or achieve specific goals. According to Self-Determination Theory (SDT), motivation can be divided into two broad types: intrinsic motivation, which arises from internal satisfaction, and extrinsic motivation, which is driven by external rewards or pressures (Deci et al., 1985). Individuals who are intrinsically motivated tend to perform the behaviour because that action is inherently interesting or enjoyable to them. Whereas individuals who are externally motivated tend to perform behaviours because of an outcome separate from the action itself (e.g., money, accolades) (Ryan & Deci, 2000) – the behaviour is a means to something else.

Understanding motivations may be helpful for fostering pro-environmental behaviours (PEB), such as recycling, energy conservation, wildlife protection and reducing carbon footprints. Motivation theories help to shed light on why individuals engage (or fail to engage) in environmentally responsible actions despite the presence of other suggested predictors. For example, Stern (2000) proposed that PEB can be influenced by a combination of altruistic motives and egoistic concerns. Within the pro-environmental domain, intrinsic motivations often overlap with altruistic motives. Individuals derive internal satisfaction (i.e., intrinsically motivated) from knowing their actions contribute to environmental sustainability (i.e., altruistic motives) (Pelletier et al., 1998), a cause of which the benefits are for society at large and decisions to act sustainably are often at a personal cost (Kaiser & Wilson, 2004). PEB has been shown to be influenced by intrinsic motivations, such as a personal commitment to sustainability or a desire to align actions with values of environmental stewardship and extrinsic motivations, such as financial incentives, government regulations, or social recognition (Steg et al., 2005).

Studies also show that intrinsic motivation fosters more consistent and long-term pro-environmental behaviours compared to extrinsic motivation (Osbaldiston & Sheldon, 2003; Pelletier et al., 1998). For example, some research has suggested that individuals motivated by personal values (e.g., concern for nature) and intrinsic motivation (e.g., a sense of responsibility towards the environment) are more likely to engage in sustainable actions over time. These behaviours included reducing energy use, recycling, and adopting eco-friendly habits. Mastria et al. (2023) concluded that these behaviours were sustained over time because they aligned with deeply held beliefs rather than being driven by external rewards. In one study, Osbaldiston and Sheldon (2003) asked participants to self-select pro-environmentally related goals to perform for one week. Their findings suggested that the more participants reported an internalized motivation towards their self-selected environmental goals, the higher the reported frequency of behaviours regarding their pro-

environmental goal was during the following week, which extended onto strong intentions to keep on striving after the study was over.

Yet some studies show mixed results. In a longitudinal intervention study, Steinhorst and Klöckner (2018) investigated how monetarily compared to environmentally framed behavioural information influenced pro-environmental intrinsic motivation, intentions, and behaviour. They found that both types of information positively influenced long-term electricity-saving intentions compared to a control group (no information). However, only the environmentally framed information increased pro-environmental intrinsic motivation, which mediated effects on intentions. Further understanding of the power of motivations in influencing PEB may prove to be a promising avenue of research to help support the long-term performance of these behaviours.

Within theories of motivation, there is often an additional emphasis on the role of unconscious drives, rewards, and cognitive processes in shaping human behaviour (Baumeister, 2016). In social psychology, motivations are frequently tied to social influence and attitudes. Ajzen (1991)'s Theory of Planned Behaviour, for example, highlights how motivations, shaped by attitudes, social norms, and perceived control, predict behavioural intentions and actual actions. Additionally, Bandura's Social Cognitive Theory (1986) integrates motivation into understanding behaviours through self-efficacy, where an individual's belief in their capability to execute certain actions becomes a key driver of behaviour.

1.2 Values, Attitudes and Pro-Environmental Behaviours

One important predictor that was investigated in the early days of PEB research is personal values. According to Schwartz's theory of basic human values, individuals who prioritize self-transcendence values (e.g., benevolence and universalism) are more likely to engage in behaviours that benefit the environment (Schwartz, 1992). Stern (2000) supports this, showing that people with strong biospheric values – those who are concerned about the welfare of the environment and other living beings – are also more likely to exhibit PEB. In another study, it was found that individuals who held biospheric values reported higher intentions to act in the public interest (i.e., performing PEBs), even when personal costs were involved. This was in contrast to those with egoistic values – personal gain is prioritized over collective benefits – who reported lower intentions to perform in PEB (Steg et al., 2011).

Values influence the way individuals perceive environmental issues and their willingness to take personal action.

Additionally, environmental attitudes, which are often shaped by personal values (Stern et al., 1995), are another influence of PEB. Attitudes toward the environment reflect how individuals think and feel about environmental protection and conservation (Kaiser et al., 1999). The Theory of Planned Behaviour (TPB) (Ajzen, 1991) suggests that attitudes significantly influence intentions, which in turn affect behaviour (see Figure 1.1). Individuals with positive environmental attitudes are more likely to have intentions to act in ways that benefit the environment (e.g., recycling or conserving energy). For example, studies have demonstrated that individuals with strong pro-environmental attitudes are more likely to engage in behaviours such as energy conservation (Fielding et al., 2011), waste reduction (Habib et al., 2023) and responsible consumption (Bleidorn et al., 2021). However, the relationship between attitudes and actual behaviour is not always direct; situational constraints, habits, and social influences have been shown to interfere with this relationship (Bamberg & Möser, 2007).

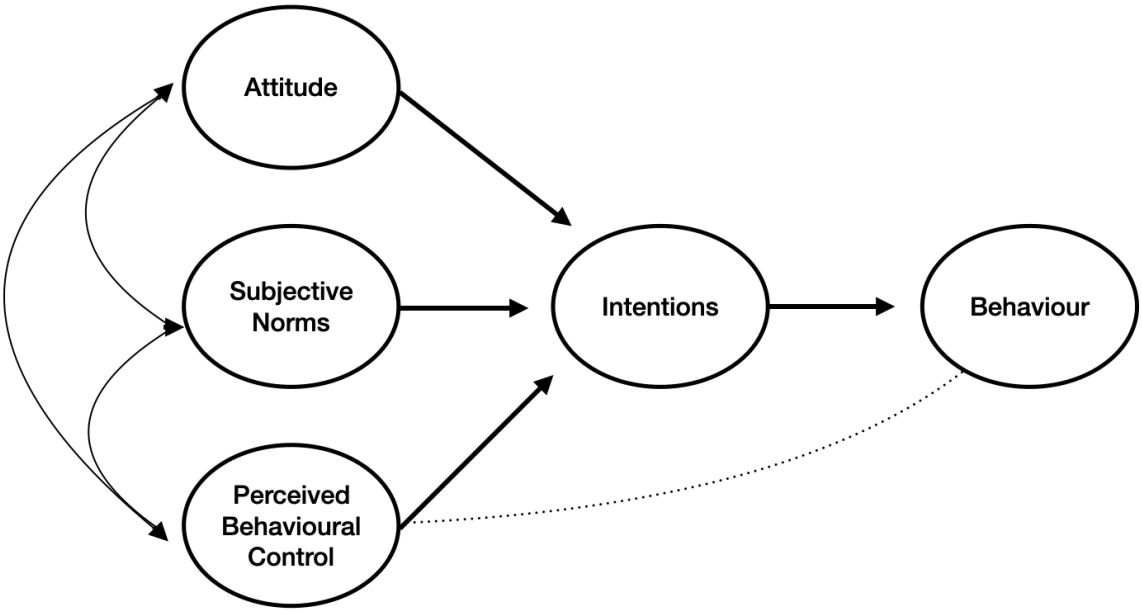

Figure 1.1. Visual representation of the Theory of Planned Behaviour model (Ajzen, 1991).

The TPB also suggests that constructs such as social norms and perceived behavioural control, in addition to attitudes, can help to explain variations in intentions and, thus, behaviour. The inclusion of these constructs may help to understand where attitudes fail to explain behaviours. Social norms – what is perceived as acceptable or expected behaviour

within a group – also play a role in influencing PEB. Social norms can be categorized as descriptive (i.e., what most people do) or injunctive (i.e., what most people approve of) (Fishbein & Ajzen, 2011). Both types of norms can impact PEB by influencing what is perceived as appropriate behaviour based on perceived social approval or disapproval. For example, research has shown that when individuals believe others are engaging in pro-environmental actions, they are more likely to follow suit and perform those behaviours as well (Goldstein et al., 2008). Descriptive norms – seeing neighbours recycle or reduce energy use – can lead to increased environmental behaviours, while injunctive norms – knowing that one's peers value and approve of PEB – further strengthens motivation. These social influences can be particularly effective in communal settings where peer behaviour is highly visible (Nolan et al., 2008).

Lastly, perceived efficacy, or the belief that one's actions can make a difference, is another factor influencing PEB. According to Bandura (1977)'s concept of self-efficacy, individuals are more likely to engage in any behaviour if they believe their actions will have a tangible impact and lead to actual results. In the context of PEB, perceived environmental efficacy refers to whether individuals believe their actions (e.g., recycling) will contribute meaningfully to environmental conservation (Tabernero & Hernández, 2011). Research has shown that individuals with a high sense of environmental efficacy are more likely to engage in sustainable practices, while those who feel powerless or doubt the effectiveness of their actions are less inclined to make efforts (Bamberg & Möser, 2007). In fact, campaigns that highlight the collective impact of individual actions, such as reducing carbon footprints, have been shown to be effective at enhancing perceptions of efficacy and promoting PEB (Van der Linden, 2015; Van der Linden et al., 2015).

The literature often overlaps in the use of values and attitudes in the explanation of behaviour. Schwartz (1992) outlined 'motivational' personal values to be desirable goals varying in importance and serving as guiding principles in one's life. Davidov et al. (2008) define values as "deeply rooted, abstract motivations that guide, justify or explain attitudes, norms, opinions and actions" (p. 2). In general, an attitude is defined as a psychological tendency that is expressed by evaluating a particular object or entity with some degree of favour or disfavour (Eagly & Chaiken, 1998). Attitudes can be understood as a reflection of held values (Schwartz & Bilsky, 1987) and often 'informed' by values (Nazirova & Borbala, 2024). Values arguably become attitudes once directed at a particular attitude object (Stern et al., 1995). Recall, Ryan and Deci (2000) describe motivation as an energy driving individuals to act in certain ways to meet their psychological needs or achieve specific goals –

motivation, simply put, is the 'why' behind behaviours. Both values and attitudes help us understand motivations and perhaps may be understood as different ways to categorise relevant cognitions that underpin motivations – both values and attitudes help us to understand why individuals engage in certain behaviours (Ertz & Sarigöllü, 2019).

However, Schwartz (1992)'s and Ryan and Deci (2000)'s definitions have introduced the concept of 'goals' in this discussion. Goals are an important concept to consider in understanding why individuals engage in certain behaviours. We discuss the relevance of the goals below.

1.3 Goals, Intentions and Pro-Environmental Behaviours

A number of social-cognitive theories on motivation include a discussion of goals. For example, Weiner (1985)'s Attribution Theory outlines a framework to understand how an individual makes sense of events that have happened. This framework is rooted in the explanation of goal-oriented behaviours where individuals ascribe causal attributions on the basis of evaluations of outcomes (i.e., 'success' or 'failure') of a relevant goal. Weiner (1985) outlines psychological and behavioural consequences as a result of different causal attributions. Additionally, the Expectancy-Value Theory (Eccles, 1983), Achievement-Goal Theory (Ames, 1984) and Bandura's Self-efficacy (Bandura, 1977) theory all include a discussion of goals.

The underlying implication is that much of human behaviour is goal-directed behaviour; therefore, to understand the influences of behaviour, it is also important to examine the relevance goals. Locke and Latham (2002) describe goals simply as "the object or aim of an action" (p. 705), but goals can also be conceptualised as mental representations of behaviours or behavioural outcomes (Dijksterhuis & Aarts, 2010). According to Dijksterhuis and Aarts (2010), goals are the starting point of arguably all behaviour because goals tend to be linked to specific actions and, in return, provide a reference point for cognition and action.

Kaiser and Wilson (2004) suggest that pro-environmental behaviours (PEBs) should be considered goal-directed behaviours and that a consideration of goals in the discourse around motivations may extend our understanding of the performance of PEBs beyond what attitudes and values can explain. PEB actions are part of a 'subjective reality' unique to the individual (Kaiser & Wilson, 2004) that is shaped by how individuals try to achieve their pro-

environmental goals (Stern, 2000). PEBs are often behaviours in which the individual performs for a subjective reason (Greve, 2001) – the individual chooses to act in a way to protect or benefit the environment without any separate gain (e.g., monetary, time, convenience) from their actions. Pro-environmental behaviours often come at a cost to the individual. For example, choosing to ride a bike or use public transit instead of driving a car typically means a longer commute for the individual (i.e., loss of time, greater inconvenience).

Since the individual performs pro-environmental behaviours for subjective reasons, Kaiser and Wilson (2004) argues that intentions behind actions should be the focus. For example, individuals do not cut down trees to purposefully harm the environment, they likely are focusing on some aesthetic composition of their property. Similarly, it is possible for someone not to drive their car because they want to limit their carbon emissions, but it is also possible that they chose public transit because they want to save money. It is important to understand the individuals' subjective reality, to understand the 'why' behind the action, an aspect which environmental attitudes alone may not capture. A shift to a focus on PEBs as goal-directed behaviours may offer useful insights into variations in the individual performance of PEBs.

Greve (2001) suggests that any framework used to investigate behaviours must be able to distinguish between different types of behaviours (e.g., voluntary, involuntary, reflexive, purposeful). Many of the behavioural actions that social psychologists would like to investigate are separated from other kinds of action (e.g., reflexes) on the basis that they are performed because of a desire to reach a certain goal and believe that the behavioural action will help them reach this desired end state (Greve, 2001). This desire and belief towards a goal is transformed into a behavioural intention according to Greve (2001). Perugini and Bagozzi (2001) also assert that 'desires' precede intentions. While desires are influenced by constructs such as attitudes, social norms, and perceived behavioural control, they also incorporate motivations with respect to goals. Behavioural antecedents (i.e., attitudes, social norms and perceived behavioural control) are 'filtered' through the individual's desire towards a certain end state (i.e., a goal), and then intentions are formed accordingly (Perugini & Bagozzi, 2001).

The Extended Model of Goal-directed Behaviour (EMGB; Perugini and Conner (2000)) builds on pre-volition models such as the Theory of Planned Behaviour (TPB) (Ajzen, 1991) by introducing a consideration of goals in the model. Building on work that has demonstrated the utility of understanding goals to understand intentions (Deci, 1991; Locke

& Latham, 1990), the EMGB includes antecedents such as behaviour desire, goal desire, anticipated emotions, norms, past behaviour, and perceived behaviour control to explain variations in behaviour intentions. The notion is that behavioural intentions reliably precede behaviour (Fishbein & Ajzen, 2011), and constructs such as attitudes, norms, and perceived behavioural control help to explain variations in intentions and, thus, behaviour.

Perugini and Conner (2000) suggest that the TPB is not designed to examine behaviours as a function of goals. They argue that an assumption within the TPB is that goals are distal determinants of behaviour, and their influence is explained by proximal determinants of behaviours such as attitudes (Eagly & Chaiken, 1998). Consequently, goal-related constructs are assumed not to add to the prediction of behavioural volitions above and beyond attitudes. In their EMGB model, Perugini and Conner (2000) include additional constructs such as behaviour desire, goal desire and anticipated emotions (Figure 1.2), which have direct links to goals. They suggest that the desire to achieve that outcome is the key motivational construct in predicting behaviour – this form of desire has a central role in goal-directed behaviours. Perugini and Bagozzi (2001) argue that by ignoring goals or desires, the TPB fails to consider other sources for how intentions are formed. Attitudes, social norms and perceived behavioural control provide reasons for acting but do not incorporate the motivational content needed to form an intention to act (Perugini & Bagozzi, 2001). According to them, desires represent the motivational state of mind wherein appraisals and reasons to act are transformed into a motivation to do so. This motivation or desire is hypothesized as the most proximal determinant of intentions in the MGB.

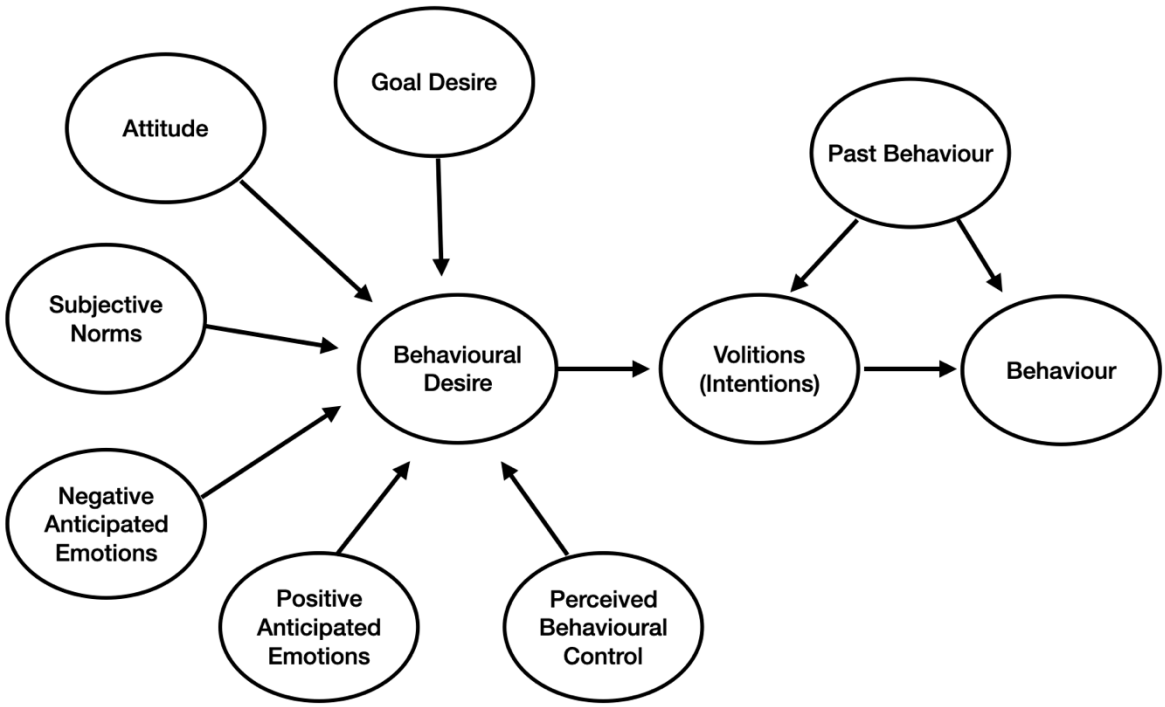

Figure 1.2. Visual representation of the Extended Model of Goal-Directed Behaviour (Perugini & Conner, 2000)

Anticipated emotions are also thought to be related to goal outcomes as well. Anticipated emotions represent the appraisal of the consequences of achieving and not achieving a goal – corresponding to positive and negative emotions (Perugini & Bagozzi, 2001). An attitude is typically constant over reasonable periods of time (Ajzen & Fishbein, 2000) and is not typically understood as a response to outcomes. The benefit of including anticipated emotions in the model, is that the individual's appraisal of goal achievement and goal failure changes from time to time and depending on the context (Perugini & Bagozzi, 2001). Therefore, the inclusion of such a construct incorporates information from goals, but also captures an 'imminent' influence of intentions in addition to enduring aspects.

In research, the TPB has been improved upon by considering goals; more specifically, Richetin et al. (2008) have demonstrated the ability to explain more variance in intentions to perform a behaviour above and beyond the TPB model. In their study, Richetin et al. (2008) compared the TPB, and the EMGB in explaining variations in the intention to drink fizzy drinks. They found that the EMGB explained 67% of the variations in intentions, whereas the TPB explained 56%. Additionally, the EMGB has proven to be a reliable model in explaining various types of environmental behaviours such as, responsible hotel consumer behaviour

(Han & Yoon, 2015), energy consumption (Cheung et al., 2017), recycling (Bezzina & Dimech, 2011), and the use of public transportation (Carrus et al., 2008) behaviours. Therefore, using a pre-volition model with considerations of goals is useful in explaining pro-environmental behavioural intentions and, subsequently, the behaviour itself. Both constructs, goals and intentions appear to be particularly significant for understanding PEB.

Stern (2000)'s definition of PEBs appears to agree with Greve (2001). Stern (2000) suggests that 'environmentalism' or PEBs should be defined on the basis of the intent behind the actions rather than on the evaluation of their impact. They cite that, for example, many people in the United States reported that they avoid purchasing aerosol cans because they want to reduce the harm to the ozone layer. When, in fact, ozone-destroying substances had been banned in the United States for 20 years at the time. Often, with PEBs, individuals may not be certain that their actions are truly helpful; what is important is their intent behind the action – did they behave in a certain way because they desired to help the environment (Stern, 2000)?

Research in environmental psychology has also commented on intentions, specifically research focusing on contact with nature. Contact with nature has been shown to be related to many beneficial outcomes, such as increased nature connectedness (Martin et al., 2020; Mustapa et al., 2019), place attachment (Colley & Craig, 2019), well-being (Beyer et al., 2016) and health (Irvine et al., 2013; Mansor et al., 2012; Martin et al., 2020). In a scoping review, Meredith et al. (2020) concluded that 10 min of sitting or walking in a variety of natural settings was enough to significantly and positively improve psychological and physiological markers of mental well-being for college-aged individuals. These markers included measurements of attention, physiology (i.e., cortisol and heart rate) as well as self-reported affect. Contact with nature has also been shown to be related to pro-environmental stewardship (Chan et al., 2016), and PEB (Alcock et al., 2020; Martin et al., 2020; Whitburn et al., 2020). In one study, Hoover (2021) found that appreciative (as opposed to consumptive and abusive types of) outdoor activities in childhood were found to predict 12.3% of the variance in adolescent pro-environmental citizenship behaviours (e.g., participating in a wildlife protection group, talking to others about PEBs).

'Contact with nature' typically refers to the experience of natural environments (i.e., urban or non-urban outdoor environments that are dominated either by vegetation or water bodies) by individuals, whether intentional or incidental (Keniger et al., 2013; Marselle et al., 2021). It has been theorized that direct, intentional contact with nature would show the greatest effects in terms of beneficial outcomes compared to indirect, incidental contact

(Keniger et al., 2013; Marselle et al., 2021). ‘Direct’ contact with nature is where the individual is in close physical proximity to nature (e.g., walking or swimming); consequently, ‘indirect’ is when the individual is not in close proximity to nature (e.g., watching a nature video). ‘Intentional’ contact with nature refers to contact with nature where nature is part of the central focus of the interaction or activity; individuals generally have these interactions because they seek to have contact with nature. Whereas for incidental contact, contact with nature is typically a by-product of the activity and not the focus. We adapt these definitions from the frameworks presented by Marselle et al. (2016) and Keniger et al. (2013).

Within this line of research, intentions possibly play a large role. Martin et al. (2020) found that intentional contact with nature (i.e., visiting natural spaces at least once a week) was associated with higher household pro-environmental behaviours. Using a large national survey Richardson et al. (2020)’s findings lends support to the notion that intentional contact with nature shows greater effects. Participants were asked about their nature experiences, such as the amount of time spent in nature and the type of activities they did. They used these responses to predict pro-conservation behaviour using stepwise multiple regression analysis. Richardson et al. (2020) reported that significant items retained in the analysis were intentional direct activities such as smelling wildflowers, collecting shells, listening to bird songs, and watching bees. These activities predicted pro-conservation better than the time spent in nature. The authors conclude that the effect may have been driven by the engaging nature of the activities, such that smelling wildflowers, for example, accentuated the individual’s awareness of the biodiversity in their vicinity.

An application of Goal Systems Theory (Kruglanski et al., 2002) may also help to understand the pattern of results. According to the theory, goals are organised in a hierarchical structure. Individuals often have one overarching goal and then several subordinate goals that serve as a means to attain the overarching superordinate goal. It is possible for individuals to have a superordinate goal to ‘enjoy nature’ and then have subordinate goals to ‘engage in nature’ and to ‘protect nature’. These subordinate goals would overlap cognitively. Efforts to achieve one would demonstrate overlap and support the other because they are all part and parcel of the same superordinate goal. These effects may relate to intentions – the intention to have contact with nature should also be related to intentions to perform PEBs since behavioural intentions are a logical consequence of goals (Greve, 2001; Perugini & Bagozzi, 2001). Therefore, intentional contact with nature may be related to the performance of PEBs and an important aspect to consider in the explanation of the variation in PEBs.

In sum, this introduction has conceptualised PEBs as intentional (Greve, 2001) goal-directed behaviours (Kaiser & Wilson, 2004). PEBs are actions that are characterised by a choice made in order to benefit the environment, often at a cost to the individual (Kaiser & Wilson, 2004). Therefore, it is important to consider what goal the individual has in mind and the subsequent intention associated with that goal. This introduction also identified that pre-volition models such as the Theory of Planned behaviour (Ajzen, 1991) and the Extended Model of Goal-Directed behaviour (EMGB) (Perugini & Conner, 2000) can help us understand the relevant antecedents regarding intentions towards a behaviour. These models place importance on attitudes – which are unique from values in that attitudes are directed towards a specific attitude object (Stern et al., 1995) – in addition to self-efficacy, social norms and desires. One additional factor we have identified is motivation. This dissertation uses Deci and Ryan (2012)'s definition, namely that motivations are internal processes that initiate, guide and sustain goal-directed behaviours. Perugini and Conner (2000) arguably incorporate desires into their EMGB model as an operationalization of motivation. This dissertation aims to extend these findings by considering other ways to operationalize motivations with the objective of explaining variations in PEBs.

Chapter 2

Dissertation Aims

This dissertation aimed to contribute to the broader understanding of how different motivational constructs explain variations in pro-environmental behaviour (PEB). We adopted the understanding of PEBs as an intentional goal-directed behaviour (Kaiser & Wilson, 2004; Stern, 2000) to this end. Across four research projects, we aimed to examine different constructs' explanatory power in explaining the variation of PEBs while commenting on different methodological approaches as well. We examined how feedback might support behaviour maintenance using an experimental approach, the predictive power of goal importance ratings on daily behaviours with the use of dynamic multi-level modelling, how pre-volitional models can help explain the variance in actual behaviour with a daily diary method, and lastly, how intentional contact with nature might also explain variations in PEBs by developing a measurement scale.

In the Chapter 4 research project, we focused on observing the effect of outcome-related feedback on recycling behaviour and whether it would support the maintenance of recycling behaviour across contexts. Within the context of goal-directed behaviours and within the goal-setting literature, feedback is often cited as an important motivator. Harkin et al. (2016) suggest that feedback may reinforce ongoing performance. In considering PEBs as goal-directed behaviours, feedback should also have an impact on PEBs such as recycling. We sought to understand not only if outcome-related feedback – that is, feedback that is directly related to the behavioural outcome in reference to a goal – is helpful for behaviour performance in the recycling domain but also with what frequency it should be presented. In Study 1, by manipulating the frequency of outcome-related feedback, we examined if the number of behaviour repetitions participants performed would be affected.

Additionally, the current literature regarding PEB in unfamiliar contexts is inconsistent. While many studies report that pro-environmental behaviours tend to decrease while individuals are on vacation (Dolnicar et al., 2017; Wu et al., 2021), they disagree about the potential cause. It is unclear from the literature if this effect is due to the change in the waste sorting system, suggesting that lack of knowledge or self-efficacy is a contributing factor or if there is a drop in motivation due to the hedonic nature of being on vacation. In Study 2, we examined if feedback would support behaviour maintenance in unfamiliar contexts. In Study 3, we aimed to replicate the findings from Study 1 and also investigate if

differences in performance when comparing familiar and unfamiliar contexts are due to motivational aspects, such as goal desire, or the changes in recycling sorting rules.

We identified many studies investigating recycling behaviour have relied on self-reported behaviour. However, self-report behaviour has its disadvantages (e.g., recall bias, desirability bias, see section 3.1 for more details), but ultimately, there is difficulty in maintaining experimental control. In fact, self-reported and actual recycling behaviour have been shown to be weakly correlated (Huffman et al., 2014). A few in-lab paradigms have been used to study PEB. Notably, Lange et al. (2018) developed an in-lab computerised task where participants were evaluated on their energy consumption choices. In a similar vein, we developed an in-lab computerised task to simulate recycling behaviour. The development of a computerised task allowed us to limit the disadvantages associated with self-report measures and to experimentally manipulate the presentation frequency of feedback and changes in context.

In Chapter 5, we aimed to observe the dynamic interplay between goals and two sustainable behaviours (i.e., recycling and green consumption behaviour). In continuing to conceptualise PEBs as goal-oriented behaviours, we aimed to investigate if the relationship between goals and behaviours could be dynamic rather than directional. A lot of success has been reported in the goal-setting literature with respect to the power of goals to predict behaviour (McEwan et al., 2016). Some literature suggests that behaviour performances may impact future mental states (i.e., goals) (Locke & Latham, 2002), indicating the possibility of a dynamic relationship, yet to our knowledge, this has not been directly tested in an applied setting. Through the use of a time-series analysis with dynamic structural equation modelling, examining the cross-lagged effects between goals and behaviours over time allowed us to draw conclusions regarding the nature of the relationship between them. Results would have implications for goal-setting interventions: if goals are found to be influenced by previous behaviour occurrences, then progress monitoring or feedback could be considered essential, not additive, within the intervention. Results would also have implications for the current understanding of the relationship between goals and behaviour and the ways in which to leverage a possible dynamic relationship.

In Chapter 6, we aimed to test the validity of various constructs, drawing from pre-volition models and research about goals and barriers in explaining the variance in sustainable behaviours over time. It is with this study that we incorporate intentions in the effort to explain variations in PEBs. Most pre-volition studies that focus on behavioural antecedents (e.g., TPB, EMGB) aim to explain the variance in behavioural intentions. Very

few studies have measured actual behaviour, even less when considered micro-longitudinally. Measuring behaviour over a 3-week period reduces measurement error due to recall bias usually at play in self-report measures of behaviour frequency one month prior, increasing the reliability of the behaviour measurement.

We focused on two types of behaviours: recycling and sustainable consumption. Given the unique nuances associated with each behaviour, we expected that the additions of perceived busyness and perceived wealth to a model would reflect relevant considerations of barriers (or difficulties) specific to each behaviour and, therefore, improve the models' ability to explain variations in behaviour. We expected that by including relevant antecedents regarding doing comparing to not doing behaviours and by including perceived barriers, we aimed to provide valuable additions to a potential model relevant to studying and explaining variations in sustainable behaviour. Recycling behaviour includes actions such as placing plastic, paper, metal glass, etc., items in their appropriate bins both inside and outside the home. Green consumption behaviour includes actions such as avoiding purchasing plastic items, avoiding buying in excess, and purchasing reusable items. While recycling and green consumption behaviours may be considered similar enough (i.e., both related to the household), they are also sufficiently different as they are related to varying degrees of difficulty regarding time, energy and money requirements. Thus, we aimed to also demonstrate the robustness of the dynamic effects by testing the model using two different behaviours.

Lastly, in Chapter 7, we aimed to develop a self-report measure that would differentiate between intentional and incidental contact with nature and use the measure to explain variations in pro-environmental behaviour. The influences of contact with nature on individuals is a growing area of research; in particular, previous research has demonstrated the explanatory power of considering contact with nature in explaining pro-environmental behaviours. Generally speaking, individuals who have more frequent contact with nature tend to frequently perform pro-environmental behaviours as well (Richardson et al., 2020; Whitburn et al., 2019). Inspired by existing frameworks offering typologies with how to categorise experiences with nature – intentional vs incidental and direct vs. indirect (Marselle et al., 2021) – the current project aimed to develop a measure of contact with nature that would capture the individual's experience and improve upon measures of exposure in explaining variations in pro-environmental behaviours. This measurement tool would also help to answer theoretical questions regarding the benefits of contact with nature that remain unaddressed – that direct intention contact with nature would demonstrate greater beneficial

outcomes compared to indirect, incidental contact with nature (Bratman et al., 2019; Keniger et al., 2013; Marselle et al., 2021).

However, what is currently missing from the literature is support from participant data about interactions with nature that can be reliably classified according to the four typologies.. Over three studies, we aimed to develop a preliminary scale, to be tested in a fourth validation study. The development of a preliminary Experience with Nature scale might lend support to the importance and the utility of considering experience when measuring contact with nature in certain contexts. It would also expand the current knowledge of intentions and the different ways we can study intentional behaviours above and beyond capturing behavioural intentions in the way that pre-volitional models currently do.

Chapter 3

Dissertation Methodology

3.1 Experimental Approaches

As digital technology evolves, computerized tasks have become a useful approach in behavioural and psychological science. Computerised tasks allow for precise control over experimental variables, real-time data collection, and reproducibility (Barchard & Williams, 2008). In measuring pro-environmental behaviour (PEB), computerized tasks allow researchers to measure and manipulate the psychological factors that drive such behaviours. Below, we examine how computerized tasks have been applied in psychological studies, with an emphasis on their relevance to understanding and promoting PEB.

Computerised tasks allow researchers to have a high degree of experimental control within their studies. Experimental control refers to the ability to isolate and manipulate independent variables while minimizing the influence of extraneous variables (Gallistel, 2009). Historically, this was achieved through traditional laboratory settings where physical environments, timing, and stimuli presentation were tightly regulated. However, these settings often presented challenges like variability in human-administered tasks and logistical constraints, such as participant availability and physical space (Kirk, 2013). The rise of computerized tasks has addressed many of these issues, providing a standardized platform where stimuli can be presented with precision and responses can be accurately recorded without human error (Barchard & Williams, 2008) and often presented online. These tasks include reaction time measures, computerized questionnaires, simulations, and gamified experiments. The use of software platforms such as E-Prime, PsychoPy, and Inquisit allows researchers to design and implement complex experimental designs that control for timing, stimuli presentation, and response recording. As psychologists have sought to understand relevant influences behind PEB, identifying factors such as personal values, environmental attitudes, social norms, and cognitive biases as key drivers (Gifford & Nilsson, 2014), the study of PEB has increasingly turned to computerized tasks to explore the cognitive and emotional processes that underpin PEB decision-making. Key contributions of computerized tasks in this domain include simulated environmental scenarios and decision-making paradigms.

Computerized simulations and virtual reality environments have been used to immerse participants in scenarios where they must make decisions about resource use, energy consumption, or environmental conservation. For example, Liao et al. (2024) investigated through immersive virtual reality environments, how individuals' emotions influence decisions regarding climate action. Participants were placed in virtual scenarios that simulated environmental challenges, such as resource management and energy conservation. The study found that when the task was designed to evoke fear (compared to hope), individuals' attitudes towards climate change mitigation policies increased and had higher behavioural intentions. The immersive nature of the task allowed researchers to manipulate real-world scenarios, arguably achieving a more effective manipulation of emotions compared to non-virtual reality approaches. Simulated environments provide a high degree of experimental control, allowing researchers to manipulate contextual factors and observe how these factors influence behaviour.

Computerized tasks have also been used to study decision-making processes related to pro-environmental choices. Lange et al. (2018) designed the Pro-Environmental Behaviour Task (PEBT), a computerized paradigm developed to measure actual pro-environmental behaviour in the laboratory. The researchers sought to overcome the limitations of self-report measures, seeking a reliable yet valid proxy measure of real-world actions. During the task, participants were asked to make several decisions, always choosing between two options: a faster but environmentally unfriendly car or a slower but environmentally friendly bicycle. The environmentally unfriendly option switched on a set of lights, symbolizing increased energy consumption, while the environmentally friendly choice required participants to wait longer but saved energy (e.g., the lights did not switch on).

In two studies, their results demonstrated that as the waiting time for the environmentally friendly option increased, the proportion of pro-environmental choices decreased while increasing CO2 emissions associated with the unfriendly option led to more environmentally friendly decisions. The authors concluded that participants were sensitive to both the personal and environmental consequences of their actions. The use of a computerised task such as the PEBT allowed researchers to carefully manipulate their variables of choice in a controlled setting while excluding extraneous variables, allowing for conclusions about factors, such as the consideration of consequences, involved in pro-environmental decision-making.

While traditional laboratory tasks may have difficulty in replicating real-world decision-making processes, computerized tasks – especially simulations and virtual reality

environments – can create immersive experiences that closely resemble real-world contexts (Ahn & Bailenson, 2011). Nowadays, many computerized tasks are easily distributed through online platforms, enabling large-scale data collection across geographically dispersed populations. This is particularly valuable for PEB research, as it allows for the study of diverse populations and cross-cultural comparisons (Barchard & Williams, 2008). Because the factors underlying PEB may be complex, often subtle and involve important interactions with each other (Clayton & Myers, 2015), the use of computerized tasks to attempt to isolate these factors may be an important avenue of research.

Despite advances in technology, some computerized tasks may still feel artificial compared to real-world experiences, which can affect the ecological validity of the task (Schmuckler, 2001), particularly in PEB research where contextual factors like physical environment and social interactions are important (Steg & Vlek, 2009). In the study of PEB, computerized tasks have provided new insights into the cognitive and emotional drivers of environmentally responsible decision-making. While challenges remain, the continued development of computerized tasks – along with advances in technology – holds great promise for future research aimed at understanding the influences of and promoting PEB.

For the Chapter 4 project, we designed a computerised recycling task (CRT), using Inquisit programming software, to experimentally manipulate and control the presentation of feedback and changes in context. In the CRT, participants were presented with various household objects that they were asked to categorize into the appropriate household waste bins. Objects could take many forms, such as newspapers, juice boxes, glass jars, etc, but were controlled to be items one would typically find in or around the home. The task included distractor items as well. Distractors were household items that should not be disposed of in household waste bins (i.e., electronics, clothing, or furniture). These are items which individuals often need to take extra steps to dispose of properly, such as bringing them to a recycling facility. Participants were instructed to select the target (i.e., an item appropriate to be disposed of in household bins) and then drag and drop the target object into the appropriate household waste bin. The task was designed to be a proxy for real-world recycling behaviour – the same level of knowledge required to complete the task also supports recycling in the real world. In the experimental studies we manipulated the presentation of feedback as well as the familiarity of the sorting rules. Through the use of the CRT, we were able to compare performance on the task (e.g., accuracy, reaction time) with and without feedback, as well as in familiar and unfamiliar sorting rules. The task allowed us to control for extraneous variables, such as differences in the number of waste bins and the

familiarity of the sorting bins to the participants, all while precisely measuring accuracy and reaction times.

3.2 Statistical Modelling Approaches

Statistical modelling has become a useful tool in psychological research. It enables psychologists to interpret complex data, test novel hypotheses, and make predictions about psychological phenomena. Over the years, statistical methods such as structural equation modelling (SEM) and multilevel modelling (MLM) have expanded the capability of researchers to analyse intricate relationships between variables. However, the use of statistical modelling also comes with limitations. This section will outline both the advantages and disadvantages of statistical modelling in psychological research.

One of the key advantages of statistical modelling is its ability to manage complex and multi-dimensional data. Structural equation modelling (SEM) is often used to test hypotheses about relationships among latent variables, offering a way to model both direct and indirect relationships between observed and unobserved variables. SEM considers the variance and covariance among variables included in the model (Kline, 2023). SEM also enables researchers to investigate complex theories which suggest complex relationships among latent variables, and otherwise would be insufficient to model using simpler statistical techniques. For instance, testing pre-volitions theories relies heavily on SEM. Pre-volition models leverage constructs or behavioural antecedents such as behaviour desire, goal desire, anticipated emotions, norms, past behaviour, and perceived behaviour control to explain variations in behaviour intentions. There are many studies investigating PEB which have used pre-volition theories such as the Theory of Planned Behaviour (Ajzen, 1991), The Reasoned Action Approach (Fishbein & Ajzen, 2011), and the Extended Model of Goal-directed Behaviour (Perugini & Conner, 2000). According to these models, behavioural intentions reliably precede behaviour (Fishbein & Ajzen, 2011), and the identified constructs help to explain variations in intentions and, thus, behaviour. Modelling the complex relationships among these antecedents is possible with SEM. For example, Carfora et al. (2017) examined effects across behaviours to investigate the moderating role of self-identity in the prediction of PEB intentions and behaviours while controlling for past behaviour. Participants completed Time 1 questionnaires measuring pre-volitions in relation to five different PEBs. Two weeks later, participants responded to a questionnaire capturing self-reports of these behaviours. Across behaviours, the findings demonstrated that pro-

environmental self-identity was a significant moderator of the impact of perceived behavioural control on intentions as well as the effect of past behaviour on both intentions and behaviours. These conclusions were only possible with the use of statistical modelling techniques such as SEM.

In our Chapter 6 project, we started from a base pre-volition model and tested if the addition of not doing constructs and perceived barriers contributed to the additional variance explained in PEBs within the model. Our analysis approach depended on the use of SEM to model the effects. SEM permitted us to include the individual items participants respond to on the pre-volition questionnaire and model the constructs as latent variables. This approach allows for the additional consideration of variation in responses, affording the possibility of a robust model since we are able to account for multiple sources of variation (Bollen & Hoyle, 2012).

Additionally, multilevel models (MLMs) allow researchers to analyse data that are hierarchically structured, such as students nested within classrooms or repeated measurements nested within individuals. This is particularly useful in capturing and accounting for the nested relationships within data (Snijders & Bosker, 2011). For example, Stikvoort and Juslin (2022) found that when analysing relationships between motivations and intentions (using a Reasoned Action Approach (Fishbein & Ajzen, 2011)), a within-subjects analysis across behaviours yielded differing results compared to analyses between-subjects. They demonstrated that the between-subject analyses suggested that individuals who perceived strong social pressure (i.e., injunctive norms) reported weak PEB intentions; however, a within-subject analysis revealed that this relationship was, in fact, stronger. In a similar fashion, the within-subjects analysis, not between-subjects, suggested that economic gains were also related to behaviour intentions. MLMs account for the variations between observations and provide parameter estimates considering several sources of variance compared to traditional methods (Heck et al., 2010). This approach is also valuable for analysing longitudinal data.

In the Chapter 5 project, we used a time-series MLM approach through the use of dynamic structural equation modelling techniques. We used a micro-longitudinal design, measuring behaviour occurrences of both recycling and sustainable consumption behaviour and goal importance ratings daily for 3 weeks. Dynamic structural equation modelling (DSEM) allowed us to model time-variant parameters and the relationships among them. Using the vector autoregressive VAR(1) model with a time lag of one, we modelled the temporal within-person deviations from the person-specific means. The particular model

chosen for the present analysis was adapted from Hamaker et al. (2018) and can also be referred to as a multilevel extension of a cross-lagged panel model, allowing for individual differences in means and lagged effects, including random means and random lagged parameters. Examining the cross-lagged effects between goals and behaviours over time will allow us to draw conclusions regarding the nature of the relationship between them.

Statistical modelling allows for parameter estimates that consider various sources of variance and relationships among variables, arguably improving predictive capabilities in psychological research and certainly providing a more nuanced understanding of the relationships between variables (Cohen et al., 2013; Marsh et al., 2012). This makes statistical modelling particularly advantageous when testing competing hypotheses, as it can assess the relative importance of predictors

3.3 Measurement Scale Approaches

Developing reliable and valid measurement scales is central to research and theoretical advancement in psychology. Often, for many of the phenomena that psychologists would like to measure and capture, it is necessary to use self-report methods. Self-report measures can provide nuanced insights into individuals' motivations that observational methods may overlook. For instance, participants can articulate their reasons for engaging in pro-environmental behaviours, revealing personal values and beliefs (Ryan & Deci, 2000).

Self-report scales can effectively capture internal states and motivations, such as attitudes and feelings, that are not easily observable. Observational measurements can fall short in capturing internal drivers that underpin behaviour (Colditz, 2010). These internal states are an important element in fully understanding why individuals behave in certain ways. While observational methods can effectively document visible actions, they may not provide insight into the underlying psychological factors that drive behaviour. As a result, relying solely on observational data can lead to an incomplete picture of behaviour (De Young, 2000; Gifford & Nilsson, 2014). Observational methods tend to focus on external behaviour and can miss the subtleties of internal processes that motivate actions, such as motivations or attitudes toward the environment (DeVellis & Thorpe, 2021).

Well-developed scales offer consistent and standardized ways to assess constructs across different studies. When researchers measure constructs such as attitudes, motivations, or behaviours in the same way, it allows for reliable comparisons across contexts and populations. Developing scales enables researchers to operationalize these constructs into

measurable variables, turning intangible qualities into quantifiable data (Carpenter, 2018). A properly developed scale undergoes extensive testing to ensure validity and reliability, which is key to ensuring that research findings are robust and applicable (Clark & Watson, 2016). Building a reliable and valid measurement scale for capturing motivations is a complex but essential task. Addressing concerns related to reliability and validity through rigorous methodological approaches, along with leveraging the strengths of self-report measures, enhances the scale's utility and the accuracy of findings.

Reliability refers to the consistency of a measurement scale over time and across different contexts. A reliable scale ensures that the same measurement yields similar results under consistent conditions (Clark & Watson, 2016). Hair Jr et al. (2019) emphasize the importance of internal consistency reliability, often assessed using Cronbach's alpha, to ensure that items on a scale are measuring the same underlying construct. Additionally, test-retest reliability examines the stability of a scale over time. Any measurement scale should yield similar scores when administered to the same individuals at different time points (Nunnally & Bernstein, 1994). Inconsistent results across measurement occasions undermine the scale's utility in a similar fashion that one would question the utility of a ruler if it gave different measurements of the same object at different time points.

Construct validity assesses whether a scale truly measures the intended construct. The common way of assessing this is by testing for convergent validity (i.e., the degree to which the scale correlates with other measures of the same construct) and discriminant validity (i.e., the degree to which it does not correlate with unrelated constructs) (Holmbeck & Devine, 2009). For example, a scale aimed at measuring PEB would be expected to correlate positively with measures of environmental concern but not with theoretically unrelated constructs like academic performance. Additionally, content validity refers to whether the scale comprehensively covers the domain of the construct (Sireci, 1998). For example, in building a scale to capture motivations, it would be important to ensure that items reflect the full range of motivations relevant to the behaviour being studied as much as possible. Careful design of measurement scales with attention paid to the measurement’s reliability and validity allows for robust measurement scales (Clark & Watson, 2016). Over time, when different researchers use the same scale, their results can be compared or combined in meta-analyses, leading to broader insights and further development of the field. Measurement scales help advance theoretical understanding by providing concrete data to test and refine psychological theories.

In the Chapter 7 project, we sought to develop a measurement scale aimed at capturing intentional contact with nature. The ‘Experience with Nature Scale’ was developed through multiple studies, starting by identifying interactions with nature based on four typologies: intentional, incidental, direct, and indirect experiences (Marselle et al., 2021). We then performed a factor analysis to determine the best scale items that would contribute to a parsimonious measurement scale. Afterwards, we put the scale through several stages of testing, examining content validity, convergent and divergent validity, as well as reliability. It is through the development of the Experience with Nature scale, that we were able to draw conclusions on the effects of intentional contact with nature on PEBs.

Chapter 4

Reduce, reuse, recycle, repeat: The curious role of outcome-related feedback in the continued performance of recycling behaviours

Overview

In Chapter 2, we justified the adoption of a framework that represents pro-environmental behaviours as intentional goal-directed behaviours. Following this line of reasoning, we identified that one of the difficulties with promoting recycling behaviour might be the lack of feedback provided: individuals are unaware if their efforts are correct or not. The current project in this chapter aimed to investigate across three studies whether providing feedback during a computerised recycling task would support the maintenance of behaviour in familiar and unfamiliar contexts. Our results indicate that while, in familiar contexts, participants in feedback conditions pursued the task longer than those without, in unfamiliar contexts, feedback had the opposite effect. Recycling behaviour patterns in an unfamiliar context may be more heavily influenced by the changes in sorting rules rather than motivations. Knowledge contributing to factors that increase adherence to recycling programs at home and outside are of interest to several parties, including both private and public sectors. As a society, recycling programs may need to be designed with the individuals' interaction with the sorting system in mind and not based on infrastructure demands.

4.1 Introduction

Sustainability has become one of the major concerns of the 21st century. The need to adopt pro-environmental behaviours is recognised around the world, particularly concerning the contribution of individual and household behaviours (Klöckner, 2013). For example, only about 32% of waste in the United States is estimated to be recycled (*National Recycling Strategy: America Recycles Day*, 2022). A dramatic change in individuals' behaviours towards more sustainable lifestyles is paramount. Of concern for the current study is recycling behaviour.

The literature is unclear on how to promote long-lasting behaviour performance for recycling behaviour. In one study investigating solid waste reduction and recycling on a construction site, researchers determined that a goal-setting and performance feedback intervention produced a decrease in waste through increased recycling behaviour (Lingard et al., 2001). Similarly, Maki et al. (2016) reported promising results for the effect of monetary incentives in promoting recycling behaviour. Staples et al. (2020) found that electricity usage in the workplace was reduced after a goal-setting intervention program. However, all three studies did not observe a lasting effect after removing the intervention. Staples et al. (2020) speculate that participants experienced a decrease in motivation.

For some sustainable behaviours, such as reducing energy consumption, where either through monitors or invoices, individuals receive feedback about how much electricity, gas, or water they are using. By contrast, recycling behaviour is inherently limited in the feedback or reinforcement, and/or punishment one receives. Some recycling interventions have focused on introducing feedback or reinforcement and/or punishment strategies to increase performance (Karlin et al., 2015; Mozo-Reyes et al., 2016; Timlett & Williams, 2008). One example includes programs where waste sorting is controlled for accuracy by the city, and any error results in fines to the household (Kinnaman & Fullerton, 2000). These interventions come at great cost and are difficult to implement on a large scale (Lingard et al., 2001; Staples et al., 2020). Furthermore, recycling behaviour is difficult to reinforce since it is not a simple behaviour but rather one that occurs in response to various cues. One possible solution could be to introduce feedback, allowing the individual to understand correct compared to incorrect performances and allowing the possibility to reinforce or reward the behaviour.

4.1.1 Feedback

He et al. (2010) make specific recommendations for behaviour change maintenance. They recommend interventions to (1) encourage individuals to self-reinforce and self-reflect on their experiences and (2) maintain the cyclical loop of intrinsic motivation through promoting interest, curiosity, optimal challenge, competence, enjoyment, and feedback. Similarly, Harkin et al. (2016) suggest that feedback may reinforce ongoing performance. Karlin et al. (2015) also found that feedback had an average energy savings of 8-12% across eco-friendly studies. The authors speculate that feedback based on goal comparisons can keep attention focused on the task-motivation level. Additionally, a study in England determined that personalised feedback cards were most effective in reducing recycling contamination compared to door-to-door communication (i.e., nudges and feedback) and financial rewards (Timlett & Williams, 2008).

Various forms of feedback have been used in previous research, such as persuasion messages, social comparisons, and outcome-related feedback such as progress reports (Dupré & Meineri, 2016). Outcome-related feedback — feedback corresponding to an outcome or the consequence of the behaviour — may be an integral part of promoting behaviour since individuals can think about their performance in quantifiable terms, as opposed to behaviour-related feedback i.e., confirmation that the behaviour has been performed. In a meta-analysis of effective short-term and long-term diet interventions for healthy eating and weight loss, feedback on outcomes of the behaviour explained more variance in the result (adj.R% = 12 and 43.8 respectively), in comparison to general feedback of the behaviour (adj.R% = 4.4 and 30.8 respectively)(Samdal et al., 2017). Neuroscience research also supports these findings with evidence that the dorsolateral striatum responds strongly after positive outcomes during learning (e.g., accuracy) and may support ongoing performance by coupling the signalling of outcome feedback with behaviour sequences (Smith & Graybiel, 2016). Thus, the efficacy of outcome-related feedback may be rooted in increased motivation to continue behaviour repetitions and by providing quantifiable information directly related to the goal, thus reinforcing behaviour.

Furthermore, the frequency of feedback may have an effect. In an energy consumption study, the frequency of monitoring was significantly related to experiencing positive outcomes, which in turn predicted an increase in environmental behaviour, ecological worldview, environmental concern, and pro-environmental identity (Webb et al., 2014).

4.1.2 Context

Recycling behaviour can be influenced by the context as well. Specifically, individuals tend to recycle less when away from home, for example, when on vacation. Dolnicar et al. (2017) found that pro-environmental appeals to recycle did not reduce waste when individuals were on vacation compared to when at home. Additionally, home-context intentions were not predictive of recycling while on vacation. They concluded that interventions must be tailored to the home versus vacation context. They further suggested that the hedonic nature of being on vacation may have had an influence. Miao and Wei (2013) reported a similar finding. They found that individuals reported more recycling behaviours at home compared to while on vacation.

Díaz-Meneses and Vilkaite-Vaitone (2020) identified five barriers to recycling when on vacation: (1) focusing on relaxing/rest, (2) being opposed to recycling, (3) lack of info/misguided regarding how to recycle, (4) lack of reward/incentive to recycle, and (5) recycling being an inconvenience. Miller et al. (2015) also suggested that barriers or difficulties reduce recycling in a new context. However, Wu et al. (2021) found the opposite effect. In their study, individuals recycled more on vacation than at home. They suggested this effect was due to the infrastructure being better on vacation than at home. In a review, Varotto and Spagnolli (2017) report that among various interventions to increase recycling behaviour, environmental alterations (e.g., the distance from home to recycling points) resulted in significant increases. Similarly, Geiger et al. (2019) reported that contextual factors are significantly related to recycling behaviour. More specifically, they found that individuals who owned single-family homes (compared to individuals to rent apartments) were more likely to recycle.

The contextual factors may be summarised more generally as factors influencing self-efficacy or perceived recycling-related ability. Past studies have identified self-efficacy as a contributor to motivation to perform behaviours (Na-Nan & Sanamthong, 2019). Higher levels of self-efficacy towards pro-environmental behaviours were more predictive of responsible pro-environmental behaviours (Shafiei & Maleksaeidi, 2020). Moreover, self-efficacy was a significant mediator of the relationship between pro-environmental identity and green purchase behaviour (Le & Manh, 2022) . Recent research suggests that an important barrier to recycling for most people is the lack of understanding, confusion about recycling properly and the lack of motivation to seek the information needed (Roy et al., 2022). In sum, the literature is unclear as to why individuals recycle less while on vacation. The current research aimed to disentangle motivational and sorting rule effects on recycling behaviour and determine if feedback supports continued pursuit of recycling behaviour.

4.1.3 Overall Project Aims

The present research project aimed to observe the effect of outcome-related feedback on recycling behaviour and whether it may support the maintenance of recycling behaviour across contexts. Many studies investigating recycling behaviour have relied on self-reported behaviour, which has disadvantages: recall bias, desirability bias, and ultimately, difficulty to control experimentally. In fact, self-reported and actual recycling behaviour have been shown to be weakly correlated (Huffman et al. (2014). Few in-lab paradigms study pro-environmental behaviour. Some researchers have employed in-lab tasks where participants are asked to dispose of materials, and unbeknownst to them, their behaviour was recorded. Notably, Lange et al. (2018) developed an in-lab computerised task where participants were evaluated on their energy consumption choices. They found that choices on the task were consistent across trials, demonstrated construct validity and were sensitive to manipulations, thus concluding that the task was psychometrically useful for studying pro-environmental behaviour. Therefore, we developed an in-lab computerised task to simulate recycling behaviour, to limit the disadvantages associated with self-report measures in a similar fashion to Lange et al. (2018) but for recycling, and to experimentally controll situational factors. The task will allow us to experimentally manipulate the presentation frequency of feedback and changes in context and, consequently, the recycling sorting rules.

Knowledge of factors that reinforce behaviour specific to recycling behaviours could help inform the design of behaviour change interventions. It is important to understand not only if outcome-related feedback is helpful for behaviour performance but also with what frequency it should be presented. In Study 1, by manipulating the frequency of outcome-related feedback, we examined if the number of behaviour repetitions participants performed would be affected.

Furthermore, the current literature regarding pro-environmental behaviour in unfamiliar contexts is inconsistent. While most studies report that pro-environmental behaviours tend to decrease while individuals are on vacation, they disagree about the potential cause. It is unclear from the literature if this effect is due to the change in the waste sorting system, suggesting that lack of knowledge or self-efficacy is a contributing factor or if there is a drop in motivation due to the hedonic nature of being on vacation. In Study 2 (pre-registered), we examined if feedback would support behaviour maintenance in unfamiliar contexts. In Study 3 (pre-registered), we aimed to replicate the findings from Study 1 and also investigate if differences in performance when comparing familiar and unfamiliar contexts are due to motivational aspects or the changes in recycling sorting rules.

4.1.4 Computerised Recycling Task

As mentioned previously, we designed a computerised recycling task (CRT), using Inquisit programming software, to experimentally manipulate and control the presentation of feedback and changes in context. In the CRT, participants were presented with various household objects that they were tasked to categorize into the appropriate household waste bins. Objects could take many forms, such as newspapers, juice boxes, glass jars, etc. Waste bins were organized into 5 categories: plastic, glass/metal, paper, organic/food, and undifferentiated waste[1]. There were two types of trials: one in which only the target was presented, with the waste bins below, and another type in which three items were presented: only one item was the target, and the other two were distractors, with waste bins below. Distractors took the form of household items that should not be disposed of in household waste bins, such as electronics, clothing, or furniture. The presentation of individual stimuli and location of stimuli was randomized. Participants were instructed to select the target (i.e., an item appropriate to be disposed of in household bins) and then drag and drop the target object into the appropriate household waste bin. See Appendix A for figures showcasing the task.

Across all studies, participants were instructed, "Your goal is to recycle correctly. It is important that you achieve this goal. Please respond as quickly as possible." Participants, depending upon the experimental condition, received feedback during the entire task. For feedback presentation, participants could see a green progress bar at the top of the screen that accumulated the number of items they had sorted correctly. The experimental trials had a response timeout of 4 seconds, or it was recorded as an error. Across all studies, the task always included a practice, an experimental block, and an additional block of trials. After the experimental block of trials, participants were then proposed to continue with the task with a reminder of the goal. They were informed they could stop whenever they felt they had reached their goal. We operationalized behaviour maintenance as the number of additional trials participants chose to perform.

All studies were conducted under approval of the ethic committee Commissione per la Valutazione della Ricerca del Dipartimento di Psicologia (CRIP), Protocollo N. RM-2021-409. Study 2 and Study 3 were preregistered, while Study 1 was not.

4.2 Study 1

[1] The household bin system was chosen to resemble as much as possible the waste sorting system in place in the city the study was conducted assuming that majority of the participants would reside there.

4.2.1 Study Aims

The aim of this study was to test whether feedback manipulation influenced behaviour maintenance. Using the CRT, we manipulated the frequency of outcome-related feedback to determine which frequency leads to the highest number of behavioural repetitions. Lastly, this study tested the convergent validity of the task with self-reported pro-environmentally related measures.

4.2.2 Methods

4.2.2.1 Participants, Procedure, and Experiment Design

We based our a-prior sample size determination on the effect of the manipulation on the number of additional trials tested with an ANOVA between-factor design focusing on the difference between the control condition and one of the three experimental conditions (3 linear contrasts: -1, +1, 0, 0; -1, 0, +1, 0; and -1, 0, 0, +1). To obtain a medium effect (f^2 = .25) with 80% power and an alpha of .05, we would need a sample of 128.

An initial 144 participants participated in the study. Fourteen participants' data were removed for exiting the study part-way. Thus, there were 130 participants (females = 92, 71%; *M*age = 25.77, *SD* = 6.92). Most of the sample was from Italy (n = 93, 71%). On average, participants indicated that the Computerised Recycling Task (CRT) waste sorting system was 'somewhat the same' (*M* = 3.65, *SD* = 0.94) as the one they used at home.

After providing informed consent, participants completed the CRT. Participants were randomly assigned to one of four conditions depending on the feedback frequency: control (no feedback) versus outcome-related feedback at every trial versus every 20 trials versus every 80 trials. After the task, participants completed surveys assessing pro-environmental behaviour (PEB) and attitude and demographic information. Participants were then debriefed and thanked for their participation. The experiment was available in Italian and English and lasted, on average, 30 minutes.

4.2.2.2 Materials

Computerised Recycling Task (CRT). After a demonstration video of the task, participants were randomly assigned to one of the four experimental conditions. Participants completed a block of 40 practice trials, an experimental block of 80 trials, and the additional trials block. Feedback conditions continued during the additional trials. The main dependent variable of interest was the number of additional trials participants completed, but also accuracy and mean reaction time (RT) were considered. See Appendix A for figures demonstrating the task.

Past PEB frequency scale (Schultz et al., 2005; Walton & Austin, 2011). The PEB frequency scale was adapted from two scales from previous research and included additional items of our own design to measure behaviour regarding specific stimuli presented in the task. In total there were 29 items. Participants were presented with the prompt, "How often have you done each of the following the past month?" Responses were recorded on a 5-point frequency scale with the option to indicate "non applicable". The scale included 7 items adapted from Schultz et al. (2005), such as, "Picked up litter that was not your own" and 4 items from Walton and Austin (2011) for example, "Made an effort to conserve resources in your home, such as electricity, natural gas, and water for environmental reasons." An additional 18 items were included to measure behaviour frequencies of waste sorting behaviour that directly correspond to stimuli presented in the task, such as, "Return[ing] old medicines to pharmacies".

From a Principal Component Analysis, we identified 4 separate factors[2]: a 'low frequency' factor, (6 items; $\alpha = 0.90$), consisting mainly of items designed to measure behaviour frequencies for the distractor items (e.g., batteries, corks, medicine) or otherwise behaviours that would reasonably occur infrequently within a month's time; a medium-frequency behaviour (4 items, $\alpha = 0.86$), (4 items; $\alpha = 0.86$). which are also included as distractors in the CRT task, however since they are often difficult to dispose of in household bins, e.g., furniture, individuals are typically pressured to follow proper protocols; a high-frequency behaviour factor (4 items, $\alpha = 0.92$), which referred to items individuals typically encounter every day and are expected to be of common knowledge of how to dispose of them properly, i.e., recycling plastic; and lastly, a responsible consumption factor (4-items, $\alpha = 0.89$) of which items appear to tap into behaviour complimentary to recycling, such as shopping habits but also the conservation of resources. Scores in the factor were calculated for each factor to be used in subsequent analyses.

Recycling attitude scale (Tilikidou et al., 2002). Recycling attitude was measured using a scale adapted from Tilikidou et al. (2002). Only 15 items ($\alpha = 0.83$) of the original 28-item scale were included upon recommendation from the researchers because of their reliability analysis. The scale measures attitudes specific to recycling with items such as, "Recycling benefits are worth-while my time and effort." Items were measured on a 5-point agreement scale.

[2] See Supplementary materials S1 for details of the principal component analysis.

Pro-environmental identity scale (Whitmarsh & O'Neill, 2010). The pro-environmental identity scale consisted of four items ($\alpha = 0.61$) that were measured on a 5-point agreement scale. The scale included items such as, "I think of myself as someone who is very concerned with environmental issues."

4.2.3 Hypotheses

We expected to find a main effect of feedback on CRT performance (H1), such that participants in feedback conditions would perform more additional trials than those in the control condition. It was also expected that feedback at every trial would lead to the highest number of CRT trials completed (H2). Additionally, we expected that performance on the CRT would demonstrate a relationship with self-report PEB measures (H3). Exploratory analyses would evaluate the moderating role of individual differences in PEB constructs on the predictive relationship between feedback and the number of additional CRT trials completed (H4).

4.2.4 Analyses and Results

Overall, participants were fairly accurate on the CRT ($M = 0.81$, $SD = 0.22$). On average, the trial reaction time was 1675ms ($SD = 537$), and participants completed 88 ($SD = 72.9$) additional trials.

4.2.4.1 Feedback Effect

Descriptive statistics by condition are listed in Table 4.1. A one-way ANOVA analysis showed a main effect of feedback on the number of trials completed, $F(3,127) = 14.58$, $p = .003$, $\eta_p^2 = 0.256$

Table 4.1. Means (SD) of accuracy, RT, and additional trials performed by experimental condition, Study 1

	Control	Feedback Every 80 trials	Feedback Every 20 trials	Feedback Every trial
Overall Accuracy	0.80 (0.13)	0.85 (0.07)	0.85 (0.10)	0.85 (0.07)
Additional Block Accuracy	0.75 (0.25)	0.86 (0.16)	0.83 (0.20)	0.81 (0.25)
RT	1702 (599)	1614 (404)	1672 (528)	1734 (638)
Additional Trials	38.19 (48.29)	81.31 (61.23)	110.29 (72.12)	140.6 (73.42)

Note. Control n = 36; Feedback every 80 trials n=36; Feedback every 20 trials n=34; Feedback every trial n=25. Reaction time (RT) is reported in milliseconds.

The three planned contrasts were tested using adjusted alpha levels of .0167 per test. Comparisons using Tukey's HSD showed that all 3 planned linear contrasts were significantly different from each other: control vs. every trial ($p < .001$), control vs. 20 trials ($p < .001$), and control versus 80 trials ($p = .003$). This result provides support for hypothesis H2: individuals in the feedback at every trial condition performed the highest number of trials. We did not observe an effect of feedback on accuracy in the additional block, $F(3,127) = 1.45$, $p = .231$, on overall accuracy, $F(3,127) = 1.898$, $p = .133$, or reaction time, $F(3,127) = 0.28$, $p = .839$.

4.2.4.2 Individual Differences in PEB

Correlation analyses (Table 4.2) between performance measures and measures of pro-environmental individual differences showed that there was not a significant relationship between individual differences and the number of additional trials participants performed. We found significant correlations between accuracy and reaction time with individual differences such that individuals who reported high medium frequency behaviours tended to respond faster on the task and individuals reporting higher levels of recycling attitude, PEB frequency and PE identity also tended to perform more accurately on the task. Interestingly, overall accuracy was more strongly related to individual differences than accuracy in the additional block. Thus, hypothesis H3 is partially supported: while we observed significant correlations between individual differences and reaction time and accuracy, we did not observe a significant correlation between individual differences and the number of additional trials performed.

We conducted moderation analyses with each factor separately to observe if accounting for individual differences may alter the predictive value of feedback on performance in the CRT. We compare the control condition and feedback on every trial condition to maximize performance differences. The moderation analyses revealed no significant interactions between Low-frequency PEB, Medium-frequency PEB, High-frequency PEB, Recycling Attitude, or Pro-environmental identity in predicting the number of additional trials participants performed, accuracy, or reaction time (see Appendix B for full details), but accuracy in the additional block was more strongly related to additional trials. Thus, hypothesis H4 was not supported.

Overall, results indicate that feedback supported behaviour maintenance as indicated by the number of additional trials participants chose to complete in the feedback conditions compared to the control. Additionally, accuracy and reaction time were related to self-report individual differences validating the task.

Table 4.2. Correlations between all measures in Study 1

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Additional Trials	.02	.02	.14	-.02	-.03	.00	-.26	.19	.32*
1. Low-frequency behaviour		.31*	.56***	.49***	.35***	.29*	-.02	.30*	.17
2. High-frequency behaviour			.18	.55***	.64***	.45***	.18	.36***	.21
3. Medium-frequency behaviour				.52***	.19	.39***	-.33***	.43***	.28*
4. Sustainable consumer behaviour					.60***	.65***	-.04	.54***	.21
5. Recycling Attitude						.61***	.12	.31*	.15
6. PE Identity							-.26	.46***	.37***
7. Reaction Time								-.64***	-.55***
8. Overall Accuracy									.60***
9. Additional Block Accuracy									

Note. N = 130. *p<.05, **p<.01, ***p<.001. PE = Pro-environmental

4.3 Study 2

4.3.1 Aims

In Study 2, we examined if the presentation of feedback would overcome the negative effect of context changes on recycling behaviour. Thus, this study examined the possible effect of feedback in supporting behaviour maintenance as the context of sorting rules changed. We designed the study to simulate recycling behaviour both at home and while on vacation to increase the ecological validity of the study as much as possible. Additionally, we examined if goal desire would be affected by feedback presentation. We tested if feedback had an indirect effect on behaviour maintenance by increases in motivation, or desire, towards one's goals. For Study 2 we did not include measures of individual differences given that the literature suggests there is very little correlation between pro-environmental identity, attitudes and past behaviour and PEB in novel contexts (Oliver et al., 2021).

4.3.2 Method

4.3.2.1 Participants, Procedure, and Experiment Design

We based our a-priori sample size determination on the effect of the manipulation on the number of additional trials tested with an ANOVA between-factor design focusing on the difference between the three experimental conditions (3 linear contrasts). To obtain a medium effect (f^2 = .25) with 80% power and an alpha of .05, we would need a sample of 128.

On average, participants (N = 201) were 27 years of age (SD = 9.27). Most participants identified as female (n = 131) and were from Italy (n = 189). After informed consent, participants completed the CRT, in which they were randomly assigned to one of three experimental conditions (feedback for two blocks vs. feedback for one block vs. no-feedback control). In block one, participants were asked to sort waste in a familiar context (i.e., at home) and in block two, they were asked to sort waste in an unfamiliar context (i.e., while on vacation). Therefore, participants who received feedback for two blocks experienced feedback in both familiar and unfamiliar contexts; participants who received feedback for one block only received feedback in the familiar context; and participants in the control condition did not receive feedback at all. The outcome measure of interest was the number of additional trials participants performed in the vacation context. Goal desire was also measured and included as a possible moderating variable. After the task, participants responded to a few demographic questions and were then debriefed and thanked for their participation. The entire study took about 30 minutes to complete and was available in Italian.

4.3.2.2 Materials

The CRT for Study 2 followed the basic procedure as Study 1 such that participants were presented with various everyday objects that they had to categorise into appropriate waste bins. Participants were told that they should behave on the task as they would typically at home. They responded to a few items to make salient the home context, such as asking participants to indicate if they lived in a city or countryside or if they lived in a single-family home or apartment. Waste bins were organised into 5 categories as before. However, for experimental block 1 waste bins were designed to resemble as much as possible the sorting system participants had at home. For experimental block 2, waste bins were organised into one of the alternative options and thus did not resemble the sorting system the participant used at home. Therefore, the waste sorting system used for the task followed an idiosyncratic method. Options were restricted to 5-bin systems with the intention to keep the sensory aspects of the task constant across conditions.

Participants completed 10 practice trials to familiarise themselves. Then, participants were told that their task was to dispose of trash around their home, and their goal for the task was to recycle correctly. Goal desire was measured on a 7-point agreement scale, at the beginning and the end of the first block, with the item, "How strongly would you describe your desire towards the goal to recycle correctly?" Participants completed a block of 80 trials in the familiar context in which feedback was presented according to the randomly assigned experimental conditions. Feedback was delivered at every trial since this was the frequency of which the greatest effect was seen in Study 1.

After the first block, participants were told to imagine that they would go on a 5-day vacation. They responded to a few items to make salient the vacation context, such as asking participants to indicate if they would like to stay in a city or the countryside, in a rented home or a hotel. Participants then completed a second block of 80 trials, during which feedback conditions continued. After the second block of trials, participants were then proposed to go on with the task. They were informed that they could stop whenever they felt they had reached the goal. Thus, the total task consisted of 10 practice trials and 160 experimental trials plus additional trials at the participants' choice.

4.3.3 Hypotheses

We expected to find a main effect of feedback: participants receiving feedback would perform more additional trials than the control condition (H1). Additionally, we expected to observe that participants receiving feedback for both contexts would perform more additional trials in the second block compared to the other conditions. Consequently, it was also expected that participants in the control condition would perform the least number of

additional trials in the second experimental block compared to the other conditions (H2). Lastly, we expected a main effect of condition on goal desire (H3). We expected to observe a differential increase in goal desire depending upon feedback condition. More, specifically we expected that participants who received feedback would report a stronger goal desire response compared to the control condition. If an effect of condition on goal desire is found, we also expected that goal desire may prove to be a mediating factor in explaining the relationship between feedback and the number of trials completed (H4).

4.3.4 Analyses and Results

Overall, participants were quite accurate on the task (M = 0.79, SD = 0.09). On average, the number of trials performed was 56.68 (SD = 39.81), and the reaction time was 2898ms (SD = 606). Using a one-way ANOVA analysis, we observed a main effect of condition on the number of additional trials participants performed, $F(2,198) = 6.18$, p = .002, $\eta_p^2 = 0.0635$. However, comparisons using Tukey's HSD showed that planned contrasts indicated an effect in the unexpected direction. Participants who did not receive feedback in the unfamiliar condition performed more additional trials than those who received feedback for both familiar and unfamiliar contexts (control vs. familiar p = .787; control vs. familiar and unfamiliar p = .018; familiar vs. familiar and unfamiliar p = .002); therefore, we reject hypothesis H2 (Table 4.4).

Table 4.4. Means (SD) of performance and self-report measures by experimental condition, Study 2

	Control	Familiar Feedback	Familiar and Unfamiliar Feedback
Familiar Block Accuracy	0.81 (0.07)	0.81 (0.08)	0.82 (0.07)
Unfamiliar Block Accuracy	0.77 (0.11)	0.79 (0.10)	0.80 (0.08)
Additional Block Accuracy	0.73 (0.22)	0.75 (0.17)	0.66 (0.28)
Overall Accuracy	0.79 (0.08)	0.80 (0.09)	0.81 (0.07)
Reaction Time	2226 (425)	2262 (374)	2264 (428)
Goal Desire T1	5.97 (0.98)	5.97 (0.95)	5.76 (1.09)
Goal Desire T2	6.09 (0.95)	5.97 (1.05)	5.90 (1.02)
Goal Desire difference	0.12 (0.38)	0.00 (0.94)	0.14 (0.54)
Additional Trials	60.88 (39.26)	65.34 (36.68)	42.75 (39.19)

Note. Control n = 64; Familiar Feedback n=65; Familiar and Unfamiliar Feedback n=72. Reaction time is reported in milliseconds.

We did not observe a main effect of condition on overall accuracy, $F(2,198) = 1.63$, $p = .198$, on accuracy in the familiar context ($F(2,198) = 0.711$, $p = .492$), on accuracy in the unfamiliar context ($F(2,198) = 1.597$, $p = 0.205$), on T2 goal desire ($F(2,198) = 0.618$, $p = .540$), or on goal desire difference ($F(2,198) = 0.898$, $p = .409$). Therefore, we reject hypotheses H3 and H4.

The correlations between the study measurements are included in Table 4.5. Additional trials was weakly correlated with goal desire T1 and strongly correlated with accuracy in the additional trial block. Goal desire T1, T2, and goal desire difference were all correlated with additional block accuracy. Goal desire T2, but not T1 demonstrated a weak relationship with unfamiliar block accuracy. This may suggest that goal desire T2 captured some aspects of being familiar with the task not reflected in goal desire T1.

The results indicate that feedback may have the opposite effect when individuals are in

Table 4.5. Correlations between all measures in Study 2

	1.	2.	3.	4.	5.	6.	7.	8.
Additional Trials	.16*	.13	-.05	-.09	-.02	.42***	-.07	.03
1. Goal Desire T1		.79***	-.33***	.09	.06	.20***	.07	.08
2. Goal Desire T2			.32***	.22***	.15*	.30***	.19*	-.11
3. Goal Desire Difference				.19*	.14	.15*	.18*	-.29***
4. Familiar Block Accuracy					.51	.21***	.74***	-.42***
5. Unfamiliar Block Accuracy						.52***	.95***	-.47***
6. Additional Block Accuracy							.46***	-.29***
7. Overall Accuracy								-.52***
8. Reaction Time								

Note. $N = 201$. *$p<.05$, **$p<.01$, ***$p<.001$.

novel contexts. Furthermore, feedback did not appear to be related to aspects of motivation (i.e., goal desire) or accuracy in the novel context. Thus, contrary to expectations, the effect of feedback may not be rooted in an increase in motivation, at least for unfamiliar contexts. However, Study 2 may have confounded two aspects related to unfamiliar contexts: changes in motivations and changes in sorting rules, therefore we cannot draw strong conclusions.

4.4 Study 3

4.4.1 Aims

Study 3 in part aimed to replicate findings from Study 1 but also aimed to compare recycling behaviour and goal desire in familiar and in unfamiliar contexts independently from changes in sorting rules. As such, we adjusted the experimental conditions in the CRT to compare recycling behaviour on vacation and at home while keeping the specific waste sorting rules constant. Thus, we aim to draw conclusions about relevant motivations during the task independent of changes in sorting rules. Additionally, as in Study 1, we included the measure of PEB frequency to be correlated with performance on the task.

4.4.2 Methods

4.4.2.1 Participants, Procedure, and Experiment Design

Sample size determination is focused on the analysis of the effect of feedback on number of trials completed using goal desire as a mediator. Sensitivity analysis determined that to detect a very small effect where the correlations among variables in the mediation model are 0.20 with 90% confidence level and 0.80 power, a sample size of 250 is required; to detect a small effect (r = 0.25) with 90% confidence level and 0.80 power, a sample size of 210 is required; and to detect a moderate effect (r = 0.30) with 90% confidence level and 0.80 power, a sample size of 110 is required. Participants (N = 199) were, on average, 26 years of age (SD = 10.96). Most participants identified as female (n=168) and were all from Italy.

The study was a between 2x2 design whereby there were 2 levels of a between-level feedback manipulation (feedback vs. no feedback), and 2 levels of a between-level context manipulation (home vs. vacation context). Thus, there were four, randomly assigned, experimental conditions: (1) no feedback/vacation context; (2) feedback/vacation context; (3) no feedback/home context; and (4) feedback/home context. The outcome measure of interest was the number of additional trials participants performed after the experimental block. Goal desire and self-efficacy were also measured and included as possible mediating variables. After the task, participants respond the pro-environmental behaviour frequency scale and to complete demographic questions. The entire experiment took about 20 minutes to complete. The study was available in Italian.

4.4.2.2 Materials

CRT. After informed consent, participants indicated the waste sorting system they used at home to determine the sorting system presented. Participants completed 20 practice trials and responded to a few items in reference to their home (i.e., where they live) or vacation (i.e., where they would like to stay), depending on the condition. Then participants responded to four items measuring goal desire and self-efficacy about recycling. We measured goal desire using the items, “The goal of recycling correctly is something I desire to do,” and “How strongly would you describe your desire towards the goal to recycle correctly?” (α = .88). Responses were recorded on a 7-point agreement scale, and a 7-point desire scale (from no desire to strong desire), respectively. We measured self-efficacy using the items, “I’m confident that I can recycle correctly,” and “For me recycling correctly is ....” on a 7-point agreement scale and a 7-point difficulty scale (from very difficult to very easy) respectively (α = 0.68).

After the items, participants completed the experimental block of 80 trials with the same instructions as Study 1. Participants assigned to receive feedback saw an empty bar at the top of the screen which filled-in with green, accumulating the number of items they sorted correctly. Afterwards, participants were proposed to continue with the task with a second reminder of the goal. They were informed they could stop whenever they felt they had reached their goal. Thus, the total task consisted of one practice block of 20 trials, 80 experimental trials, and additional trials at the participants' choice. We adjusted the task to use only multi-item trials to include more variability in accuracy measurements, given that in Study 1 and 2 the accuracy level was high.

Self-Report Measures. After the task, participants completed one survey assessing pro-environmental behaviour (PEB) frequency (Schultz et al., 2005; Walton & Austin, 2011) as done in Study 1. Using the same factor structure as in Study 1 we observed that all four factors demonstrated reasonable reliability: low-frequency behaviour (6 items, $\alpha = 0.81$), medium-frequency behaviour (4 items, $\alpha = 0.75$), high-frequency behaviour (4 items, $\alpha = 0.89$), and a responsible consumption factor (11 items, $\alpha = 0.80$).

4.4.3 Hypotheses

We expected a main effect of feedback: participants receiving feedback would perform more additional trials than those in the control condition (H1). Additionally, we expected a main effect of context (H2). Participants in the home condition would complete more additional trials than in the vacation context. We also expected that Goal desire would be predictive of the number of additional trials (H3) as well as self-efficacy is expected to be predictive of the number of additional trials (H4). Lastly, Goal desire was expected to mediate the effect of context on the number of additional trials (H5), and feedback was expected to moderate the mediation of goal desire on the effect of context on the number of additional trials (H14).

4.4.4 Analysis and Results

Descriptive statistics by condition are shown in Table 4.6. Using a two-way 2x2 ANOVA analysis, we observed a main effect of feedback on the number of additional trials (AT) participants performed ($F(1, 195) = 17.301$, $p = <.001$, $\eta_p^2 = 0.0815$). Participants in the feedback condition performed more additional trials than those in the control condition. Comparisons of planned contrasts using Tukey's HSD showed that, when comparing control home to the feedback home conditions, the difference in the number of trials performed was not significant ($p = .063$). We found a significant difference in the number of AT performed

when comparing feedback vacation and control vacation conditions (p = .005); when comparing feedback home and control vacation conditions (p = .03); and when comparing control home and feedback vacation conditions (p = .009). We did not find a main effect of context (F(1,195) = 0.242, p = .6236); there were no significant differences in the number of additional trials performed when comparing 'home' and 'vacation' conditions, nor did feedback interact with context (F(1,195) = 0.424, p = .515).

Table 4.6. Means (SD) of accuracy, goal desire and additional trials performed by experimental condition, Study 3

	Home Control	Home Feedback	Vacation Control	Vacation Feedback
Experimental Block Accuracy	0.83 (0.11)	0.82 (0.14)	0.80 (0.11)	0.82 (0.10)
Additional Block Accuracy	0.68 (0.24)	0.76 (0.24)	0.75 (0.22)	0.83 (0.07)
Overall Accuracy	0.81 (0.10)	0.81 (0.14)	0.81 (0.10)	0.83 (0.08)
Reaction Time	2225.10 (315.06)	2217.43 (342.09)	2266.40 (293.76)	2178.23 (301.54)
Goal Desire	6.08 (1.18)	6.28 (0.62)	6.23 (1.02)	6.02 (0.98)
Self-efficacy	5.30 (0.97)	5.43 (0.89)	5.38 (0.95)	5.12 (1.08)
Additional Trials	45.93 (34.85)	63.07 (35.27)	44.98 (33.90)	68.47 (33.02)

Note. Home Control n = 45; Home Feedback n=56; Vacation Control n = 49; Vacation Feedback n=49. Reaction time is reported in milliseconds.

Additionally we did not find a significant difference across conditions in experimental block accuracy[3], self-efficacy[4], overall accuracy[5], experimental block accuracy[6] or reaction time[7]. However, we found a significant difference among conditions when considering additional block accuracy (effect of context F(1,195) = 6.056, p = .015; effect of feedback

[3] effect of context F(1,195) = 0.218, p = .641; effect of feedback F(1,195) =0.001, p = .981
[4] effect of context F(1,195) = 0.785, p = .377; effect of feedback F(1,195) = 0.215, p = .643
[5] effect of context F(1,195) = 6.056, p = .015; effect of feedback F(1,195) = 7.54, p = .007
[6] effect of context F(1,195) = 6.056, p = .015; effect of feedback F(1,195) = 7.54, p = .007
[7] effect of context F(1,195) = 0.000, p = .37; effect of feedback F(1,195) = 1.13, p = .29

$F(1,195) = 7.54$, $p = .007$). Participants in the vacation condition ($M = .79$, $SD = 0.17$) demonstrated a higher additional block accuracy than those in the home condition ($M = .73$, $SD = 0.24$), and the feedback condition ($M = .79$, $SD = 0.18$) demonstrated a higher additional block accuracy than the control condition ($M = .72$, $SD = 0.23$). We did not find an interaction effect, $F(1,195) = 0.026$, $p = .874$. We conducted further correlation analyses across contexts, to explore this effect, and found that the relationship between AT and additional block accuracy was stronger for the home context ($r = .51$, $p = <.001$) than for the vacation context ($r = .41$, $p = <.001$).

Self-report measures were significantly related to performance on the task. In particular, AT was weakly related to goal desire and the responsible consumption factor but strongly related to accuracy in the additional trials block. Individuals who completed more additional trials tended also to report higher levels of goal desire, responsible consumption behaviour, and had a higher accuracy in the additional block. We tested if goal desire mediated the relationship between feedback and AT. While the model was significant, $F(2,196) = 11.04$, $p<.001$, $R^2 = .10$. The direct relationship between feedback condition and goal desire was not significant ($p = .999$), nor the mediated effect.

We did not find a significant relationship between self-efficacy and AT (Table 4.7). Self-efficacy was weakly correlated with reaction time (negatively) and with accuracy in the additional trial block but showed a moderate relationship with the responsible consumption factor, and accuracy in the experimental block. Self-efficacy demonstrated a strong relationship with the high frequency behaviour factor, which implied that those who recycle more often (i.e., plastic, paper, glass, organic and metal materials) tended to report higher self-efficacy to recycle during the task. Given that both self-efficacy and additional trials, but not goal desire, were significantly correlated with accuracy in the additional block, it would suggest that self-efficacy may play a more important role in behaviour maintenance than goal desire.

These results replicate findings from Study 1: feedback supported continued performance on the task, as indicated by the number of additional trials participants performed when comparing conditions. However, given that we did not find an effect of context, we cannot conclude that the result observed in Study 2 was due to motivational aspects related to being on vacation and suggests the role of sorting rule changes as a possible factor to explain the results.

Table 4.7. Correlations between all measures in Study 3

	1	2	3	4	5	6	7	8	9	10
Additional Trials	.14*	.09	.12	.16*	.04	.13	-.15*	.05	.46*	.13
1.Goal Desire		.40***	.15*	.20*	.46***	.24***	.16*	.25***	.10	.25***
2.Self-efficacy			.14	.09	.40***	.22***	-.16*	.29***	.17*	.30***
3.Low-frequency behaviour				.65***	.19*	.38***	.12	-.07	.01	-.09
4.Medium-Frequency behaviour					.06	.39	.03	-.02	.10	-.02
5.High- frequency behaviour						.17*	-.09	.41***	.21***	.37***
6. Responsible Consumption							.01	.01	-.01	.01
7.Reaction Time								-.38***	-.37***	-.43***
8.Experimental Block Accuracy									.46***	.95***
9.Additional Block Accuracy										.61***
10.Overall Accuracy										

Note. $N = 199$. *p<.05, **p<.01, ***p<.00.

4.5 General Discussion

The present research project aimed at testing the effect outcome-feedback had on recycling behaviour and if outcome-feedback supported the maintenance of recycling behaviour across contexts. We developed an in-lab computerised task to simulate recycling behaviour to limit the disadvantages associated with self-reported behaviour and to experimentally control for context.

Study 1 focused on testing if outcome-related feedback frequency contributed to the behaviour maintenance of recycling behaviour. A main effect of feedback was observed in the number of additional trials participants performed, and contrast analyses confirmed that participants in the feedback at every trial condition performed the highest number of trials, in comparison to the other two feedback conditions. A similar result was found in Study 3, where individuals in the feedback condition completed more trials than those in the control, independent of the context. It is thought that, particularly when relevant to the goal, feedback can support motivation to continue efforts toward that goal (Harkin et al., 2016). The current project offered a green bar at the top of the screen to allow participants to self-monitor their progress. Perhaps participants were motivated to continue behaviour repetitions because the

feedback presented also supported goal monitoring. Of course, it can be quite difficult to monitor progress without any sense of how far one is from reaching that goal, which is inherently lacking during typical recycling behaviour. The more one can understand their progress towards the goal, even better so in quantifiable terms (Chang et al., 2017), the more effective they are at monitoring their progress in turn their motivation towards the goal increases, and thus they may be more likely to achieve their goal (Harkin et al., 2016).

Study 2 focused on testing if outcome-related feedback contributed to the behaviour maintenance of recycling behaviour while considering the effects of context changes. A main effect of feedback was observed in the number of trials participants performed; however, the effect was in the opposite direction than expected. Participants not receiving feedback for the unfamiliar context completed more trials than those receiving feedback. One explanation is that participants adopted learning goals for the unfamiliar context. When the context changed from 'home' to 'vacation' and the sorting rules changed accordingly, perhaps participants were interested simply in learning the new system sufficiently. In this scenario, feedback allowed participants to decide that they had sufficient accuracy to stop the task, whereas those without feedback were unable to judge if they had adequately learned the new sorting rules. In fact, while it is only a small nonsignificant difference, participants in the feedback condition performed more accurately than those in the control condition for the novel context. These results are in line with previous research: Karlin et al. (2015) concluded that across different types of feedback, users typically engage with feedback initially while they learn how to reduce their energy consumption, but then users stop engaging with the feedback, and energy conservation decreases. Moreover, Dolnicar et al. (2017) suggest that interventions may have differing effects for individuals in unfamiliar (e.g., vacation) contexts.

In Studies 2 and 3, we observed that goal desire was positively correlated with the number of additional trials participants chose to complete. We did not observe any effect of feedback on motivation, (i.e., goal desire). One explanation is that perhaps the effect of outcome-feedback can be understood from behaviourist principles of reinforcement and punishment (Morse & Kelleher, 2022). The presentation of feedback, the use of a green bar, was focused on the behavioural outcome (i.e., accuracy). Our presentation of feedback did not offer any overt motivationally encouraging aspects, such as messages of 'good job' or 'great work'. Therefore, perhaps outcome-related feedback may not influence motivations but rather has a direct effect of reinforcing the behaviour.

Lastly, while we found significant correlations with self-report individual differences in pro-environmental behaviour frequency, recycling attitude, and pro-environmental

identity, we did not find that these differences interacted with performance on the task as expected. More specifically, we did not observe any effects of feedback condition on accuracy nor any moderation effect of accuracy on the number of additional trials performed by condition. We suspect that this was due to the overall high accuracy level in this sample. Increasing the difficulty of the task will help to observe differential performances by condition in future studies. Additionally, it is possible that the task may have gamified recycling for participants, and thus the results may overestimate behaviour in the real world. Nonetheless the task undoubtedly captures knowledge of recycling rules and organization, which would contribute to recycling behaviour.

Taken all together, results suggest that motivation and feedback for recycling behaviour are complex and are not equal in different contexts (Miao & Wei, 2013; Miller et al., 2015). However, it's still not clear if this effect is due to the change in the waste sorting system, suggesting that lack of knowledge, or self-efficacy as contributing factors, or if there is a drop in motivation due to the hedonic nature of being on vacation (Miao & Wei, 2013; Miller et al., 2015; Wu et al., 2021). The current study suggests that the change in sorting rules may have a more important role than motivations. Future studies should focus on parcelling out motivational effects from potential behavioural barriers and consider that interventions may need to consider the dynamics between unfamiliar and familiar contexts for individuals.

4.5.1 Limitations

Our study focused on five-bin sorting systems and included participants who had at least some experience with recycling; therefore, applying the results found within the study to other populations may be limited. When comparing differences in individuals who are recycling for the first time or who change from simple systems to more complicated ones (and vice versa), our results may not be applicable, and the effects may be more nuanced.

4.5.2 Conclusions

The results of this project provided two possible points of interest to consider when increasing adherence to recycling systems. Firstly, feedback may serve to reinforce recycling behaviour. Our results suggest that, at least for the short-term, individuals in new contexts would interact with feedback while learning the new sorting rules. Secondly, while recycling systems are typically designed based on infrastructure demands, the focus may be better put on the individual's interaction with waste sorting systems and anticipating the negative impact rule changes have on behaviour for when individuals inevitably change their environments. The current project focused on comparisons between home and vacation

contexts however, rule changes may, and typically do, occur across home, work, school, or other public (e.g., public transportation, airports) contexts especially if one travels across city or regional lines on a regular basis. While the current project focused on testing if feedback could be used as a relatively simple intervention to address these concerns, our results also suggest that changes in public policy may also be useful. Perhaps government bodies should be interested in implementing standard sorting rules across the state rather than allowing infrastructure differences to dictate these systems.

Chapter 5

The dynamic interplay between goals and pro-environmental behaviours: Examining recycling and sustainable consumption

Overview

In Chapter 4, we used a computerized task to investigate the effect of feedback on recycling behaviour in different contexts. While the computerized task proved to be advantageous in precisely quantifying several aspects surrounding recycling behaviour and then allowing us to make valid comparisons between contexts, the approach raised questions surrounding the ecological validity of the results. In this chapter, we aimed to adopt an ecologically valid approach to investigating the influences of motivations on pro-environmental behaviours (PEBs). In continuing to examine PEBs as goal-directed behaviours, we aimed to directly observe the effect of goals on behaviours day-by-day. Within a micro-longitudinal design, we measured behaviour occurrences and goal importance daily for 3-weeks. While the literature suggests that behaviour performances may impact future mental states (i.e., goals), to our knowledge, this has not been directly tested in an applied setting. The current study's primary aim is to observe the dynamic interplay between goals and two sustainable behaviours (i.e., recycling and green consumption behaviour). By using a time-series modelling approach, examining the cross-lagged effects between goals and behaviours over time will allow us to draw conclusions regarding the nature of the relationship between them.

5.1 Introduction

Because implementing one's beliefs may characterised as a goal (Kaiser & Wilson, 2019), many pro-environmental behaviours can be considered goal-directed behaviours (Kaiser & Wilson, 2004). Therefore, one way to address current concerns regarding environmental sustainability (Steg, 2022; Steg et al., 2005; Vlek & Steg, 2007; Winter & Koger, 2004) may be by leveraging the relationship between pro-environmental behaviours (PEBs) and goals. There is a lot of research attesting to the relationship between goals and behaviour, such that goals tend to predict behaviour (McEwan et al., 2016). It is the aim of the current study to investigate the relationship between goals and PEB.

Kaiser and Wilson (2004) suggests that PEBs may be considered goal-directed behaviours. Pro-environmental behaviours often come at a cost, both small and/or large, to the individual. For example, taking the extra effort to sort waste properly may cost an individual extra time (compared to throwing everything in one bin) and purchasing sustainably packaged products, in some cases, can cost more money compared to unstainable packaging. Therefore, pro-environmental behaviours are often behaviours in which the individual performs for a subjective reason (Greve, 2001) – the individual chooses to act in a way to protect or benefit the environment without any obvious gain (e.g., monetary, time, convenience) from their actions. These actions are part of a 'subjective reality' (Kaiser & Wilson, 2004) that is shaped by how individuals try to achieve their pro-environmental goals (Stern, 2000). Since the individual performs pro-environmental behaviours for subjective reasons, Kaiser and Wilson (2004) argues that intentions behind actions should be the focus. For example, individuals do not drive cars because they want to pollute the air, but likely because they wish for a safe and quick way to get from point A to point B. It is important to understand the 'why' behind the action, an aspect which environmental attitudes alone may not capture. A shift to a focus on PEBs as goal-directed behaviours may offer useful insights into variations into the individual performance of PEBs.

Locke and Latham (2002) described goals as "the object or aim of an action" (p. 705). Additionally, goals are often conceptualised as mental representations of behaviours or behavioural outcomes (Dijksterhuis & Aarts, 2010). According to Dijksterhuis and Aarts (2010), goals are the starting point of arguably all behaviour because goals tend to be linked to specific actions and, in return, provide a reference point for cognition and action. In fact, the Goal-Framing theory suggests that goals "frame" what individuals attend to and thus may

affect what knowledge or attitudes are cognitively accessible, the strength of the goal, and subsequent behaviour (Lindenberg & Steg, 2007). Lindenberg and Steg (2013) describe human beings as predisposed to strive towards improvements. They further outline that behaviour is chronically one-sided – improvement will be selective, depending on the overarching goal that is focal at a given moment. Thus, the relative strength of one's goal at any given time should be a strong predictor of subsequent behaviour.

Additionally, research has suggested that goals related to doing behaviours compared to not doing behaviours are not simply the opposite of one another. Instead, they can be understood as having separate underlying goal systems (Richetin et al., 2011; Richetin et al., 2020; Richetin et al., 2012). Goals related to not performing sustainable behaviours tend to follow themes related to the difficulties or inconveniences of sustainable behaviours (e.g., they require too much effort) (Richetin et al., 2012). Richetin et al. (2012), in examining resource consumption, showed that the most common goal towards reducing resource consumption was to "save, protect, and respect nature", whereas the most common goal towards not reducing resource consumption was to "maintain one's lifestyle". Their findings suggest that the strength of both the doing and not doing goals reported by participants were significant predictors of PEBs. Taking the literature surrounding the effects of goals on behaviour together, the underlying assumption appears to be that goals precede behaviour, with little comment on the possibility of a dynamic relationship between the two. Is it possible that behaviours can also influence subsequent goals?

A lot of success has been reported in the goal-setting literature with respect to the power of goals to predict behaviour (McEwan et al., 2016). Individuals in goal-setting interventions tend to show greater behaviour change (in positive directions) than individuals in control conditions across a wide range of behaviours and settings (e.g., school, workplace, exercising) (Epton et al., 2017). The goal-setting literature leaves open the possibility that previous behaviours may impact future goals through feedback or self-monitoring such that behavioural outcomes provide motivational incentives to continue (Locke & Latham, 2002, 2013, 2019), justifying in the individual's mind that they are 'on track'. Goal Setting theory suggests that for an intervention to be successful, two conditions should be met: the goal must be conscious and specific, and the goal must be sufficiently difficult (i.e., over and above what is usually achieved) (Locke & Latham, 2002). Specific and difficult goals (e.g., 'lose 10kg') tend to show greater behaviour change effect sizes in goal-setting interventions compared to vague easy goals (e.g., 'exercise more') (Kleingeld et al., 2011). For difficult goals, a sense of progress may have an influence on the strength of the goal in the future. In

fact, Huang and Bargh (2014) suggest that goals have rewarding properties and imply that goals drive behaviour through motivational processes – incremental achievement towards an overarching goal is a powerful motivator for individuals to continue.

Kaiser and Wilson (2004) suggest that within the PEB domain, the strength of the relevant conservation or sustainable goal that drives individuals to perform PEBs is evident in their continued willingness to overcome the likely hurdles, demands and sacrifices that come along with most PEBs. Therefore, it is possible that for individuals who continue to strive towards their sustainable or conservation goals, their past behaviour has contributed to the strength of the goal moving forward. Research has shown that for individuals who were prompted by their past pro-environmental actions, their pro-environmental identity was strengthened. In turn, individuals high in pro-environmental identity reported stronger behavioural intentions than those low in pro-environmental identity (Van der Werff et al., 2014). The link between identity and behaviour has been found in many studies (Geiger et al., 2019; Sharma et al., 2020; Wang et al., 2021). Van der Werff et al. (2014) conclude that past behaviour, pro-environmental identity, and future behaviour have a dynamic relationship. We suggest that perhaps the effect may be better characterised more broadly by a dynamic relationship between behaviour and goals, and identity may help explain this relationship through the rewarding value the behaviour has for specific individuals.

5.1.1 Study Aims

While the literature suggests that behaviour performances may impact future mental states (i.e., goals), to our knowledge, this has not been directly tested in an applied setting. The current study's primary aim is to observe the dynamic interplay between goals, specifically goal content and goal strength, and the frequency two sustainable behaviours (i.e., recycling and green consumption behaviour). Within a micro-longitudinal design, we measured behaviour occurrences and goal importance daily for 3-weeks. Examining the cross-lagged effects between goals and behaviours over time allowed us to draw conclusions regarding the nature of the relationship between them.

We aimed to investigate how goals are related to behaviour on any given day but also how goals and behaviours interact with future goals and future behaviours over an extended period. Specifically, we tested for directional effects compared to dynamic effects using the cross-lagged panel design. This design allowed us to directly test the effects between goals and behaviours while considering daily variations within and between individuals. To our knowledge, this model within pro-environmental behaviour has not been used previously. Results would have implications for goal-setting interventions: if goals are found to be

influenced by previous behaviour occurrences, then progress monitoring or feedback could be considered essential, not additive, within the intervention.

Additionally, we aimed to investigate the role of pro-environmental identity in the relationship between behaviour and goals. Given that the link between identity and behaviour has been found in many studies (Geiger et al., 2019; Sharma et al., 2020; Wang et al., 2021), we suggest that pro-environmental identity could augment the relationship between behaviours and goals. The current study design allows us to test the effect of pro-environmental identity at different points within the dynamic model, permitting us to draw conclusions about at which point pro-environmental identity may have the greatest effect. The results of the current study would contribute to pro-environmental behaviour research by attesting to the importance of the rewarding value of behaviours. Pro-environmental identity may prove to be a critical individual difference to tap into when considering the promotion of sustainable behaviours, not only because of the driving factors associated with beliefs and attitudes but perhaps due to the level of reward individuals experience from behaviour occurrences that strengthens the relationship between behaviours and goals.

In focusing on two sustainable behaviours, we aimed to capture possible variations in the effect depending upon the specific behaviour. Recycling behaviour includes actions such as placing plastic, paper, metal glass, etc., items in their appropriate bins both inside and outside the home. Green consumption behaviour includes actions such as avoiding purchasing plastic items, avoiding buying in excess, and purchasing reusable items. While recycling and green consumption behaviours may be considered similar enough (i.e., both related to the household), they are also sufficiently different as they are related to varying degrees of difficulty regarding time, energy and money requirements. Thus, we aimed to demonstrate the robustness of the dynamic effects by testing the model using two different behaviours.

5.2 Methods

5.2.1 Study Design and Procedure

The study followed a longitudinal ecological momentary assessment design. Participants were recruited through the university network and through convenience sampling. Participants had to be at least 18 years old with reliable email access. After providing informed consent, participants were assured that their email was used solely to distribute the survey, would not be shared with anyone, and would be deleted at the end of the project.

The entire experiment duration was 22 days, including the baseline questionnaire. The baseline measure took about 30 minutes, and each daily dairy took 5 minutes of their time. Participants could withdraw from the experiment at any time and were given the option to receive a personalised report of their responses at the end of the study. Participants had the option to either receive credits or monetary compensation for their participation (at least 75% of the study). Participants were given three opportunities to recover a missed assessment. More than 2 missed assessments in a row resulted in exclusion from the study.

Participants were told the study was about consumer behaviours and that the study would be 22 days long. After informed consent, participants were asked to complete the baseline survey measuring past pro-environmental behaviour frequency and pro-environmental identity, along with demographic information. For the following 21 days (24 including make-up measurements), participants completed daily diary measurements assessing goal importance, recycling behaviour and green consumption behaviour. Participants received an email notification at 19:00 to complete the daily diary entries. A reminder was sent at 21:00 if they still hadn't completed the survey at that time. The survey remained open until noon the next day. Upon completion, participants were debriefed and allowed to request a report of their daily behaviour responses.

5.2.2 Measures

5.2.2.1 Baseline Measures

Pro-environmental Identity Scale. The pro-environmental identity scale field (Whitmarsh & O'Neill, 2010) consisted of four items that were measured on a 7-point Likert scale. The scale demonstrated poor reliability with a Cronbach's alpha of 0.45. The scale included items such as, "I think of myself as someone who is very concerned with environmental issues." Due to the low reliability results with the pro-environmental identity measure should be interpreted with caution.

5.2.2.2 Daily Diary Measures

Goals. The results of a pre-test measuring goals individuals indicate referring to recycling and green consumption behaviours produced a list of the 5 most common goals (see Appendix D). During the baseline questionnaire, participants were asked to select one of these goals as most relevant to them regarding doing and not doing each behaviour separately. Of these selected goals, we asked participants to indicate, on a 7-point scale, how important each goal was for each measurement day (1= not important at all, 7=very important). In total, there were four-goal ratings for each measurement day (i.e., recycling

doing, recycling not doing, sustainable consumption doing, and sustainable consumption not doing).

Sustainable Behaviours. In a similar fashion to Bissing-Olson et al. (2016)'s longitudinal study, for each measurement day, we asked about the frequency of two sustainable behaviours: recycling (at home and outside of the home) and sustainable consumption behaviours. Participants were asked whether they performed several behaviour indicators of each type (yes/no format), such as "Did you recycle plastic today?", or "Did you purchase any plastic today?". The summation of the behaviour indicators (19 items concerning recycling and 10 items concerning green consumption) was used for analyses. The results indicated that the recycling behaviour indicators (Ω_{home} = .73; Ω_{out} = .89; Ω_{total} = .87) and the sustainable consumption indicators (Ω = .76) demonstrated reasonable-good reliability.

5.2.3 Sample Size

Sample size determination focused on the planned cross-lagged panel analysis. Multilevel modelling centres on the number of measurement occasions, not only on the number of participants. Research using simulation studies for a continuous time model (including between-person variance, which is a univariate version of the cross-lagged model) suggests that for a 3-week study (21 measurements), a sample size of 100-250 would be able to detect a high auto-effect and minor individual differences (Hecht & Zitzmann, 2021). Furthermore, research using real data with a wide range of measurement occasions (1304-90849) suggests that a sample size of 1616 occasions would allow for reasonable fit statistics using the cross-lagged model (Orth et al., 2021). Thus, we aimed to collect data from 200 participants with the goal of at least 150 complete data (after accounting for attrition) for the final analysis.

5.2.4 Hypotheses

Goals predict behaviour (H1). Following the literature, we expected to find that goal importance on day 1 is predictive of behaviours on day 1 (H1.1). Additionally, an analysis of the time-lagged relationship between goal importance on day n and behaviours on day n+1 will allow for conclusions about the robustness of the effect of goal importance on behaviour (H1.2). We also aim to compare the effects of doing and not doing goals. We expected to find that doing goal importance is more predictive of behaviours than not doing goal importance, such that doing goal ratings demonstrate a positive relationship with behaviour (H1.3) and not doing goal demonstrate a negative relationship with behaviour (H1.4). Lastly, we aimed

to explore if the predictive value of goal importance on behaviour is similar in magnitude for both behaviours (H1.5).

Behaviour predicts goals (H2). The hypotheses regarding behaviour predicting goal importance are similar to H1 but with a focus in the opposite direction. We aimed to test if the time-lagged relationship between behaviour on day n and goal importance on day n+1 will allow for conclusions about the robustness of the effect (H2.1). We also aimed to compare the effects of doing and not doing goals. We aim to test if the behaviour is more predictive of doing goal importance compared to not doing goal importance. We expected to find that behaviours demonstrate a positive relationship with doing goal ratings (H2.2) and a negative relationship with not doing goal ratings (H2.3). Lastly, we aimed to explore if the predictive value of behaviour on goal importance is similar in magnitude for both behaviours (H2.4).

The relationship between goals and behaviours is characterised as a dynamic relationship (H3). In this hypothesis, we aimed to test if daily goal importance demonstrates a directional relationship in predicting daily behaviours or if the relationship is better characterised as dynamic. We expected to find a dynamic relationship (i.e., daily goal importance predicts behaviour as well as daily behaviour, in turn, predicts goal importance) based on the literature regarding the reinforcing nature of behaviours.

Pro-environmental self-identity augments the dynamic relationship between goals and behaviour (H4). Lastly, we aimed to test if individual differences in pro-environmental identity influences the relationship between goal importance and behaviour. Specifically, we were interested in the time-lagged relationship between behaviour on day n and goal importance on day n+1 (H4.1). This would allow us to draw conclusions about the reinforcing nature behaviour may have for people high in pro-environmental identity. Additionally, we include exploratory analyses regarding the influence of the time-lagged goal day n and goal day n+1 relationship (H4.2), the time-lagged behaviour day n and behaviour day n+1 relationship (H4.3) and lastly, the time-lagged goal importance day n and behaviour day n+1 relationship (H4.4). We plan these analyses for both behaviours (H4.5) and with the doing and not doing goal importance distinctions (H4.6), with the aim to explore and examine any differences in the above effects.

5.2.5 Analysis

Dynamic structural equation modelling (DSEM) allows us to include multilevel extensions of autoregressive (AR) models, which model time-variant parameters and the relationships among them. Using the vector autoregressive VAR(1) model with a time lag of

one, we model the temporal within-person deviations from the person-specific means by regressing a vector with observations at occasion *t* on the vector of observations at the preceding occasion (Figure 5.1).

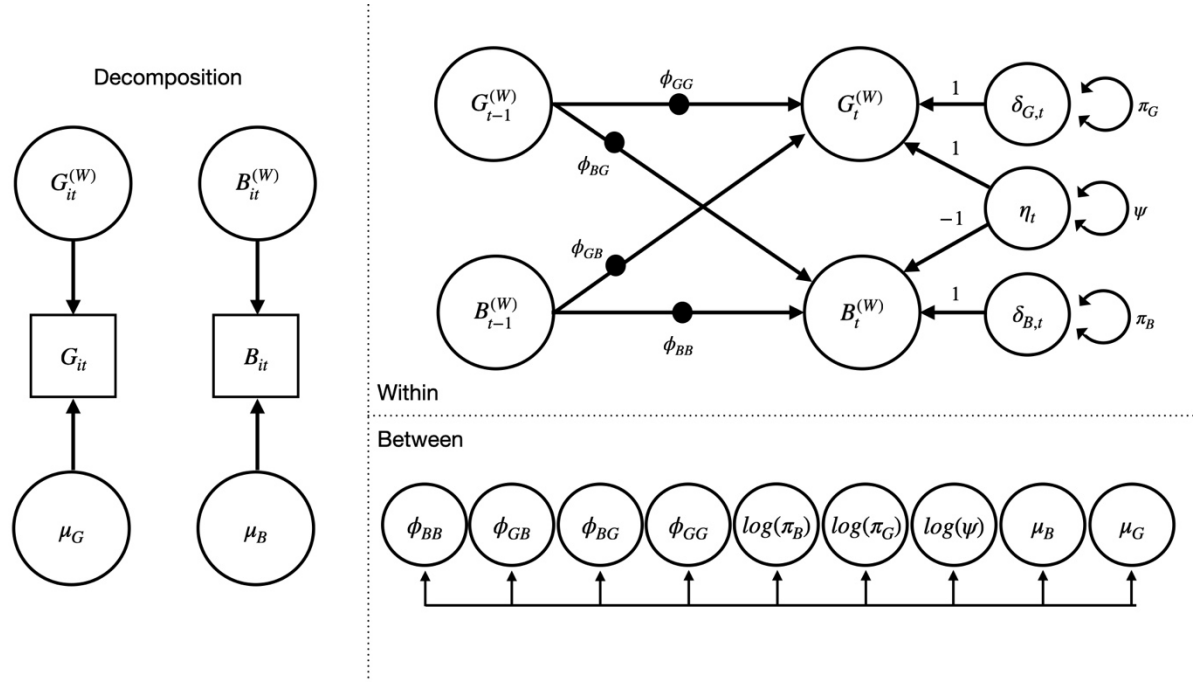

Figure 5.1. Representation of the multilevel VAR(1) model with random innovation variances and covariance. The left part represents the decomposition into within-person (time-varying) and between-person (time-invariant) components. The top right shows the within-person level model. The bottom right shows the between-person level model, which includes the between-person components of the observed data as well as all the random effects of the model, represented with the solid black. The random variances at the within-person level are modelled using their log at the between-person level. $_i$ = each individual. $_t$ = each time occasion. G_{it} = goal importance ratings. B_{it} = behaviour frequency. μ_G= within-person means for goal importance. μ_B= within-person means for behaviour frequency. $G_{it}^{(W)}$ = the temporal deviations from μ_G. $B_{it}^{(W)}$ = the temporal deviations from μ_B. ϕ_{GG} = the autoregressive pathway between $G_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{BB} = the autoregressive pathway between $B_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. ϕ_{BG} = the cross-lagged pathway between $B_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{GB} = the cross-lagged pathway between $G_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. δ = the residuals or innovations. η = the shared residuals or innovations. π = the unique residuals or innovations. ψ = negative covariance between individuals.

Thus, the data is decomposed into within-person and between-person components, where G_{it} and B_{it} represent goal importance (G) and behaviour (B) scores of individual *i* at time *t*. The μ's are the within-person means that form the between-person part of the model,

and $G_{it}^{(W)}$and $B_{it}^{(W)}$ represent the temporal deviations of individual *i* at occasion *t* from these within-person means.

The particular model chosen for the present analysis was adapted from Hamaker et al. (2018) and can also be referred to as a multilevel extension of a cross-lagged panel model, allowing for individual differences in means and lagged effects, including random means and random lagged parameters. The innovation variances and their covariance were fixed to be equal across individuals, estimated at the within-person level, ψ, and modelled using their log at the between person level, log (ψ).

5.2.5.1 Priors

For the models, we used a Bayesian estimator. The prior distribution for unknown parameters was defined using the defaults included in Mplus. For the means and intercepts, a univariate prior with mean zero and variance equal to 10^{10} is the default, and for the covariance matrices, an inverse Wishart distribution with a zero matrix for scaling and degrees of freedom equal to the number of variables less 1 is the default (Hamaker et al., 2018).

5.3 Results

5.3.1 Descriptive Statistics

An initial 225 (female = 176) participants entered the study website, whereas 153 participants completed the study in full. A further nine participants were excluded based on acquiescent responses, leaving the final total to be 144 (118 female) complete participant data, which resulted in 3130 daily diary data points. On average, our final sample was 24 years of age (*SD* = 4.99), 56% reported having an income of less than 12,000 euros, 65% reported living at home with their parents, 43% reported having a master's degree, 67% reported living in an apartment, 71% reported having their waste collected directly at home, and 80% reported being students.

We conducted an analysis of the intra-class correlation coefficient (ICC) for the six variables of interest (i.e., daily goal importance, and daily behaviours) in the study. We did so by fitting an 'empty' multilevel model with only the variable of interest included, allowing for random intercepts and random slopes. Based on the output of this model, we then computed the ICC using the estimates for the intercept and the residuals. The ICC for daily goal importance and daily behaviours demonstrates a substantial amount of variation at the within-person level, justifying the use of a multi-level model for this data. Based on the ICC we observed that 41% (ICC = 0.594) of the variation in recycling doing goal importance, 42

% (ICC = 0.594) of recycling not doing goal importance, 45% (ICC = 0.546) of sustainable consumption doing goal importance, 46% (ICC = 0.537) of sustainable consumption not doing goal importance, 49% (ICC = 0.506) of recycling behaviour, and 80% (ICC = 0.200) of variation in sustainable consumption behaviour is explained by within-persons variation. From the ICC analyses, it can already be noted that there is a substantial difference in the variation between recycling and sustainable consumption behaviours. Sustainable consumption appears to be much more varied than recycling in our sample.

Table 5.1. Point estimates (posterior means) and 95% credible intervals for fixed effects (i.e., means) and random effects (i.e., variances)

	Model 1		Model 2		Model 3		Model 4	
Variable	Fixed effects	Random effects	Fixed effects	Random effects	Fixed effects	Random effects	Fixed effects	Random effects
$\phi_{GG,i}$	**0.179 [0.12,0.24]**	**0.06 [0.04,0.09]**	**0.17 [0.11,0.23]**	**0.07 [0.04,0.10]**	**0.15 [0.09,0.21]**	**0.06 [0.04,0.09]**	**0.17 [0.11,0.23]**	**0.06 [0.04,0.10]**
$\phi_{BB,i}$	**0.25 [0.19,0.30]**	**0.03 [0.02,0.06]**	**0.09 [0.03,0.15]**	**0.06 [0.04,0.09]**	**0.25 [0.20,0.31]**	**0.04 [0.02,0.07]**	**0.09 [0.03,0.14]**	**0.06 [0.04,0.09]**
$\phi_{GB,i}$	0.02 [-0.002,0.03]	**0.002 [0.001,0.004]**	0.03 [-0.01,0.07]	**0.01 [0.002,0.01]**	0.003 [-0.02,0.02]	**0.002 [0.001,0.004]**	0.01 [-0.03,0.05]	**0.01 [0.003,0.02]**
$\phi_{BG,i}$	0.001 [-0.16,0.15]	**0.16 [0.06,0.31]**	-0.04 [-0.10,0.03]	**0.02 [0.01,0.05]**	-0.02 [-0.16,0.12]	**0.12 [0.05,0.26]**	-0.04 [-0.10,0.03]	**0.02 [0.01,0.05]**
$\mu_{G,i}$	**4.96 [4.76,5.16]**	**1.55 [1.20,2.02]**	**4.61 [4.39,4.82]**	**1.71 [1.34,2.19]**	**4.90 [4.70,5.10]**	**1.53 [1.19,1.99]**	**4.53 [4.30,4.75]**	**1.84 [1.45,2.38]**
$\mu_{B,i}$	**8.59 [8.19,0.03]**	**6.28 [4.84,8.31]**	**4.38 [4.27,4.50]**	**0.34 [0.24,0.49]**	**8.58 [8.16,9.01]**	**6.16 [4.18,8.25]**	**4.38 [4.27,4.50]**	**0.35 [0.24,0.50]**
$Log(_{\varphi,i})$	**-4.38 [-5.21,3.83]**	**0.67 [0.24,1.33]**	**-3.43 [-4.00,-3.00]**	**1.32 [0.67,2.14]**	**-4.45 [-5.09,-3.84]**	**0.67 [0.26,1.32]**	**-2.87 [-3.36,-2.46]**	**2.00 [1.14,2.96]**
$Log(\pi_{G,i})$	**-0.67 [-0.87,-0.46]**	**1.50 [1.15,1.99]**	**-0.27 [-0.47,-0.09]**	**1.16 [0.87,1.55]**	**-0.47 [-0.66,-0.28]**	**1.28 [0.98,1.70]**	**-0.32 [-0.55,0.12]**	**1.39 [1.04,1.88]**
$Log(\pi_{B,i})$	**1.54 [1.42,1.65]**	**0.44 [0.32,0.60]**	**0.32 [0.16,0.49]**	**0.90 [0.69,1.20]**	**1.54 [1.42,1.66]**	**0.42 [0.31,0.58]**	**0.29 [0.13,0.46]**	**0.89 [0.67,1.20]**

Note. Model 1 = Doing goal and recycling. Model 2 = Doing goal and sustainable consumption. Model 3 = Not-doing goal and recycling. Model 4 = Not-doing goal and sustainable consumption. Significant effects are formatted in bold. . $_i$ = each individual. μ_G= within-person means for goal importance. μ_B= within-person means for behaviour frequency. ϕ_{GG} = the autoregressive pathway between $G_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{BB} = the autoregressive pathway between $B_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. ϕ_{BG} = the cross-lagged pathway between $B_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{GB} = the cross-lagged pathway between $G_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. δ = the residuals or innovations. η = the shared residuals or innovations. π = the unique residuals or innovations. ψ = negative covariance between individuals.

All four VAR(1) models demonstrated good fit indices as indicated by an examination of the Potential Scale Reduction Factors which were close to 1, following conventional guidelines. Table 5.1 presents the fixed and random effects for all four models. From these estimates, there is evidence that, on average, over time, there is a significant amount of variation in daily goal importance ratings and daily behaviours. While the effects are significant ($\phi_{GG,i}$ and $\phi_{BB,i}$) the small estimates suggest a substantial amount of variation left unexplained. Furthermore, the results suggest that there was no effect of goal importance at time t-1 on behaviours at time t across individuals ($\phi_{BG,i}$) for all of the models, suggesting that goal importance ratings do not have a lasting effect on future behaviours. The same conclusion can be drawn for the effect of behaviour at time t-1 on goal importance at time t across individuals ($\phi_{GB,i}$) – suggesting we did not find enough evidence to support a dynamic model of goals and behaviours.

5.3.2 Within-Person Effects

The autoregressive effects for goal importance ($\phi_{GG,i}$) were comparably strong for all models, suggesting that overall, individuals tend to be moderately consistent in their goal importance ratings over time for both behaviours (Table 5.2). The exception being with Model 3 (i.e., not doing goal and recycling), suggesting that doing goals with respect to recycling are more consistently rated than not doing goals. Significant estimates ranged from 0.15 to 0.18, suggesting a fair amount of variation in goal importance ratings left unexplained.

We observed a notable difference between the behaviours when comparing recycling and sustainable consumption. The autoregressive effects ($\phi_{BB,i}$) for recycling were higher than those for sustainable consumption, suggesting that individuals were more consistent in their recycling behaviours over time compared to sustainable consumption.

Additionally, we found a small significant effect of the $\phi_{GB,i}$ path (0.04) for doing goal (DG) and recycling behaviour but not for sustainable consumption. This result suggests that only for recycling, behaviour at time t-1 has a small effect on goal importance at time t. This result offers some evidence for the rewarding hypothesis, which is to say that previous behaviours influence future goals, although the effect is quite small. We did not observe any other dynamic effects for the not doing goal models. Lastly, for all models we didn't find an effect of past goals on future behaviours ($\phi_{BG,i}$), suggesting that the effect of goals on behaviour is within-day specific and does not have a lasting effect over time.

Table 5.2. Point estimates (posterior means) and 95% credible intervals for standardised within-person effects

Variable	Model 1	Model 2	Model 3	Model 4
$\phi_{GG,i}$	**.18** **[.14, .22]**	**.17** **[.12, .21]**	**.15** **[.11, .19]**	**.17** **[.13, .21]**
$\phi_{BB,i}$	**.25** **[.20, .29]**	**.09** **[.05, .13]**	**.25** **[.21, .29]**	**.09** **[.05, .13]**
$\phi_{BG,i}$	-.02 [-.06, .2]	-.02 [-.06, .02]	-.02 [-.06, .01]	-.02 [-.06, .02]
$\phi_{GB,i}$	**.04** **[.002, .08]**	.04 [-.003, .07]	.01 [-.03, .04]	.01 [-.03, .05]
$\pi_{G,i}\delta_{G,i}$	**.86** **[.82, .89]**	**.84** **[.80, .97]**	**.88** **[.84, .90]**	**.80** **[.74, .83]**
$\pi_{B,i}\delta_{B,i}$	**.88** **[.85, .91]**	**.88** **[.86, .91]**	**.87** **[.84, .90]**	**.86** **[.83, .89]**
R_G^2	**.14** **[.12, .18]**	**.16** **[.13, .20]**	**.12** **[.10, .16]**	**.21** **[.17, .26]**
R_B^2	**.12** **[.10, .16]**	**.12** **[.09, .14]**	**.13** **[.10, .16]**	**.14** **[.11, .17]**

Note. Model 1 = Doing goal and recycling. Model 2 = Doing goal and sustainable consumption. Model 3 = Not-doing goal and recycling. Model 4 = Not-doing goal and sustainable consumption. Significant effects are formatted in bold. $_i$ = each individual. ϕ_{GG} = the autoregressive pathway between $G_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{BB} = the autoregressive pathway between $B_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. ϕ_{BG} = the cross-lagged pathway between $B_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{GB} = the cross-lagged pathway between $G_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. δ = the residuals or innovations. π = the unique residuals or innovations.

5.3.3 Between-Person Effects

Examining the between-persons level correlations among the effects, we found that all models demonstrated a significant correlation between the mean goal importance rating and the mean behaviour (Tables 5.3 and 5.4). Therefore, on average goals tend to be moderately related to their respective behaviours. These effects were higher for recycling models (0.39) compared to sustainable consumption (0.25-0.29). This result suggests that individuals still tend to perform recycling and sustainable consumption behaviours even when seemingly motivated not to perform them. Interestingly, for sustainable consumption, not doing goals (NDG) appears to be more strongly related to behaviour than doing goals (DG). This is in line with the within-level findings, that the R^2 for behaviours and goal importance ratings were higher for the NDG compared to the DG. For sustainable consumption, motivations for

not doing the behaviour may be more heavily weighed compared to motivations in favour of doing the behaviour.

For the recycling DG model (Model 1) we found that the autoregressive parameter for goal importance $\phi_{GG,i}$ was significantly correlated with the lagged effect of goals on behaviour $\phi_{BG,i}$ (Table 5.3). This result suggests that, on average, across persons, the greater the consistency in goal importance ratings, the greater the effect of goals (t-1) on subsequent behaviours. We did not observe this effect for any of the other models.

We further observed significant correlations between the log effects. The log effects allowed us to model the unique innovations for goal importance, behaviours and the shared negative covariance. Therefore, these parameters quantify the amount of variability attributed to dynamic error, on average, across persons with respect to goal importance, behaviour performance and the relationship between these two factors. For the recycling DG model, we observed significant negative correlations between $log(\pi_{G,i})$ and $\mu_{G,i}$ and $log(\pi_{G,i})$ and $\mu_{B,i}$ (Table 5.3). Suggesting that individuals who had a larger innovation variance for goals, on average, tended to have a lower overall mean for goal importance, and a lower overall mean for behaviour. Put simply, the more varied their goal importance ratings were over time, the lower they tended to rate the goals in terms of importance, on average, and the less behaviours they tended to perform. A similar result was found for the recycling NDG model. However, only the effect between $log(\pi_{G,i})$ and $\mu_{G,i}$ was significant (Table 5.4, Model 3). These effects were not significant for sustainable consumption behaviour. This might suggest that the relationship between goal variability and behaviour is more important for explaining recycling behaviour compared to sustainable consumption behaviour.

For both recycling models we also observed significant correlations between $log(\pi_{B,i})$ and $\mu_{G,i}$ and $log(\pi_{B,i})$ and $\mu_{B,i}$. Results suggest that larger unique innovation variances were associated with a higher overall mean for goal importance, as well as a higher frequency of recycling behaviours. This effect was stronger for NDGs (Table 5.4, Model 3) than for DGs (Table 5.3, Model 1).

Table 5.3. Point estimates (posterior means) for between-persons level correlations among the effects, Doing Goal models

Variable	Model 1								Model 2							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1. $\phi_{GG,i}$																
2. $\phi_{BB,i}$	.20								-.15							
3. $\phi_{GB,i}$	.15	.27							.06	.30						
4. $\phi_{BG,i}$	**.44**	.12	.12						.17	-.27	-.12					
5. $\mu_{G,i}$	.13	.13	-.09	.25					-.13	.11	.02	.05				
6. $\mu_{B,i}$	.13	.24	-.22	-.02	**.39**				.03	.10	-.22	-.35	**.25**			
7. $Log(_{\varphi,i})$	.00	.20	.15	-.06	.07	-.02			.003	-.13	.09	-.12	-.01	.28		
8. $Log(\pi_{G,i})$	-.15	-.02	.18	-.42	**-.50**	**-.21**	.24		-.01	-.01	.19	.00	-.19	-.04	.28	
9. $Log(\pi_{B,i})$	.15	.13	.01	-.18	**.23**	**.52**	.04	.08	-.12	-.01	-.17	-.21	.19	**.78**	.43	.11

Note. Model 1 = Doing goal and recycling. Model 2 = Doing goal and sustainable consumption. Significant effects (95% credible intervals) are formatted in bold. $_i$ = each individual. μ_G= within-person means for goal importance. μ_B= within-person means for behaviour frequency. ϕ_{GG} = the autoregressive pathway between $G_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{BB} = the autoregressive pathway between $B_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. ϕ_{BG} = the cross-lagged pathway between $B_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{GB} = the cross-lagged pathway between $G_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. δ = the residuals or innovations. π = the unique residuals or innovations. ψ = negative covariance between individuals.

Table 5.4. Point estimates (posterior means) for between-persons level correlations among the effects, Not Doing Goal models

Variable	Model 3								Model 4							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1. $\phi_{GG,i}$																
2. $\phi_{BB,i}$	.22								-.11							
3. $\phi_{GB,i}$	-.09	.29							.17	.24						
4. $\phi_{BG,i}$	.21	-.12	.29						.10	-.01	.10					
5. $\mu_{G,i}$	-.04	.06	.16	.19					.11	.06	.10	-.15				
6. $\mu_{B,i}$	-.05	.23	-.11	-.13	**.39**				-.09	.11	-.13	-.33	**.29**			
7. $Log(_{\varphi,i})$	-.03	.14	.13	-.08	.04	.01			.29	-.04	.17	-.11	-.13	.38		
8. $Log(\pi_{G,i})$	-.02	.05	-.02	-.42	**-.34**	-.16	.24		-.13	-.08	-.06	.04	-.19	-.08	.33	
9. $Log(\pi_{B,i})$	-.04	.14	-.23	-.15	**.32**	**.52**	-.03	.05	.08	-.03	-.10	-.21	**.22**	**.77**	**.49**	.02

Note. Model 3 = Not-doing goal and recycling. Model 4 = Not-doing goal and sustainable consumption. Significant effects (95% credible intervals) are formatted in bold. $_i$ = each individual. μ_G= within-person means for goal importance. μ_B= within-person means for behaviour frequency. ϕ_{GG} = the autoregressive pathway between $G_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{BB} = the autoregressive pathway between $B_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. ϕ_{BG} = the cross-lagged pathway between $B_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{GB} = the cross-lagged pathway between $G_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. δ = the residuals or innovations. π = the unique residuals or innovations. ψ = negative covariance between individuals.

5.3.4 Pro-environmental Identity Analyses

Lastly, we aimed to test if individual differences in pro-environmental identity influence the relationship between goal importance and behaviour. We used the cross-lagged panel models and included pro-environmental identity within the model. To do this, we computed the correlation of the construct with each parameter. The results are presented in Table 5.5.

We found that for recycling, both doing and not doing models demonstrated similar effects. Pro-environmental identity was significantly and positively correlated with average goal importance ratings (.34). This suggests that participants who reported high pro-environmental identity also tended to report higher goal importance ratings across 3 weeks. This holds true for both doing- and not doing-related goals. We also observed a significant negative correlation between pro-environmental identity and the $log(\pi_{G,i})$ parameter (-.23). This can be interpreted to mean that participants who reported high levels of pro-environmental identity also tended to report smaller unique innovation variations in their goal importance ratings across the three weeks.

For sustainable consumption behaviours, the doing model had one significant correlation. We observed a significant negative correlation between pro-environmental. identity and the auto-regressive effect of behaviours (-.31). Therefore, participants who are high in pro-environmental identity also tend to have a smaller carry-over effect of sustainable consumption behaviours across days. For the not doing model, two effects were significant. We observed a significant negative correlation between pro-environmental identity and the auto-regressive parameter for behaviour (identical effect as the doing model), as well as the effect of behaviours on subsequent goal importance ratings (-.38). Suggesting that, participants who are high in pro-environmental identity also tend to have a smaller effect of behaviour influencing a subsequent not doing goal importance rating. Simply put, for individuals with high pro-environmental identity, previous behaviours decrease the importance of reasons not to perform sustainable consumption behaviours the next day.

Table 5.5 Point estimates (posterior means) for between-persons level correlations among the effects, and pro-environmental identity

	PEI			
	Model 1	Model 2	Model 3	Model 4
$\phi_{GG,i}$	.036	.097	.015	.110
$\phi_{BB,i}$	-.053	**-.306**	-.009	**-.306**
$\phi_{GB,i}$	-.335	-.226	-.003	**-.376**
$\phi_{BG,i}$	.127	-.034	.058	-.022
$\mu_{G,i}$	**.341**	-.028	**.336**	-.157
$\mu_{B,i}$	.053	.171	.105	.085
$Log(_{\varphi,i})$	-.251	.017	-.196	.170
$Log(\pi_{G,i})$	**-.229**	-.115	**-.238**	-.085
$Log(\pi_{B,i})$	-.035	.089	-.018	.062

Note. Model 1 = Doing goal and recycling. Model 2 = Doing goal and sustainable consumption. Model 3 = Not-doing goal and recycling. Model 4 = Not-doing goal and sustainable consumption. Significant effects (95% credible intervals) are formatted in bold. $_i$ = each individual. μ_G= within-person means for goal importance. μ_B= within-person means for behaviour frequency. ϕ_{GG} = the autoregressive pathway between $G_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{BB} = the autoregressive pathway between $B_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. ϕ_{BG} = the cross-lagged pathway between $B_t^{(W)}$ and the previous time occasion $G_{t-1}^{(W)}$. ϕ_{GB} = the cross-lagged pathway between $G_t^{(W)}$ and the previous time occasion $B_{t-1}^{(W)}$. δ = the residuals or innovations. ψ = negative covariance between individuals.

5.4 Discussion

Using a micro-longitudinal design, we measured recycling and sustainable consumption behaviour occurrences and goal importance daily for 3 weeks. The current study's primary aim was to observe the dynamic interplay between goals and two sustainable behaviours (i.e., recycling and green consumption behaviour). Specifically, we tested for directional effects compared to dynamic effects using the cross-lagged panel design, modelled after Hamaker et al. (2018). Examining the cross-lagged effects between goals and

behaviours over time allowed us to draw conclusions regarding the nature of the relationship between them.

5.4.1 Goals and Behaviours

Our results indicated that goals are related to behaviours, supporting hypothesis H1. We observed that, on average, across participants, goals were correlated with behaviours (supporting H1.1). We observed significant positive correlations between behaviours and goal importance ratings for both recycling and sustainable consumption behaviours and doing and not doing models. The positive correlation between doing goal importance ratings and PEBs is in line with previous research. Goals are often found to be predictive of behaviours, such as in goal-setting interventions (Staples et al., 2020). In particular, in previous research, the strength of overarching life goals, such as 'to help better the world', was a significant predictor of household PEBs (Barszcz et al., 2023).

Overall, recycling model correlations were greater than sustainable consumption model correlations (supporting H1.5). This may reflect the participants' experiences with the behaviour before the study. Recycling has been a topic of discussion for several years and campaigns to promote recycling behaviour in society are common (Graedel et al., 2011). Therefore, it is likely that our sample was very familiar with recycling as a concept and a behaviour. Whereas sustainable consumption is a relatively new concept, at least in mainstream society (Dimitrova et al., 2022), as such, it is possible that our sample was less familiar with 'sustainable consumption' as a concept and as a behaviour. These differences in previous experiences with each behaviour may have contributed to goal importance ratings having a stronger relationship with behaviour for recycling than sustainable consumption.

Interestingly, not doing goals were equally as correlated with recycling behaviours as doing goals (.39) in our study. Previous research with doing and not doing distinctions across a range of behaviours has demonstrated a similar effect as well. Richetin et al. (2011) found that in examining physical activity behaviours, doing intentions and not doing intentions were both positive predictors of the behaviour. Additionally, in the current study, we found that for sustainable consumption, not doing goals (.29) were more strongly correlated with the behaviour than doing goals (.25), although this difference is quite small to be meaningful. This pattern of results, a not doing construct being stronger than a doing construct, has not been reported in previous research. It appears as though even when participants reported strong reasons not to perform sustainable consumption behaviours; they still tended to do them. One possible explanation for these results is that it may also be a reflection of participants' previous experiences with the behaviour. If sustainable consumption was in fact,

relatively new to our participant sample, it is possible that the high motivations towards not doing the behaviour are a reflection of a hesitancy towards the behaviour itself. Previous research has demonstrated that individuals are more hesitant to adopt new PEBs, when that behaviour is viewed as inconvenient (Saphores et al., 2012).

Therefore, hypotheses H1.3 and H1.4 were not supported. We did not find that doing goals were more predictive of behaviours than not doing goals. For recycling, the magnitude of the effect was identical. This would suggest that both types of goals equally contribute to the performance of recycling behaviours. Individuals equally weigh the reasons to perform recycling against reasons not to recycle.

5.4.2 Behaviours and Goals

We found a small significant effect of the $\phi_{GB,i}$ path (0.04) for doing goal (DG) and recycling behaviour but not for sustainable consumption. This result suggests that only for recycling, behaviour at time t-1 had a small effect on goal importance at time t. This result offers some evidence for the rewarding hypothesis (H2.1), which is to say that previous behaviours influence future goals, although the effect is quite small. We did not observe any other dynamic effects for the not doing goal models (H2.2, H2.3, H2.4, H2.5, H2.6).

This result may be interpreted to mean that for recycling behaviour, previous behaviour occurrences influence subsequent goals. Moral licensing is an effect often reported in the behaviour spillover literature. This is when an individual performs one type of PEB but does not perform other PEBs after, with the apparent reasoning that they either have ‘done enough’ or that their previous act ‘makes up for’ the possible negatives associated with not doing the other PEB (Gholamzadehmir et al., 2019; Maki et al., 2019). It is possible that the same effect but in the opposite direction may have occurred in the current study. One can imagine that an individual may have failed to recycle the previous day and then endeavours to ‘make up for it' the following day, strengthening the relative goal. Further research would be needed to confirm this assertion, but it is in line with goal-setting theories. The goal-setting literature suggests that previous behaviours may impact future goals through self-monitoring. Individuals likely monitor and evaluate their behavioural outcomes, which, in turn, provides motivational incentives to continue (Locke & Latham, 2002, 2013, 2019). This monitoring may help the individual feel as if they are ‘on track’ with their goals. It is possible that individuals who fail to recycle previously make up for it in subsequent days to get back on track with their goals.

5.4.3 Dynamic Relationship

We tested if daily goal importance demonstrates a directional relationship in predicting daily behaviours or if the relationship is better characterised as dynamic. For all models, we didn't find an effect of past goals on future behaviours ($\phi_{BG,i}$), suggesting that the effect of goals on behaviour is within-day specific and does not have a lasting effect over time. Therefore, hypothesis H1.2 was not supported. While we did find a small effect of the $\phi_{GB,i}$ path in the doing goal recycling model, we cannot conclude that the relationship between goals and behaviours was dynamic in this context because only one path was significant. The pattern of results suggests that the behaviour itself may be an important driver across days. As discussed in section 5.4.2, previous behaviour occurrences may be an important determinant of current goal strength. The 'updating' of current goals based on previous behaviours may be further explained by Perugini and Bagozzi (2001)'s explanation of anticipated emotions. They suggest that an individual's anticipated emotions, with respect to the performance of a particular behaviour, captures the individual's appraisal of goal achievement and goal failure (Perugini & Bagozzi, 2001). Anticipated emotions change from time to time and depending on the context. It is possible that individuals incorporate their reaction to a previous failure into their anticipated future reactions with respect to goal achievement. The way in which past behaviour has an effect on future goals may work through this construct.

5.4.4 Pro-environmental Identity

We sought to investigate the role of pro-environmental identity in the relationship between behaviours and goals, given that the link between identity and behaviour has been found in many studies (Geiger et al., 2019; Sharma et al., 2020; Wang et al., 2021). The results indicated partial support for the hypotheses. We found that for recycling, both doing and not doing models demonstrated similar effects. Pro-environmental identity was significantly and positively correlated with average goal importance ratings. This suggests that participants who reported high pro-environmental identity also tended to report higher goal importance ratings, on average, across three weeks. This holds true for both doing- and not doing-related goals. These results are in line with the previous literature. Individuals high in pro-environmental identity tend to report high frequencies of PEBs (Udall et al., 2020; Udall et al., 2021).

For both models regarding sustainable consumption behaviours, we observed a significant negative correlation between pro-environmental identity and the auto-regressive effect of behaviours. Participants who were high in pro-environmental identity also tended to

have a smaller carry-over effect of sustainable consumption behaviours across days. Only for the not doing model, two effects were significant. We additionally observed a significant negative effect of behaviours on subsequent goal importance ratings. For individuals with high pro-environmental identity, previous behaviours was related to a decrease in the importance of reasons (i.e., goal importance rating) not to perform sustainable consumption behaviours the next day. For individuals high in pro-environmental identity, not doing goal importance rating were not the stronger predictor of sustainable consumption behaviours. In the doing goal model, we did not observe this effect; the influence of doing goals remained independent of pro-environmental identity.

While we did not identify any literature examining the connection between pro-environmental identity and goals, research on identity and behaviour may be in line with these findings. Van der Werff et al. (2014) demonstrated that pro-environmental identity was strengthened for individuals who were prompted by their past pro-environmental actions. In turn, individuals high in pro-environmental identity reported stronger behavioural intentions than those low in pro-environmental identity. In the current study, while we did not prompt individuals directly with their past behaviour, it can be presumed that they were reasonably aware of their behaviours given the daily diary format, and it is possible that individuals high in pro-environmental identity were more acutely aware of their past behaviours. This effect could also be related to anticipated emotions (as discussed in section 5.4.3) – perhaps individuals high in pro-environmental identity reacted to their past sustainable consumption behaviours positively and thus were less likely to rate not doing goals as highly important on subsequent days. Another possible explanation of this effect is social norms. In a replication of the Van der Werff et al. (2014) study, Liu and Ng (2023) reported that the recall of past PEB strengthened pro-environmental identity by increasing subjective norms of the behaviour. They concluded that recall of past behaviour increased the perceived commonness of PEB (i.e., subjective norm), thereby indirectly bolstering environmental self-identity and sustainable consumption behaviour through a normative social influence.

5.4.5 Doing and Not Doing

Regarding the comparison between the effects of doing and not doing goals, overall, we found few differences. In examining the within subjects' effects across days, we did not find any meaningful differences in the magnitude of the relationship between goal importance and behaviour frequency. The correlation results with pro-environmental identity suggest that participants who reported high pro-environmental identity also tended to report higher goal importance ratings for recycling, on average, across three weeks. This holds true for both

doing- and not-doing related goals. In this regard, distinctions between not doing and doing goals were not meaningfully different, suggesting that both the reasons to perform PEBs and reasons not to perform PEBs help us understand variations in the behaviour. Both of these effects can help us understand the frequency of these PEBs in future research.

We did find a small significant effect of the $\phi_{GB,i}$ path for doing goal and recycling behaviour but not for sustainable consumption. This result suggests that previous behaviours influence future goals, but only for doing goals. It appears that regarding possible causal effects between behaviours on goals, future research should focus on doing goals for recycling behaviour. On the other hand, for sustainable consumption not doing goals appeared to be influenced by pro-environmental identity. We additionally observed that for individuals with high pro-environmental identity, previous behaviours were related to a decrease in the importance of reasons (i.e., goal importance rating) not to perform sustainable consumption behaviours the next day. This may suggest that for sustainable consumption behaviors not doing goals may have a unique effects that interact with pro-environmental identity. The influence of not doing goals may be an important avenue for future research regarding sustainable consumption behaviours.

5.4.5 Limitations

One limitation of the current study is that most participants in our sample were students. It is possible that they may not practice sustainable consumption as often, or are as familiar with the concept, compared to older, independent individuals. Utilizing a student sample may have also contributed to the low reliability found with the pro-environmental identity measure. It is possible that the measure selected is more suitable for older populations. Therefore, our findings regarding sustainable consumption behaviour may not be generalizable.

Additionally, the current study focused on the relationship between goals and behaviours. To our knowledge, this study is the first of its kind to investigate the relationship between behaviours and goals using a time-series modelling approach. As such, we chose to focus on the simple effect; however, the current study cannot comment on the possible 'drivers' or mechanisms of the observed results. Therefore, future research replicating the findings with a community sample, as well as including additional constructs such as anticipated emotions and social norms, could help build upon these findings.

5.4.6 Conclusions

Overall, the results of the current study are encouraging. The effects of goals on behaviour appear to be quite nuanced. We found that goal importance ratings were predictive PEBs, but this effect was limited within the same day. The dynamic structural equation model analysis allowed us to observe a small effect of previous behaviours on subsequent goals. To our knowledge, this result is the first of its kind. This result demonstrated the utility of considering PEBs as goal-directed behaviours and may also apply to other goal-directed behaviours as well. We discussed the possibility of constructs such as anticipated emotions as a possible explanation, yet further research is needed to replicate these findings and to further tease apart the effects.

Chapter 6

Explaining variations in pro-environmental behaviour: A multi-construct approach

Overview

In Chapter 5, we used a daily diary method to investigate the effect of goals on pro-environmental behaviours. In the current study, we analysed the same data, focusing on behavioural intentions in addition to goals to explain variations in actual PEBs. The current study used constructs from various approaches to explain variations in sustainable behaviours. We considered two types of behaviours, recycling and sustainable consumption, to test the constructs' predictive robustness and to highlight the important nuances associated with each behaviour. We measured pre-volition constructs (i.e., attitudes, norms, perceived behaviour control, and behaviour desire, etc.) and perceived barriers (i.e., wealth, busyness), including a distinction between doing and not doing goals at baseline. Then, recycling and sustainable consumption behaviours were measured over a three-week period using a daily diary method. We tested for the explanatory power of the base pre-volition doing model using a Structural Equation Modelling analysis and subsequently tested for the incremental validity of not doing constructs and the perceived barriers. The pattern of results for recycling behaviour and sustainable consumption behaviours diverged greatly. We discussed how the findings suggest that recycling may be conceptualised as an incidental behaviour and sustainable consumption may be conceptualised as deliberate, highlighting the importance of considering sustainable behaviours as overlapping yet distinct. We also discuss the potential limits of pre-volition models in explaining actual behaviour.

6.1 Introduction

The world's concerns regarding environmental sustainability and the ways in which we must confront impending crises can arguably be addressed by changes in human behaviour. To this end, social psychology plays an important role in helping us understand how we can intervene to promote sustainable lifestyles (Steg, 2022; Steg et al., 2005; Vlek & Steg, 2007; Winter & Koger, 2004). One possible avenue for research into behaviour change would be to explore the antecedents and identify relevant predictors of pro-environmental behaviours as potential targets for intervention. The present paper aimed to draw on and include constructs from various approaches – namely pre-volition constructs, possible barriers, and an examination of goals – to explain pro-environmental behaviours.

Implementing one's beliefs may be characterised as a goal (Kaiser & Wilson, 2019), and many pro-environmental behaviours tend to be considered goal-directed (Kaiser & Wilson, 2004). Pro-environmental behaviours are often performed with intentions or specific reasons behind them, most often related to environmental concerns (Stern, 2000). Kaiser and Wilson (2004) suggested that concerning pro-environmental behaviour, an individual's behaviour may indicate the desire to achieve a certain conservation goal, especially if the behaviours they exhibit are difficult. Therefore, it is advantageous to consider the role of goals as a source of variations in pro-environmental behaviours. In fact, research suggests that goal setting is a useful behaviour change technique for encouraging the performance of pro-environmental behaviours (Epton et al., 2017), attesting to the important role of goals in directing behaviour.

Much like its predecessors namely the Theory of Planned Behaviour (TPB; Ajzen (1991)) and the Reasoned Action Approach (RAA; Fishbein and Ajzen (2011)) – the Extended Model of Goal-directed Behaviour (EMGB; Perugini and Conner (2000)) has proven to be a reliable model in explaining various types of environmental behaviours. This pre-volition model leverages constructs such as goal desire to explain responsible hotel consumer behaviour (Han & Yoon, 2015), energy consumption (Cheung et al., 2017), recycling (Bezzina & Dimech, 2011), and the use of public transportation (Carrus et al., 2008) behaviours. Pre-volition models (i.e., TPB, RAA, EMGB) include antecedents such as behaviour desire, goal desire, anticipated emotions, norms, past behaviour, and perceived behaviour control to explain variations in behaviour intentions. The idea being that behavioural intentions reliably precede behaviour (Fishbein & Ajzen, 2011), and constructs

such as attitudes, norms, and perceived behavioural control help to explain variations in intentions and thus behaviour. The TPB has been improved upon by considering goals; more specifically, Richetin et al. (2008) have demonstrated the ability to explain more variance in intentions to perform a behaviour above and beyond the TPB model. Therefore, using a pre-volition model with considerations of goals would be useful in explaining pro-environmental behaviours.

Considerations of goal content could also prove to be useful in explaining variations in pro-environmental behaviours. Goal-framing theory suggests that goals 'frame' what individuals attend to and thus may affect what knowledge or attitudes are cognitively accessible, the strength of the goal, and subsequent behaviour (Lindenberg & Steg, 2007). In fact, Sintov et al. (2019) found that cognitive accessibility of composting behaviours mediated the behaviour spillover effect on recycling behaviour. Goal-framing theory identifies 3 types of goal frames: hedonic, gain, and normative. Hedonic goal frames typically activate subgoals related to improvement in how one's feeling, pleasure, and mood; gain goal frames typically activate subgoals related to changes in personal resources such as money; and lastly, normative goal frames typically activate subgoals related to the appropriateness of behaviour, and what one 'ought to do' (Lindenberg & Steg, 2007). Following goal frames research, it has been shown that normative goals (i.e., doing the right thing) are strongly predictive of pro-environmental behaviour as they can be easily applied and remain dominant in changing situations (De Groot & Steg, 2009; Lindenberg & Steg, 2007). Tang et al. (2020) demonstrated this effect in their study about green consumer behaviour. In contrast, hedonic goals (i.e., pleasure-related) demonstrate a weak relationship (Lindenberg & Steg, 2007). Hameed and Khan (2020) found that normative and hedonic goal frames were strongly related to sustainable consumer intentions. This study also found that gain goal frames did not demonstrate a significant relationship with sustainable consumer intentions in their sample. The literature appears to be mixed regarding gain goals (i.e., money-related) (Chakraborty et al., 2017; Donmez-Turan & Kiliclar, 2021; Hogg & Stanley, 2020).

Furthermore, research has suggested that goals related to doing behaviours compared to not doing behaviours are not simply the opposite of one another. Instead, they can be understood as having separate underlying goal systems (Richetin et al., 2011; Richetin et al., 2020; Richetin et al., 2012). Goals related to not performing sustainable behaviours tend to follow themes related to the difficulties or inconveniences of sustainable behaviours (e.g., they require too much effort) (Richetin et al., 2012). Richetin et al. (2012), in examining resource consumption, showed that the most common goal towards reducing resource

consumption was to “save, protect, and respect nature”, whereas the most common goal towards not reducing resource consumption was to “maintain one’s lifestyle”. The present study intends to examine if qualitatively different goals differentially predict the performance of sustainable behaviours. We also aimed to examine if the inclusion of antecedents related to not doing the behaviour in the model would add additional explanatory power in the variation in sustainable behaviours.

Lastly, Attitude-behaviour-context theory suggests that any given behaviour can be understood in the context of an interaction between attitudes and contextual variables with respect to the particular behaviour (Stern, 2000). Decisions to perform sustainable behaviours are often because of desires to implement personal beliefs and/or attitudes above and beyond the potential costs. Given that, pro-environmental behaviours are often considered cumbersome, time-consuming, expensive (in some cases), and requiring extra effort to perform (Kaiser & Wilson, 2019; Kollmuss & Agyeman, 2002; Truelove & Gillis, 2018), we should carefully consider the nuances associated with pro-environmental behaviours, and not assume that each behaviour operates on identical principles. We outline these concerns considering two types of pro-environmental behaviours: recycling and sustainable consumption behaviour. Recycling behaviour which includes actions such as placing plastic, paper, metal glass, etc., items in their appropriate bins both inside and outside the home. Whereas green consumption behaviour includes actions such as avoiding the purchase of plastic items, avoiding buying in excess, and purchasing reusable items. With respect to recycling there is largely a widespread acknowledgement of the benefits of recycling to the environment, whereas green consumption behaviours are relatively new (at least compared to recycling) ways to support environmental causes. Furthermore, both behaviours are associated with varying degrees of difficulty; recycling may be more associated with difficulty due to sorting system rules and time requirements, whereas green consumption may have a monetary cost concern.

We suggest that for pro-environmental behaviours, considerations of additional perceived barriers could add explanatory power to a potential model. It stands to reason that not only one’s perceived behaviour control could influence one’s desire or intention to perform the relevant behaviour, but additionally, relevant perceptions tied to other costs that have been identified with pro-environmental behaviours (i.e., time and money) should also be considered (Ertz et al., 2016; Truelove & Gillis, 2018). Regarding pro-environmental behaviours, perceived busyness, perceived wealth, and perceived power have been shown to

explain low pro-environmental frequency (Grimmer et al., 2016; Guagnano et al., 1995; Steg & Vlek, 2009; Stern, 2000).

6.1.1 Aims

The current study aimed to test the validity of various constructs, drawing from pre-volition models, research about goals and barriers, in explaining the variance in sustainable behaviours over time. Most pre-volition studies that focus on behavioural antecedents (e.g., TPB, RAA, MGB, EMGB) aim to explain the variance in behavioural intentions. Very few studies have measured actual behaviour, even less when considered micro-longitudinally. The current study employes a daily diary method, to measure behaviour over a 3-week period. In doing so we aimed to reduce measurement error due to recall bias usually at play in self-report measures of behaviour frequency one month prior, increasing the reliability of the behaviour measurement. While this measure is still self-reported, we expected that the daily diary method would be a better proxy of actual behaviour compared to recalling behaviour of one month prior.

We focused on two types of behaviours: recycling and sustainable consumption. Given the unique nuances associated with each behaviour, we expected that the additions of perceived busyness and perceived wealth to a model would reflect relevant considerations of barriers (or difficulties) specific to each behaviour and, therefore, improve the models' ability to explain variations in behaviour. We expected that by including relevant antecedents regarding doing comparing to not doing behaviours and by including perceived barriers, we aimed to provide valuable additions to a potential model relevant to studying and explaining variations in sustainable behaviour.

6.2 Methods

6.2.2 Study Design

The study followed a longitudinal ecological momentary assessment design. Participants were recruited through the university network. Participants had to be at least 18 years old and have reliable access to email. After providing informed consent, participants were told the study was about consumer behaviours and asked to complete a baseline questionnaire and 21 daily dairy entries. Participants completed daily diary measurements assessing recycling behaviour and green consumption behaviour. They received an email notification at 19:00 to complete the entries. The survey remained open until noon the next day. Upon completion, participants were debriefed and given the option to request a report of their daily behaviour responses. Participants were assured that their email was used solely to

distribute the survey, was not shared with anyone, and would be deleted at the end of the project.

The entire experiment was completed in 22 days and was completely online. The baseline measure took about 30 minutes to complete, and each daily dairy 5 minutes to complete. Participants could withdraw from the experiment at any time. Participants received credits if they completed at least 75% of the study. They were given two opportunities to recover from a missed assessment. More than two missed assessments or two missed assessments in a row resulted in exclusion from the study.

Ethical approval for the study was provided by the Commissione per la Valutazione della Ricerca del Dipartimento di Psicologica at the Università degli Studi di Milano Bicocca (N. RM-2023-624).

6.2.3 Measures

6.2.3.1 Baseline Measures

Extended Model of Goal-Directed Behaviour. Means, standard deviations and reliabilities for all measures can be found in Appendix C. We asked participants to respond to two separate pre-volition questionnaires: one regarding recycling behaviour and a second regarding sustainable consumption behaviour. Participants first indicated a reason why they would (or would not) recycle or practice sustainable consumption behaviours within the following three weeks. We provided participants with a list of 8 goals to choose from. The list of 8 goals was informed from a pre-test (see Appendix D) and included goals that referenced normative frames (i.e., “to do the right thing”), hedonic frames (i.e., “to simplify my life”), and gain frames (i.e., “to save money”). The goal desire items were built in reference to this self-selected goal. Then, participants responded to questionnaire items measuring intentions (2 items), goal desire (2 items), attitudes (6 items), and perceived behavioural control (2 items) in reference to doing the behaviours (i.e., recycling, and sustainable consumption) and not doing the behaviours. Additionally, we measured anticipated emotions (6 items), injunctive norms (1 item), and descriptive norms (1 item) with respect to each behaviour. In total, we included 78 items. All measures demonstrated reasonable to very good reliability except for recycling not doing experiential (3 items; a = 0.38) and not doing instrumental attitudes (3 items; a = 0.58); see Appendix C for full details. Past behaviour was measured by a separate scale (see below) and included within the model.

Additionally, we included perceived busyness and perceived wealth within the model. In a study by Ertz et al. (2016) examining the effect of contextual factors on pro-

environmental behaviour, the Perceived Barriers scale demonstrated high reliability (Busyness a = 0.86, Wealth a = 0.87, Power a = 0.86). Perceived power was not included in the current study as it overlaps with perceived behavioural control. We adapted the scale for the current study to include eight items (wealth 4 items, a = 0.79; busyness 4 items a = 0.88) where responses are recorded on a 7-point agreement scale.

Pro-environmental Behaviour Frequency. The pro-environmental behaviour frequency measure was adapted from two scales from previous research and includes an additional 18 items of our own design to measure specific recycling behaviours. We included this measure as an operationalization of past behaviour to be included in the pre-volition model. In total, there are 29 items (α = 0.88). Participants were presented with the prompt, "How often have you done each of the following the 'past year'?" Responses were recorded on a 7-point frequency scale with the option to indicate "non-applicable".

The scale included seven items adapted from (Schultz et al., 2005), such as "Picked up litter that was not your own". Three items were removed from the original scale following the recommendation of the researcher, and two additional items regarding recycling were removed because they demonstrated overlap with other scales. Four items were adapted from (Walton & Austin, 2011) — two items were not used from the complete scale because they demonstrated overlap with the Schultz et al. (2005) items. The scale included items such as "Made an effort to conserve resources in your home, such as electricity, natural gas, and water for environmental reasons."

6.2.3.2 Daily Diary Measures (21 assessments).

In a similar fashion to Bissing-Olson et al. (2016)'s longitudinal study, for each measurement day, we asked about the frequency of two sustainable behaviours: recycling (at home and outside of the home), and consumption behaviours. Participants were asked whether they performed several behaviour indicators of each type of behaviour (yes/no format), such as "Did you recycle plastic today?", or "Did you purchase any plastic today?" The summation of the behaviour indicators (19 items with respect to recycling and 10 items with respect to green consumption; see Appendix F) was then used for analyses. To test for the reliability of the daily behaviour measures, we used a multilevel modelling approach where we accounted for both within- and between-persons variation. The results indicated that the recycling behaviour indicators (Ω_{home} = .73; Ω_{out} = .89; Ω_{total} = .87) and the sustainable consumption indicators (Ω = .76) demonstrated reasonable-good reliability.

6.2.4 Sample Size Determination

Considering the Structural Equation Modelling (SEM) analysis required for the modelling of pre-volitions in explaining behaviour, conventions suggest that the sample size should be at least 100 participants (in some cases, 200 or 300 for complex models) (Jackson, 2001; Anderson & Garbing, 1984). Following a participant-parameter (N:q) ratio recommendation of 10:1 (Bentler & Chou, 1987), for a model with ten parameters, we would need 100 participants to achieve adequate power. Furthermore, the literature suggests that for a model in which multiple indicators per factor are included, smaller sample sizes may achieve reasonable fit indices (Wolf et al., 2013). Therefore, with the aim of collecting 150 (complete) participant data and including multiple indicators per factor, we expected to achieve reasonable power for the SEM analysis.

6.2.5 Hypotheses

Starting from a base supported by the literature, we expected that the pre-volition model would explain a significant amount of variation in behavioural intentions as well as a significant amount of variation in behaviour. Additionally, we expected that the additions of the not-doing constructs and perceived busyness and wealth would explain a significant amount of additional variation in behavioural intentions and behaviour. We also expected that the pattern of results among the constructs would reflect relevant nuances specific to each behaviour, suggesting that sustainable behaviours, while overlapping, should not be treated as identical.

Table 7.1. Pearson's R Correlation Matrix, Recycling Constructs

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.Total Recycling		.09	-.08	**.27**	.11	-.08	**-.19**	**.16**	.06	**-.17**	-.12	**.16**	.05	**.21**	-.04	**.27**
2.Goal Desire D			**-.20**	**.49**	**.30**	-.15	.04	**.48**	**.28**	**-.40**	**-.31**	**.61**	**-.32**	**.51**	**-.34**	**.36**
3.Goal Desire ND				**-.27**	**-.23**	**.31**	-.06	**-.22**	-.12	**.37**	**.28**	**-.27**	**.34**	**-.26**	**.32**	**-.24**
4.PBC Cap D					**.58**	**-.45**	.05	**.51**	**.27**	**-.46**	**-.38**	**.64**	**-.42**	**.77**	**-.61**	**.31**
5.PBC Aut D						**-.34**	**.20**	**.28**	.14	**-.32**	**-.26**	**.48**	**-.38**	**.55**	**-.43**	.16
6.PBC Cap ND							.11	**-.32**	**-.19**	**.29**	**.33**	**-.25**	**.43**	**-.41**	**.51**	**-.25**
7.PBC Aut ND								-.01	-.07	**.16**	.13	.05	-.02	.04	.01	-.03
8.Experiential Attitudes D									**.63**	**-.49**	**-.44**	**.59**	**-.39**	**.56**	**-.48**	**.23**
9.Instrumental Attitudes D										**-.31**	**-.29**	**.32**	**-.24**	**.30**	**-.30**	**.13**
10.Experiential Attitudes ND											**.65**	**-.53**	**.45**	**-.55**	**.48**	**-.20**
11.Instrumental Attitudes ND												**-.44**	**.47**	**-.46**	**.45**	**-.14**
12.Behaviour Desire D													**-.52**	**.82**	**-.59**	**.34**
13.Behaviour Desire ND														**-.59**	**.73**	-.10
14.Intentions D															**-.73**	**.29**
15.Intentions ND																**-.22**
16.Past Behaviour																

Note. $N = 153$. Significant correlations ($p < .05$) are reported in bold. Probability values have been adjusted for multiple tests. D = doing. ND = not-doing. PBC = perceived behaviour control. Cap = Capability. Aut = Autonomy.

Table 7.2. Pearson's R Correlation Matrix, Sustainable Consumption Constructs

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.Total Behaviour		.11	-.09	**.26**	.13	-.14	-.15	.16	.14	-.13	-.12	.16	-.03	.16	**-.18**	**.20**
2.Goal Desire D			.15	**.56**	**.36**	**-.35**	-.03	**.56**	**.41**	**-.39**	**-.38**	**.57**	**-.48**	**.59**	**-.45**	**.28**
3.Goal Desire ND				**-.16**	**-.22**	**.24**	.04	.11	.11	.17	.09	-.16	.04	-.11	.15	**-.18**
4.PBC Cap D					**.69**	**.37**	-.07	**.56**	**.43**	**-.39**	**-.42**	**.73**	**-.43**	**.83**	**-.65**	**.37**
5.PBC Aut D						**-.54**	-.07	**.42**	**.37**	**-.39**	**-.42**	**.52**	**-.37**	**.67**	**-.61**	**.25**
6.PBC Cap ND							**.26**	**-.42**	**-.31**	**.43**	**.45**	**-.52**	**.48**	**-.59**	**.67**	**-.31**
7.PBC Aut ND								**-.18**	-.11	.10	.05	-.09	.17	-.08	**.17**	**-.17**
8.Experiential Attitudes D									**.72**	**-.46**	**-.51**	**.64**	**-.51**	**.64**	**-.47**	**.30**
9.Instrumental Attitudes D										**-.36**	**.53**	**.40**	**-.29**	**.47**	**-.36**	.15
10.Experiential Attitudes ND											**.82**	**-.49**	**.47**	**-.41**	**.45**	**-.28**
11.Instrumental Attitudes ND												**-.44**	**.43**	**-.41**	**.49**	**-.19**
12.Behaviour Desire D													**-.57**	**.87**	**-.62**	**.44**
13.Behaviour Desire ND														**-.53**	**.65**	**-.30**
14.Intentions D															**-.71**	**.43**
15.Intentions ND																**-.35**
16.Past Behaviour																

Note. $N = 153$. Significant correlations ($p < .05$) are reported in bold. Probability values have been adjusted for multiple tests. D = doing. ND = not-doing. PBC = perceived behaviour control. Cap = Capability. Aut = Autonomy.

6.3 Results

An initial 225 (female = 176) participants entered the study website whereas 153 (female = 126) participants completed the study in full. On average our final sample was 24 years of age (*SD* = 5.67), 56% reported having an income of less than 12,000 euros, 65% reported living at home with their parents, 43% reported having a master's degree, 67% reported living in an apartment, 71% reported having their waste collected directly at home and 80% reported being students. Descriptive statistics are reported in Appendix C.

We present a correlation matrix between doing and not doing constructs in Tables 6.1 and 6.2. These results illustrate that doing and not doing are not simply opposites of one another, with correlations as low as *r* = .05 (i.e., autonomy PBC) and as high as *r* = -.73 (i.e., intentions). In fact, a qualitative inspection of self-selected goals for doing compared to not doing revealed that 50% of participants indicated "to save, protect and respect nature" as a reason for recycling, and 47% indicated "to save" as a reason to not recycle; 47% indicated "to save the ecosystems and preserve the fauna" as a reason to practice sustainable consumption and 38% indicated to "to save, protect and respect nature" as a reason to not practice sustainable consumption.

These differences outline that goals for doing pro-environmental behaviours are not simply opposites of goals for not doing these behaviours. Furthermore, we noted some variation between the two behaviours, such that participants did not simply report the same goal for each behaviour at the same rate. Goals with respect to recycling were clearly divided between normative aspects to save and protect the environment (i.e., doing related) and goals related to being inconvenienced (i.e., not doing). Whereas for sustainable consumption the pattern was less clear. While goals for doing sustainable consumption were dominated by desires to protect the environment, a fair number of participants indicated "to save" (23%) as a reason to do such behaviours. Reasons for not doing sustainable behaviours were also quite varied with only a few selecting 'inconveniencing' related goals (~10%; for full details see Appendix C).

Our analysis for determining if the addition of not doing constructs and barriers improve the explanatory power of pre-volition constructs on behaviour follows two methods. First, we focused on testing the explanatory power of the base pre-volition model using a Structural Equation Modelling (SEM) analysis, then we tested for incremental validity using a multiple regression analysis to determine if the addition of not doing constructs adds a significant amount of additional variation explained.

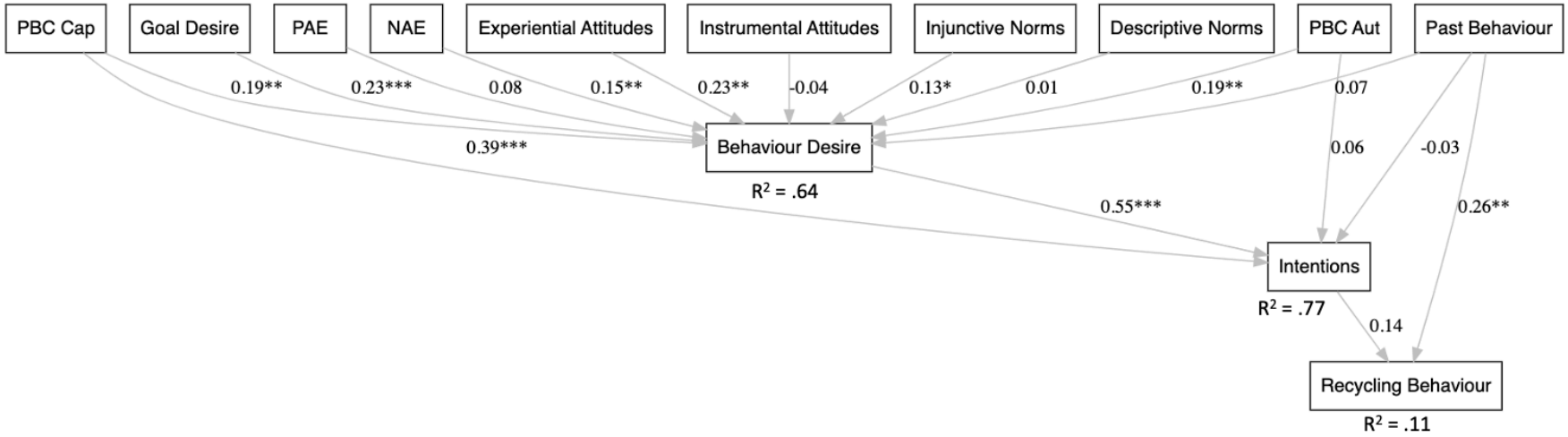

Figure 6.1. Pre-volition (doing) model for Recycling Behaviour.

Note. * $p < .05$ ** $p < .01$ *** $p < .001$. PBC = Perceived Behaviour Control. Cap = Capability. Aut = Autonomy. PAE = Positive Anticipated Emotions. NAE = Negative Anticipated Emotions.

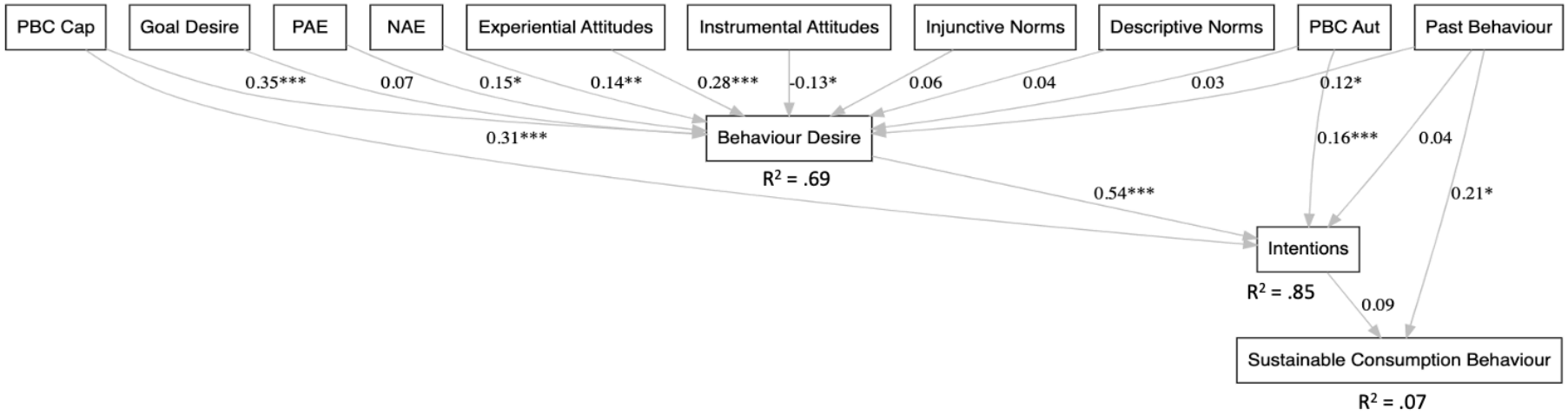

Figure 6.2. Pre-volition (doing) model for Sustainable Consumption Behaviour.

Note. * $p < .05$ ** $p < .01$ *** $p < .001$. PBC = Perceived Behaviour Control. Cap = Capability. Aut = Autonomy. PAE = Positive Anticipated Emotions. NAE = Negative Anticipated Emotions.

SEM analyses were completed with R software using the package lavaan (Rosseel, 2012) with maximum likelihood (ML) as the estimation method. Behaviour was included in the model as the within-person mean across 21 days ($M_{recycling}$ = 8.68, $SD_{recycling}$ = 2.59, $M_{consumption}$ = 4.38, $SD_{consumption}$ = 0.75), then scaled to have a mean of 0 and a standard deviation of 1 before inclusion in the model. Both models demonstrated reasonable fit indices following guidelines recommended by Hu and Bentler (1999). For both models, CFI (recycling = .99, consumption = .97) and TLI were above .95 (recycling = .99, consumption = .95), and SRMR was below .06 (recycling = .03, consumption = .03), indicating a good fit between the model and data. The RMSEA index was below .05 for recycling (.03), however for sustainable consumption, this index was slightly high (.07) but within acceptable range (Hu & Bentler, 1999; MacCallum et al., 1996; Steiger, 2007).

The doing pre-volitional model explained 64% of behaviour desire for recycling. Goal desire, experiential attitudes, perceived behavioural control (both capability and autonomy), injunctive norms and negative anticipated emotions were all significant predictors of behaviour desire. Behaviour desire was the most significant predictor for intentions, followed by autonomy perceived behavioural control, explaining 77% of doing intentions. Lastly, past behaviour was the only significant predictor of average recycling behaviour. The model was able to explain 11% of the variation in mean recycling behaviour (Figure 6.1).

The base doing pre-volitional model for sustainable consumption explained 69% of behaviour desire. Experiential and instrumental attitudes, capability perceived behavioural control, both positive and negative anticipated emotions and past behaviour were significant predictors of behaviour desire. Behaviour desire and perceived behaviour control (both capability and autonomy) were significant predictors, explaining 85% of variation intentions. This model was able to explain 7% of the variation in mean sustainable consumption behaviour, with past behaviour being the only significant predictor (Figure 6.2). Results presented in table format can be found in the Supplementary Materials S.2.

In comparing the two models, there is a difference in the pattern of results. For example, while goal desire and injunctive norms were significant predictors of behaviour desire for recycling, these predictors were not significant for the sustainable consumption model. Instead, past behaviour, instrumental attitudes, and negative anticipated emotions were predictive of sustainable consumption behaviour desire (and not for recycling). Also, in explaining intentions, we see the two models diverge, where autonomy perceived behaviour control was relevant for sustainable consumption and not recycling. Lastly, the base model was able to explain more variation overall in behaviour desire and intentions for sustainable

consumption compared to recycling, whereas the model was able to explain more variation in recycling behaviour than sustainable consumption behaviour.

Table 6.3. Incremental Validity in the Prediction of Behaviour Desire Toward Recycling Behaviour

	Behaviour Desire		
	Model 1	Model 2[1]	Model 3[2]
R^2	.64	.65	.65
Doing			
Experiential Attitude	.27	.25	.25
Instrumental Attitude	-.04	-.04	-.04
Capability PBC	.21	.21	.21
Autonomy PBC	.19	.19	.18
Goal Desire	.24	.22	.22
Descriptive Norms	.01	.01	.01
Injunctive Norms	.13	.12	.13
PAE	.09	.06	.07
NAE	.12	.11	.11
Past Behaviour	.13	.15	.16
Not Doing			
Experiential Attitude		-.11	-.10
Instrumental Attitude		-.04	-.04
Capability PBC		.07	.07
Autonomy PBC		.01	.01
Goal Desire		-.02	-.02
Wealth			-.01
Busyness			-.02

Note. [a]df = 10, 142, [b]df = 15, 137, [c]df=11, 141. Significant standardised estimates ($< .05$) are reported in bold. [1]Model 1 and model 2 comparison was not significant, $F(5) = 1.01$, $p = .41$. [2]Model 2 and model 3 comparison was not significant, $F(2) = 0.11$, $p = .90$.
PBC = perceived behaviour control. Cap = Capability. Aut = Autonomy. PAE = positive anticipated emotions. NAE = negative anticipated emotions.

Starting from the pre-volitional model as a base and to determine which additional would demonstrate incremental validity for predicting behaviour desire and intentions, we conducted a series of multiple regression analyses in a stepwise manner. In the first step, model 1, we included the base doing model that was tested in the SEM analysis; in the second step, model 2, we added relevant not doing constructs; lastly, in model 3, we included perceived wealth and perceived busyness constructs. If in model 2, the not doing constructs remain significant, it would justify their contribution in explaining additional variation in doing constructs if they remain significant in model 3.

Results suggest that none of the not doing constructs predict doing behaviour desire above and beyond the doing constructs for recycling (Table 6.3). However, for doing

intentions, results indicate that not doing behaviour desire significantly predicted doing intentions. The addition of not doing behaviour desire allowed the model to explain an additional 2% of the variation in doing intentions for recycling (Table 6.4).

Table 6.4. Incremental Validity in the Prediction of Intentions of Recycling Behaviour

	Intentions		
	Model 1	Model 2[1]	Model 3[2]
R^2	.77[a]	.79[b]	.80[c]
Doing			
Behaviour Desire	.49	.44	.44
Capability PBC	.37	.33	.34
Autonomy PBC	.06	.03	.03
Past Behaviour	-.05	-.04	-.04
Not Doing			
Behaviour Desire		-.18	-.18
Capability PBC		-.04	-.04
Autonomy PBC		-.007	-.006
Wealth			-.02
Busyness			-.01

Note. [a]df = 4, 148, [b]df = 7, 145, [c]df=9,143.
Significant standardised estimates ($< .05$) are reported in bold.
[1]Significant difference between model 1 and model 2, $F(3) = 5.27$, $p = .002$. [2]Model 2 and model 3 comparison was not significant, $F(2) = 0.24$, $p = .79$.
PBC = perceived behaviour control. Cap = Capability. Aut = Autonomy.

Table 6.5. Incremental Validity in the Prediction of Recycling Behaviour

	Mean Recycling		
	Model 1	Model 2[1]	Model 3[2]
R^2	.11	.14	.15
Doing Intentions	.15	.35	.36
Past Behaviour	.46	.47	.47
Not Doing Intentions		.30	.30
Wealth			.01
Busyness			-.05

Note. [a]df = 2, 150, [b]df = 3,149, df=5, 147. Significant standardised estimates ($< .05$) are reported in bold. [1]Significant difference between model 1 and model 2, $F(1) = 5.65$, $p = .019$.
[2]No significant comparison between model 2 and model 3, $F(2) = 0.40$, $p = .67$.

Lastly, for average daily recycling behaviour, results indicate that the addition of not doing intentions explained an additional 3% of the variation in behaviour above doing intentions (Table 6.5). Note, in Model 1, intentions were not a significant predictor; however, in Model 2, both doing and not doing intentions are significant. This may reflect the differences in the algorithms between multiple regression and SEM analyses, where multiple regression allowed for predictors to correlate, and the SEM analysis did not, due to constraints we set (Nusair & Hua, 2010). Therefore, the observation that in allowing both intentions to covary, they both became significant predictors suggests that for recycling, doing and not doing intentions share considerable overlap and significantly contribute to the explanation of recycling behaviour together.

Table 6.6. Incremental Validity in the Prediction of Behaviour Desire toward sustainable consumption behaviour

	Behaviour Desire		
	Model 1	Model 2[1]	Model 3[2]
R^2	.69	.72	.72
Doing			
Experiential Attitude	.41	.39	.38
Instrumental Attitude	-.16	-.13	-.13
Capability PBC	.33	.28	.28
Autonomy PBC	.03	-.03	-.03
Goal Desire	.09	.11	.11
Descriptive Norms	.03	.03	.03
Injunctive Norms	.07	.08	.08
PAE	.19	.22	.22
NAE	.12	.11	.11
Past Behaviour	.26	.18	.18
Not Doing			
Experiential Attitude		-.14	-.14
Instrumental Attitude		.09	.09
Capability PBC		-.07	-.07
Autonomy PBC		.04	.04
Goal Desire		-.09	-.09
Wealth			-.01
Busyness			-.001

Note. [a]df = 10,142, [b]df = 15, 137, df=17, 135. Significant standardised estimates ($< .05$) are reported in bold. [1]Significant difference between model 1 and model 2, $F(5) = 2.61$, $p = .028$. [2]No significant comparison between model 2 and model 3, $F(2) = 0.27$, $p = .97$. PBC = perceived behaviour control. Cap = Capability. Aut = Autonomy. PAE = positive anticipated emotions. NAE = negative anticipated emotions.

Regarding sustainable consumption, results suggest that not doing goal desire significantly predicts doing behaviour desire and was able to contribute an additional 3% of the variance explained (Table 6.6). For doing intentions (Table 6.7) and behaviour (Table 6.8), results indicated that none of the not doing constructs predict doing intentions or behaviour above and beyond the doing constructs. In fact, for average daily sustainable consumption behaviour, the only significant predictor was past behaviour.

Table 6.7. Incremental Validity in the Prediction of Intentions towards Sustainable Consumption Behaviour

	Intentions		
	Model 1	Model 2[1]	Model 3[2]
R^2	.85	.85	.85
Doing			
Behaviour Desire	.58	.55	.55
Capability PBC	.30	.29	.29
Autonomy PBC	.15	.13	.13
Past Behaviour	.08	.07	.07
Not Doing			
Behaviour Desire		-.01	-.01
Capability PBC		-.06	-.06
Autonomy PBC		.01	.01
Wealth			-.01
Busyness			.01

Note. [a]df = 34, 148, [b]df = 7, 145, df= 9, 143. Significant standardised estimates ($< .05$) are reported in bold. [1]No significant comparison between model 1 and model 2, $F(3) = 1.28$, $p = .28$. [2]No significant comparison between model 2 and model 3, $F(2) = 0.09$, $p = .92$. PBC = perceived behaviour control. Cap = Capability. Aut = Autonomy.

Thus, the results show partial support for our hypothesis: not doing constructs significantly increased the explanatory power of classic pre-volition models but only for recycling intentions, recycling behaviour, and behaviour desire for sustainable consumption. The pattern of results, in particular, the differences between recycling and sustainable consumption, also supports our hypothesis that the explanatory power of the models would vary depending upon the behaviour in question, reflecting nuances specific to each behaviour. We observed that not doing constructs appear to be more influential early in the decision-making process for sustainable consumption, whereas not doing constructs are more influential later in the decision-making process for recycling behaviour.

Table 6.8. Incremental Validity in the Prediction of Sustainable Consumption Behaviour

	Mean Sustainable Consumption Behaviour		
	Model 1	Model 2[1]	Model 3[2]
R^2	.07	.07	.08
Doing Intentions	.07	.05	.06
Past Behaviour	.37	.37	.36
Not Doing Intentions		-.04	-.03
Wealth			.04
Busyness			-.07

Note. [a]df = 2, 150, [b]df = 2,150, df=3,149, df=5,147. Significant standardised estimates ($< .05$) are reported in bold. [1]No significant comparison between model 1 and model 2, $F(1) = 0.19$, $p = .66$. [2]No significant comparison between model 2 and model 3, $F(2) = 0.74$, $p = .48$.

With respect to the addition of barriers, none of the models tested supported the inclusion of perceived busyness or wealth in predicting behaviour desire, intentions, or actual behaviour. We performed a correlation analysis of these constructs with the pre-volitional constructs measured (see Appendix E). Results indicated that for recycling, perceived wealth does not appear to be significantly relevant to any construct, whereas perceived busyness was significantly correlated with injunctive norms (r = .19) and positive anticipated emotions (r = .27). For sustainable consumption behaviours, again perceived wealth did not significantly correlate with any construct, whereas perceived busyness significantly correlated with doing experiential attitudes (r = .23), injunctive norms (r = .17), and positive anticipated emotions (r = .25).

The results show partial support for our hypotheses regarding perceived barriers. Perceived barriers did not demonstrate incremental validity in predicting sustainable behaviours above and beyond pre-volition constructs, and perceived wealth did not significantly correlate with any constructs. However, the pattern of results with perceived busyness, namely the correlation with doing experiential attitudes only for sustainable consumption, appeared to reflect some differences between the two behaviours, supporting our hypothesis.

6.4 Discussion

The present study aimed to build a model to explain variations in pro-environmental behaviours, drawing on various approaches. We started from a pre-volitional model as a base and then tested for incremental validity of not doing constructs and perceived barriers. We focused on two types of behaviours: recycling and sustainable consumption. Given the unique nuances associated with each behaviour, we expected that the relative contributions of each construct would vary depending upon the behaviour.

6.4.1 Goal Content

Our findings indicate that self-selected goals tended to follow a pattern whereby participants did not choose the same goals for doing the behaviour as they did for not doing the behaviour. We found that this pattern was clear for recycling behaviour – about 80% of participants chose normative goals (i.e., to do the right thing, to save, or to protect and respect nature) for doing recycling, whereas about 47% chose gain-related goals, and 46% chose hedonic related goals as a reason not to recycle. Compared to sustainable consumption behaviour, 47% of participants chose a normative goal (i.e., to save the ecosystems) as a reason for doing and about 10% chose a gain goal as a reason for not practising sustainable consumption. These findings begin to draw the picture that recycling and sustainable consumption behaviours may operate on different principles and should not be treated as equal. In fact, we found that considering the daily average over the 21 days, participants recycled more ($M = 8.68$, $SD = 2.59$) in comparison to performing sustainable consumption behaviours ($M = 4.38$, $SD = 0.75$).

6.4.2 Base Model

Using a Structural Equation Model (SEM) analysis, the base pre-volition model was able to explain 77% of recycling intentions, 64% of recycling behaviour desire, 85% of sustainable consumption intentions, and 69% of sustainable consumption behaviour desire. The models performed well regarding fit indices, and the results were in line with previous research on pro-environmental behaviours. In a review, Yuriev et al. (2020) reported that for pro-environmental behaviours, pre-volition models' explained variance of intentions was, on average, 44%, explained variance of behaviour tended to range from 6% to 81%, and an average of 25% (can be as high as 60%) more variation explained in intentions compared to behaviour. A large intention-behaviour difference is quite common for most pre-volition research (Armitage & Conner, 2001; Yuriev et al., 2020).

The present study designed the behaviour measure to be a reliable measure of daily activity while limiting recall bias as much as possible by using a daily diary measure. Using a SEM analysis, the base pre-volition model was able to explain 11% of recycling behaviour and 7% of sustainable consumption behaviour. While our model did not explain a large amount of variation in behaviours, the results are in line with previous research stating that estimates are typically lower for actual behaviour than for self-reported behaviour (Armitage & Conner, 2001; Huffman et al., 2014; Yuriev et al., 2020). This is thought to be due to the tendency of self-report measures to overestimate objective measures, with about 10% of the variance due to social desirability (Kormos & Gifford, 2014; Mónus, 2021). Furthermore, we found that when examining the correlations between behaviour and the pre-volition constructs, not doing intentions (r = -.18) were significantly correlated with sustainable consumption behaviour, whereas doing intentions were not. This may explain why the base model was only able to explain 7% of the variation. The observation that not doing intentions were more correlated with behaviour than doing intentions only for sustainable consumption behaviour further highlights the differences between the two behaviours and the potential shortcomings classic pre-volition models may have depending upon the behaviour being examined.

6.4.3 Incremental Validity

6.4.3.1 Recycling

Incremental validity testing revealed that not doing constructs added to the explanatory power of the base pre-volition model. For recycling behaviour, we found that not doing behaviour desire explained an additional 2% of unique variance in intentions and that not doing intentions explained an additional 3% of unique variance in actual behaviour. These findings suggest that for recycling behaviour, considerations of not doing constructs may help to explain variations in intentions and actual behaviour, and more focus should be placed on the execution of the behaviour itself. Recall that pre-volition (Perugini & Bagozzi, 2004a), or antecedent (Ajzen, 1991) models, place pre-volition/antecedent variables as preceding intentions. Behaviours are thought to reliably follow intentions, barring interruptions out of the individuals' control (Ajzen, 1991); however, there is a large intention-behaviour gap within the pro-environmental behaviour literature (Grimmer & Miles, 2017; Hassan et al., 2016). In our sample, we found that, on average, participants reported high intentions (M = 6.23, SD = 0.96) to recycle and low intentions (M = 1.80, SD = 0.77) not to recycle, yet intentions were only moderately correlated with behaviour (r = .21). The gap

highlights the importance of considering and addressing contextual factors that may interfere with the execution of recycling behaviour. In our sample, 46% of participants indicated inconvenience-related reasons (e.g., to simplify my life) as a reason not to recycle. In line with this finding, some research has highlighted concerns around sorting waste rules (Miller et al., 2015), distinctions between being at home compared to on vacation (Dolnicar et al., 2017; Miao & Wei, 2013), limitations on knowledge and awareness (Díaz-Meneses & Vilkaite-Vaitone, 2020), and infrastructure limitations (Geiger et al., 2019; Varotto & Spagnolli, 2017; Wu et al., 2021). Our findings support the notion that more research into factors that interfere with the execution of recycling behaviours is warranted.

With respect to perceived barriers, for recycling behaviour, we found that perceived busyness was moderately positively correlated with positive anticipated emotions and injunctive norms, such that the more participants reported feeling generally busy, the more they also reported anticipating positive feelings if they recycled and that others would approve of them recycling (Ajzen, 2002; Fishbein & Ajzen, 2011). While perceived busyness did not demonstrate incremental validity in predicting behaviour desire, intentions nor actual behaviour, results suggest that for recycling, perceived busyness may have a place in other models such as the dual-inheritance theory (Davis et al., 2018), with the focus being on morality (Botetzagias et al., 2015) and where anticipated emotions and moral norms are driving factors (Davis et al., 2018; Lu et al., 2020).

6.4.3.2 Sustainable Consumption

Incremental validity testing for sustainable consumption behaviour showed that not doing goal desire contributed to an additional 3% of unique variation explained in behaviour desire. This finding suggests that motivations for not doing the behaviour are particularly relevant early in the model or before individuals form their intentions. Desires in this framework are understood as preceding intentions, and are less connected to specific actions (Perugini & Bagozzi, 2004b). We put forth that perhaps sustainable consumption behaviour is different from recycling in that reasons for not performing such behaviours are considered more heavily during the planning and elaboration phase of considering how to execute one's desires (Perugini & Bagozzi, 2004a) and are less relevant in forming intentions or executing behaviour directly.

With respect to perceived barriers, for sustainable consumption behaviour, we found that perceived busyness was moderately positively correlated with positive anticipated emotions, injunctive norms, and experiential attitudes, such that the more participants

reported feeling generally busy, the more they also reported anticipating positive feelings if they recycled, that others would approve of them recycling and that sustainable consumption is a 'good' behaviour (Ajzen, 2002; Fishbein & Ajzen, 2011). It is worth noting that the correlation between perceived busyness and instrumental attitudes was approaching significance. While, like recycling, perceived busyness did not demonstrate incremental validity in predicting behaviour desire, intentions, nor actual behaviour, results suggest that for sustainable consumption behaviour, perceived busyness may have a moral component, as with recycling, but additionally that it may have an effect early in the decision-making process given the correlation with attitudes. We did not observe any significant effects regarding perceived wealth. This may be due to the sample largely comprising of students and, thus, individuals who may not have complete control over consuming decisions.

6.4.4 Comparing Behaviours

In comparing the two behaviours, sustainable consumption may be better understood as a reasoned, intentional process than an incidental or automatic decision-making process (Gawronski & Bodenhausen, 2007; Richetin et al., 2007). This means that individuals tend to weigh the potential benefits and costs considerably before forming their intentions for sustainable consumption behaviours. This is, of course, the case for several types of pro-environmental behaviours (Follows & Jobber, 2000); however, our results indicate this may be particularly true for our sample of sustainable consumption behaviour. In our sample, we observed that participants reported a larger average difference in doing compared to not doing goal desire for recycling (M_{diff} = 1.53) than for sustainable consumption (M_{diff} = 0.93). Suggesting that participants tended to weigh reasons for not doing sustainable consumption as much as those in favour. Correlational analyses indicated that only not doing intentions (compared to doing intentions) were significantly correlated with sustainable consumption behaviour. In both the base model and incremental validity testing, past behaviour was the only significant predictor of sustainable consumption behaviour, suggesting the two may have cancelled each other out. This contrasts with recycling where only doing intentions were significantly correlated with behaviour, and when entered a model with not doing intentions, doing intentions still contributed more to the explained variance. Motivations to not perform the behaviour appear to be more strongly implicated in sustainable consumption, suggesting that the behaviour may be better characterized as deliberative.

This contrasts with recycling behaviour, where the pattern of results suggests that while participants had generally high intentions to recycle (doing intentions were also significantly correlated with behaviour, (r = .21), the pattern of actual behaviour may be

better understood as an incidental or automatic, with the focus better placed on the interruption of the execution of the behaviour. Recycling has been talked about as a pro-environmental behaviour for several years now (Derksen & Gartrell, 1993), and it is possible that recycling behaviour may have already been somewhat habitual for participants – in fact, in the base pre-volition model, negative (and not positive) anticipated emotions was a significant predictor of behaviour desire for recycling, whereas both positive and negative anticipated emotions were significant predictors of behaviour desire for sustainable consumption. This pattern of results with anticipated emotions may have partially tapped into participants' past experiences with the behaviour (Leone et al., 2005) – perhaps participants' anticipated negative emotions from recycling were a strong predictor because they had a rich past history with the behaviour whereas regarding sustainable consumption both positive and negative emotions were equally weighted because it is relatively new to them and unsure about the potential benefits. Although pre-volition models may not be equipped to disentangle fully incidental behaviour from deliberate behaviour (Richetin et al., 2008), the pattern of results found in the present study was able to capture several differences between recycling and sustainable behaviour, and points to this distinction as a possible direction for future research.

6.4.5. Limitations

One limitation of the current study is that most participants were students. While the average age was 24, and most individuals at that age should be familiar with recycling, it is possible that they may have had less of an opportunity to practice sustainable consumption compared to older, independent individuals. Therefore, our findings regarding sustainable consumption behaviour may not be generalisable.

Furthermore, the current work adds to the growing body of literature demonstrating a large intention-behaviour gap (Grimmer & Miles, 2017; Hassan et al., 2016). While in our study, we were only able to explain 14% of the variation in recycling behaviour and 7% of the variation in sustainable consumption behaviour, this result appears to be common when explaining actual behaviour compared to self-reported behaviour (Armitage & Conner, 2001; Yuriev et al., 2020). Some have argued that self-reported behaviour, given its explicit nature, better maps onto the explicitly reported pre-volitions (Conner et al., 1999; Mcauley & Courneya, 1993; Richetin et al., 2008), thus improving prediction. Therefore, if our measure of behaviour was a traditional self-report measure and not a daily diary measure, the percent of variation explained could have been more substantial. Furthermore, Ajzen (2011) argued that a low intention-behaviour relation may be indicative of the limitations of using the

reasoned action approach for that domain. Therefore, while work with pre-volitions has been useful in many domains, it may not be appropriate for examining actual behaviour and/or sustainable behaviours.

6.4.6. Conclusions

The current study's findings highlight the importance of considering the nuances associated with each of the various pro-environmental behaviours and to not assume that they operate on equal principles. When considering various constructs, we found that the pattern of significant constructs in predicting behaviour desire, intentions, and the behaviour itself, differed for recycling behaviour and sustainable consumption.

Based on these findings, distinguishing between behaviours as incidental or deliberate could be useful for future research. Behaviours characterised as incidental may call for a focus on execution (Moghavvemi et al., 2015; Sniehotta et al., 2005). Future research regarding the individual's interaction with their environment, such as sorting system rules and infrastructure demands with respect to recycling, may be more worthwhile than information-based interventions. Behaviours characterised as deliberate may call for a focus on the decision-making process before intentions are formed. Future research regarding individuals weighing the pros and cons of the behaviour, such as interventions that target attitudes or knowledge-based interventions, may be more applicable in the case of sustainable consumption

Chapter 7

Capturing experiences with nature: Development of an Experience with Nature scale to explain pro-environmental behaviours

Overview

After expanding from solely considering the dynamic nature of goals in Chapter 5 to considering relevant antecedents of behaviours alongside goals, such as behavioural intentions in Chapter 6, we sought to further explore the role of intent in explaining variations in PEB. In this chapter, we expand from considering behavioural intentions as defined from pre-volitional models to a broader understanding of intentional actions themselves. The influences of contact with nature on individuals is a growing area of research; in particular, previous research has demonstrated the explanatory power of considering contact with nature in explaining pro-environmental behaviours. Generally speaking, individuals who have more frequent contact with nature tend to frequently perform pro-environmental behaviours. Building on this, research has demonstrated that considering specific interactions with nature is also beneficial in understanding variations in pro-environmental behaviours above and beyond measurements of nature exposure. Inspired by existing frameworks offering typologies with how to categorise experiences with nature – intentional vs incidental and direct vs. indirect – the current project aimed to develop a measure of contact with nature that would capture the individual's experience and improve upon measures of exposure in explaining variations in pro-environmental behaviours. To this end, across three studies, we developed a preliminary Experience with Nature scale by identifying intentional interactions with nature supported by participant data. In a fourth study, this project then demonstrated that by capturing the individual's experience, we were able to explain more variations in pro-environmental behaviours compared to exposure to nature alone. The development of a preliminary Experience with Nature scale suggests the utility of considering experience, in particular intentional actions, when measuring contact with nature in certain contexts. Future testing and development of the scale will allow for the testing of hypotheses regarding the benefits of intentional vs. incidental and direct vs. indirect contact with nature posited by frameworks and theories.

7.1 Introduction

Contact with nature – and the many beneficial outcomes that are produced for individuals consequently – is a growing line of research. When using the term 'contact with nature', researchers typically refer to the experience of natural environments (i.e., urban or non-urban outdoor environments that are dominated either by vegetation or water bodies) by individuals, whether intentional or incidental (Keniger et al., 2013; Marselle et al., 2021). Contact with nature is related to increased nature connectedness (Martin et al., 2020; Mustapa et al., 2019), place attachment (Colley & Craig, 2019), well-being (Beyer et al., 2016) and health (Irvine et al., 2013; Mansor et al., 2012; Martin et al., 2020), restorative effects such as stress reduction and cognitive improvements (Meredith et al., 2020; Ulset et al., 2017), pro-environmental stewardship (Chan et al., 2016), and pro-environmental behaviour (Alcock et al., 2020; Martin et al., 2020; Whitburn et al., 2020). These effects have been shown traditionally for green spaces but also for blue spaces (White et al., 2010; White et al., 2021) when considering biodiversity (Carrus et al., 2015) as well as soundscapes (Buxton et al., 2021) and when considering varying types and qualities of nature (Beute et al., 2023), suggesting the effect of contact with nature on individuals is quite pervasive and robust.

There are many ways to describe contact with nature, including (but not limited to) considerations of scale or frequency, proximity, different sensory experiences, the specific activity (Frumkin et al., 2017) and by considering the degree of intent while in a natural setting (Bratman et al., 2019; Keniger et al., 2013). It has been theorized that direct, intentional contact with nature would show the greatest effects in terms of beneficial outcomes compared to indirect, incidental contact (Keniger et al., 2013; Marselle et al., 2021). By direct, we refer to contact with nature where the individual is in close physical proximity to nature (e.g., walking or swimming); consequently, indirect is when the individual is not in close proximity to nature (e.g., watching a nature video). By intentional, we refer to contact with nature where nature is part of the central focus of the interaction or activity; individuals generally have these interactions because they seek to have contact with nature. Whereas for incidental contact, contact with nature is typically a by-product of the activity and not the focus. We adapt these definitions from the frameworks presented by Marselle et al. (2016) and Keniger et al. (2013). However, the distinction between intentional and incidental contact and the differing effects on outcomes has not yet been conclusively shown.

7.1.1 Experiences with Nature

Given the multiple ways contact with nature has been described, there are several approaches to measuring contact with nature, such as considering exposure to nature or the individual's experience with nature. Some approaches, such as postal code (Bratman et al., 2019) or cumulative opportunity (Ekkel & de Vries, 2017), focus on exposure. Measures of exposure tend to capture the amount of contact, such as the frequency and duration (Bratman et al., 2019; Frumkin et al., 2017). However, by focusing solely on the frequency and duration of contact, the measurement does not capture the characteristics of the interaction experience or *how* an individual interacts with nature. It is by focusing on how individuals experience nature and the subjective nature of interactions that we can tease apart motivations such as intentions (Gaston et al., 2018; Hartig et al., 2014). Some approaches to categorizing experiences with nature include a focus on the sensory experience and the dose (i.e., the amount of nature 'received' filtered through attention and preferences) (Bratman et al., 2019), the level of biodiversity (Frumkin et al., 2017), and distinctions between viewing, being in the presence of and being actively engaged with nature (Pretty, 2004). Additionally, Marselle et al. (2021) and Frumkin et al. (2017) outline another approach: the interaction experience can be examined by following two classifications, physical proximity (i.e., direct or indirect) and intentions (i.e., intentional or incidental), allowing for four typologies of interactions. Thus, to capture aspects of intent regarding contact with nature, we consider the individual's experience according to the classifications of physical proximity, intentions, and exposure.

To our knowledge, the current literature measuring contact with nature isn't designed to assess intent. The literature offers classifications of interactions with nature based on agreed-upon definitions. If it is the primary focus, then intention is inferred. If it is a secondary focus, it is classified as an incidental contact (Frumkin et al., 2017; Marselle et al., 2021). Following these definitions, interactions with nature can be classified according to whether contact with nature is the primary focus of the interaction or if it is the secondary focus. For example, gardening, hunting, and camping would all be examples of intentional interactions with nature (Currie et al., 2016). For these examples, nature is part of the central focus of the interaction or activity; individuals generally have these interactions because they seek to have contact with nature. Whereas for interactions such as biking, socializing, or reading in nature, contact with nature is typically a by-product of the activity or simply the setting and not the focus (Marselle et al., 2016).

While not directly assessing intent, some studies have demonstrated that certain interactions produce greater beneficial outcomes. For example, Colléony et al. (2020) manipulated the 'psychological distance' from nature by instructing participants to have

different types of interactions with nature. They found that participants who were instructed to smell and touch nature reported higher nature-relatedness than those who were instructed to walk slowly. Their research focused on cues to experience meant to create high-quality interactions. Similarly, Carrus et al. (2015) reported that participants who contemplated the nature setting or who were walking and/or exercising while out in nature reported higher levels of perceived restorativeness and well-being than those who reported reading, talking, and/or socializing as their main activity during their nature experience. While these studies did not report an examination of intentions as part of their aims, based on the types of interactions and how they can be classified according to Marselle et al. (2021)'s framework – intentional/incidental and direct/indirect – it does appear that intentional interactions produce greater effects.

Interactions with nature have been researched in various ways and approaches, including a focus on activities (Carrus et al., 2015; Colléony et al., 2020), through observation or manipulation of interactions and activities (Bratman et al., 2015; Ulrich, 1979) and through self-report scales assessing frequency (Alcock et al., 2020) or perceptions and preferences (Kaplan et al., 1989); however, the intent of the individual is often implied and not explicitly discussed. An important gap in the literature is that while theoretical frameworks allow researchers to classify interactions based on distinctions of intent and physical proximity, these distinctions have not been supported by participant data. To our knowledge, there are no studies supporting these classifications based on participants reporting their subjective experiences regarding these interactions. It is the aim of the current paper, to understand how individuals classify interactions with nature in terms of intentionality and use these ratings to build a measurement tool designed to capture intentions regarding contact with nature.

7.1.2 Pro-Environmental Behaviour

There is an ever-growing body of literature focused on examining how we can explain variations in pro-environmental behaviours (Grilli & Curtis, 2021), with the hope of identifying ways to promote these behaviours and address current environmental concerns (DEFRA, 2018; Steffen et al., 2015). Some research in this area has demonstrated a relationship between contact with nature and pro-environmental behaviours. One study found that people who participated in a tree planting experience were more willing to perform pro-environmental behaviours (i.e., consumerism, energy consumption, mobility and transport, waste avoidance, recycling, and social behaviours toward conservation) (Whitburn et al.,

2019). Additionally, Alcock et al. (2020) found that more recreational time in nature was associated with more self-reported pro-environmental behaviours (both public and private).

Research with exposure to videos – an example of indirect contact with nature – may highlight the importance of considering intentions in explaining pro-environmental behaviour. In one study, Soliman et al. (2017) participants were instructed to watch a nature video. They found that after the video, participants reported higher levels of nature-relatedness but not pro-environmental behaviours. Pro-environmental behaviours were measured by observing whether participants made low-waste choices while inside the laboratory. Similarly, Lange and Truyens (2022) found that, after presenting participants with a nature video, participants did not perform differently on an environmental protection task, than those who watched a neutral video or no video at all. While there are several potential explanations for these results, such as the use of in-lab tasks to measure pro-environmental behaviour compared to self-report measures, another element that is missing is the consideration of the participant experience during the interaction. The participants' intentions to interact with nature during the experience did not appear to be assessed in these studies.

Richardson et al. (2020) builds on these findings using a large national survey where participants were asked about their nature experiences such as the amount of time spent in nature, and the type of activities they did, including both direct and indirect experiences. They used these responses to predict pro-conservation behaviour using stepwise multiple regression analysis. They reported that significant items retained in the analysis were intentional direct activities such as smelling wildflowers, collecting shells, listening to bird songs, and watching bees.

However, Martin et al. (2020) found that intentional contact with nature (i.e., visiting natural spaces at least once a week) was associated with higher household pro-environmental behaviours and not conservation behaviours but that indirect interactions (i.e., watching/listening to nature programs) were positively associated with both types of pro-environmental behaviours. It appears that intentional activities are more strongly predictive of pro-environmental behaviours, but results are mixed regarding the type of pro-environmental behaviour they can explain. An important difference may be in considering the types of interactions individuals have with nature and considering that not all interactions as equal. It is our assertion that considering motivations, such as the individual's intent during the interaction with nature and examining various types of interactions, could help further explain variations in pro-environmental behaviours.

7.1.3 General Aims

The current project aimed to develop a self-report measure that distinguishes between intentional and incidental contact with nature and use the measure to explain variations in pro-environmental behaviour. This measurement tool would help to answer theoretical questions regarding the benefits of contact with nature that remain unaddressed. The approach to scale development draws on recommendations from Boateng et al. (2018). Following these guidelines, we focused on (1) item generation and selection, (2) scale pre-testing, and (3) scale validation. Over three studies, we aimed to develop a preliminary scale.

The current project adopts a broad and inclusive definition of nature offered by Hartig et al. (2014): "*physical features and processes of nonhuman origin that people ordinarily can perceive, including the "living nature" of flora and fauna, together with still and running water, qualities of air and weather, and the landscapes that comprise these and show the influence of geological processes,"* (p. 208). Using this definition will allow for the use of the scale in various contexts and not limit the validity of the items to a particular framework.

The current project was given ethical approval by the RIGO ethical committee, Registration ID: 1046015-1045997-122537394].

7.2 Study 1: Item Generation and Selection

7.2.1 Aims

For the first study, we aimed to generate items for the scale that would reliably capture experiences associated with intentional/incidental and direct/indirect contact with nature according to the typologies presented by Marselle et al. (2021). To this end, we first planned an exploratory study in which participants were asked to respond to open-ended questions regarding examples of their intentional and incidental contact with nature.

Additionally, we aimed to present participants with a list of activities/ behaviours/ interactions generated from the literature and ask them to rate each on a bipolar scale ranging from incidental to intentional. Based on the results of this study, we would be able to have an initial evaluation of intentional and incidental contact as distinct concepts – i.e., evaluating if there is considerable overlap or if individuals conceive of them as separate concepts. We would also have a list of activities/ behaviours /interactions generated from participants with evaluations based on their representativeness of intentional and incidental contact with nature.

From this exploratory study, we expected to be able to assess what concepts or constructs are revealed for participants (both concepts of interest and potential unforeseen concepts) when responding to the items (Scott & Canter, 1997). The results of the task would

allow us to separate items (i.e., activities and behaviours) that clearly distinguish between intentional and incidental contact – as well as identify items that are less clearly associated with either construct. It is from these ratings that we expected to run an exploratory factor analysis to build a preliminary scale.

7.2.1.1 Exploratory Hypotheses

In building the scale there were a couple of additional themes we sought to explore. Following the definitions of intentional and incidental contact with nature, we hypothesised that if an individual is interacting with nature in a social context, then that interaction is incidental – their primary motivation is being social. Some research supports this, Staats and Hartig (2004) found that the restoration effects of a nature walk were greater for those who walked alone rather than with company. In a qualitative study, Hynds and Allibone (2009) found that participants who were walking in nature in a group reported thoughts around the speed at which they were walking and talking rather than thoughts of the environment. It is possible that being with others changes how the individual experiences the environment which in turn has effects on the outcomes of interest. We aimed to include examples of interactions with nature that have a social element to test this hypothesis.

We also aimed to observe if there was a difference in intent rating for the activities in which awareness or engagement is stressed compared to passive types of activities. Some research suggests that engagement activities produce greater effects when in nature than controls (Pasanen et al., 2018; Weinstein et al., 2009). For example, Richardson et al. (2022) found that after asking participants to perform noticing nature activities, activities where participants were engaged in nature (e.g., watching/listening to nature) compared to those who studied nature (e.g., observing the sky) were more significant predictors of nature connectedness. If an individual is attending to or is acutely aware of some aspect of nature, assumptions of intent could reasonably follow – our aim was to confirm if individual perceptions are in line with these assertions. To test these hypotheses, we developed mirror items by manipulating the word syntax, so that one item stresses an engaged experience, and the mirror item, a passive experience.

7.2.2 Methods

7.2.2.1 Study Design

The item generation and selection study drew on two approaches, both of which were exploratory in nature. We presented participants with an online questionnaire. The first approach was to elicit free responses of potential scale items. We asked participants to

describe activities or behaviours that would exemplify intentional and incidental contact with nature, in their own opinion / from their own experiences. Participants' responses were recorded in an open-response format. They were asked to provide three examples for each type of contact (six in total). The responses were analysed qualitatively for theme and frequency.

The second approach was to elicit dichotomous ratings of the potential scale items. We presented participants with a list of activities/behaviours/interactions generated from examples and items used in the literature and asked them to rate each. Responses are recorded on 7-point bi-polar scales ranging from *low intent* to *high intent*. The anchors of 'low intent' and 'high intent' were preferred over intentional and incidental in this case because we felt that they would be more easily understood by participants.

We performed two rounds of this questionnaire. The first included both the open-response items and the bi-polar rating items. Then we analysed the open-response items and included any examples of activities/behaviours/interactions not already covered by the initial list in a second round of the questionnaire. The second round only included the bi-polar ratings. The results were analysed quantitatively, item by item, with a focus on rating means and variability, and then both samples were combined and put through an exploratory factor analysis to aid in the final item selection.

7.2.2.2 Participant Recruitment and Sample

Our total sample (across two rounds) consisted of 130 participants. Participants were recruited through Prolific and were compensated monetarily. Only residents of the United Kingdom who were the age of majority (18 years or above) were recruited. Table 1 shows demographic details of this study, and the subsequent scale development studies. A total sample of 130 in this study, allowed us to observe a reasonable amount of variation in responses while being sufficient to perform the exploratory factor analysis (EFA). The sample size determination focuses on the EFA analysis and the model precision, given we do not focus on hypothesis testing for this study. The Experience with Nature scale is expected to have two factors (i.e., intentional and incidental); therefore, the model can be considered relatively simple. A minimum sample of 100 is expected to be sufficient for simple EFA applications using a maximum likelihood estimation method and normally distributed data (Anderson & Gerbing, 1984). Additionally, according to the N:q ratio approach (participant:parameter), an N:q ratio of 5-10 should allow for precise estimates (Bentler & Chou, 1987; Tanaka, 1987). This approach has been supported for sample size calculations

(Jackson, 2003). Given this initial analysis is exploratory we expected at least 120 participants to be sufficient to allow for reasonably precise estimates considering a two-factor structure.

Table 7.1. Demographic Frequencies for all four studies

	Sample 1	Sample 2	Study 1 Overall	Study 2	Study 3	Study 4
Gender	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)
Woman	30 (48)	32 (48)	62 (48)	65 (51)	115 (49)	146 (49)
Man	32 (51)	33 (49)	65 (50)	62 (49)	116 (49)	152 (50)
Non-binary/third gender	0 (0)	2 (3)	2 (2)	0 (0)	2 (0.9)	1 (0.3)
Prefer not to say	1 (1)	0 (0)	1 (1)	0 (0)	2 (0.9)	2 (0.6)
Age						
18-24	5 (8)	8 (12)	13 (10)	19 (15)	40 (17)	37 (12)
25-34	22 (35)	27 (40)	49 (38)	45 (35)	91 (39)	99 (33)
35-44	19 (30)	15 (22)	34 (26)	32 (25)	46 (20)	71 (24)
45-54	12 (19)	8 (12)	20 (15)	16 (13)	28 (12)	49 (16)
55-64	3 (5)	6 (9)	9 (7)	14 (11)	19 (8)	31 (10)
64+	2 (3)	3 (5)	5 (4)	1 (1)	11 (5)	14 (5)
Community Type						
Urban/city center	26 (41)	18 (27)	44 (34)	35 (28)	80 (34)	106 (35)
Suburban	25 (40)	39 (58)	64 (49)	69 (54)	115 (49)	125 (42)
Rural/countryside	12 (19)	10 (15)	22 (17)	23 (18)	40 (17)	70 (23)
Total *N*	63	67	130	127	235	301

Note. Frequencies are reported with approximate percentages in brackets.

7.2.2.3 Materials

All questionnaire items were not mandatory; participants were free to decline to answer any item.

Open response items. In the first-round questionnaire, two open-response items asked, "Please think of 1 (up to 3) activity, behaviour, or interaction that you have done in the past that is an example of high (low) intentional contact with nature." Included was a definition of high and low intentional contact corresponding to definitions of intentional and incidental contact with nature from the literature.

Closed response items. The first round of the data collection questionnaire consisted of 66 closed-response rating items. In the second-round questionnaire, 14 items were added

from intentional and incidental activities suggested by participants in the open-ended response items in the first round; the second-round questionnaire consisted of 80 rating items. All closed response items included the stem: "Please rate the following examples of interactions with nature on a scale ranging from 1(low intent) to 7(high intent). Please respond based on your personal experience," and again included the definitions of low and high intent. Responses were recorded on a 7-point scale ranging from 1 (low intent) to 7 (high intent). Higher scores indicate greater intent / the activity is an intentional experience of nature.

Items were developed based on the examples used in the literature. Our approach was to focus on activities and behaviours. Richardson et al. (2020) demonstrated that measuring contact with nature using activities explained more variance in pro-environmental behaviours than time spent in nature. We adopted this approach in building the measurement scale. We identified 30 examples of interactions with nature, including activities such as birdwatching, camping, and walking. We aimed to include interactions that tapped into different senses (i.e., smelled wildflowers in nature and listened to bird song in nature) and have a reasonable balance between direct (i.e., I went for a hike, and I spent time exercising in nature) and indirect (i.e., drove along a country road and watched birds or other animals from a window) interactions.

Additionally, we included variations of the same interaction to manipulate the level of social interaction. For example, regarding hiking, we included four variations: 'I went for a hike in nature', 'I went for a hike in nature alone', 'With friends/family, I went for a hike in nature', and 'I went for a hike in nature, with friends/family'. Seven examples of interactions with nature included these variations. We also sought to include variations of the same interaction to manipulate the level of intention. We did this by manipulating the level of awareness or attention for identical interactions by using syntax such as 'listened' vs. 'heard' and 'watched' vs. 'saw or noticed'. We expected syntax stressing attention to nature (e.g., watched and listened) to demonstrate greater intention ratings compared to passive syntax (e.g., heard or noticed). This specific syntax manipulation has never been tested before, to our knowledge, but it is in line with findings from the literature in which they manipulated awareness (Duvall, 2011; Richardson et al., 2022). Fourteen examples of interactions were included as mirror items. See Appendix G for full details.

Demographic items. For demographic items, we asked participants to indicate their age range (18-24, 25-34, 35-44, 45-54, 55-64, 64+), their gender (Woman, Man, Non-

binary/third gender, Prefer not to say) and the type of community they lived in (Urban/city center, Suburban, Rural/countryside).

7.2.2.4 Procedure

The questionnaire was presented using Qualtrics software. After signing up for the study, participants were directed to the online questionnaire page. After giving their informed consent, they were presented with the open response items first. These items were always presented first to eliminate influences from the rating items. Then, they completed the rating items, which were presented in random order, and answered a few demographic items. At the end, they were thanked for their participation. The average completion time was 15 minutes.

7.2.3 Results

All analyses were completed using R software.

7.2.3.1 Open Response Items

We analysed 378 open-response answers and cross-referenced these answers with items already included in the list of 66 closed-response items. The most frequent interactions mentioned by participants demonstrated considerable overlap with items from the literature. For example, ‘walking’ as an intentional example was mentioned 35 times, as well as various examples of exercising (i.e., running, playing football, etc.) were mentioned as examples of incidental contact 25 times.

We observed a common theme in analysing examples, such that it was common for participants to mention a specific place for intentional examples of interactions compared to incidental examples. For example, mentions of walking often included places such as ‘in a natural path’ or ‘hillwalking’, ‘going to the seaside’, ‘or ‘through the woodlands.’ There were also a lot of mentions of visiting specific national sites or protected areas. Whereas the incidental examples tended to simply mention the activity (i.e., ‘picnic with friends’, ‘kite flying’, and ‘bike riding’) without a specification of place. The relevance of place may be an important theme to explore in the future development of the scale. For this iteration we did not include any items that mentioned a specific place.

Additionally, we observed an initial indication that individuals’ perceptions of interactions with nature and the motivations driving them are quite nuanced. We observed ‘walking the dog’, ‘having a picnic’, and ‘walking’ were provided by participants as examples of *both* intentional and incidental contact. It is worth noting that walking as an intentional example often mentioned natural places, as noted above, whereas walking as an

incidental example often included connotations of commuting. We also observed 'camping' and 'going to the beach' as incidental examples, although with low frequencies.

From these responses, we decided to add 14 items to be tested in the second round of data collection because they represented gaps not covered by the initial items (Appendix, Table G.1). Certain items were not included because it was decided that they were too specific for the general population (e.g., watching the northern lights and woodworking, etc.).

7.2.3.2 Item Ratings

Means and standard deviations of intent ratings across both samples, item by item, are reported in the Appendix G. In evaluating the ratings, we considered a score of > 4 an indication of high intent, a score of 4 to be neutral and a score of < 4 to be considered an indication of low intent. Many of the ratings were in the expected direction, according to the four typologies presented by Marselle et al. (2021). For example, 'I went for a walk in nature' (M = 5.92, SD = 1.41) was rated as high intent and 'I heard a nature sounds soundtrack, playlist or podcast while in passing' (M = 2.51, SD = 1.67) was rated as low intent in line with assertions from previous work (Keniger et al., 2013; Marselle et al., 2021). However, some items were rated in an unexpected direction; for example, 'I ate outside in nature (e.g., lunch, dinner, coffee, etc.)' (M = 5.08, SD = 1.58) was rated unexpectedly high in intent. According to existing frameworks (Keniger et al., 2013; Marselle et al., 2021), eating outside should be considered an incidental interaction with nature; the primary motivation being to eat rather than enjoying nature. However, the results indicated that for participants it was considered intentional. Perhaps the act of eating is an excuse to enjoy a nice day for some individuals. Similarly, contrary to existing frameworks (Keniger et al., 2013; Marselle et al., 2021), 'I spent time exercising in nature' (M = 4.80, SD = 1.79) was also rated unexpectedly high on intent; this item was expected to be incidental, with exercising being the primary motive. Again, compared to exercising indoors, one can imagine that the decision to exercise outdoors in nature may include motivations to enjoy a nice day or enjoy the view and not focused solely on exercising.

We then computed an overall mean rating for all items expected to be categorized as either intentional or incidental, as well as direct and indirect items. We observed that intentional items (N = 40, M = 4.80, SD = 1.05) tended to be rated higher than incidental items (N = 26, M = 4.24, SD = 0.9), although the difference is small. We would have expected a larger difference between the items, suggesting that participants' motivations behind the interactions may not be in line with existing frameworks. Additionally, we

observed that items containing direct experiences of nature (e.g. 'I went wildflower picking in nature'; $N = 34$, $M = 5.33$, $SD = 1.28$) tended to be rated higher than items describing indirect experiences of nature (e.g. 'I did work or activities near a window'; $N = 26$, $M = 4.20$, $SD = 0.97$). This result suggests that perhaps participants may not perceive indirect interactions as 'true' interactions with nature.

7.2.3.2 Exploratory Factor Analysis

The EFA analysis was completed with R software using the package 'GPArotation' (Bernaards et al., 2015). Our approach to the EFA to determine the final selection of items for the scale involved four iterations of the analysis. The first iteration included the initial 66 items. Preliminary checks were met before running the EFA analysis. The Bartlett test (χ^2 (2145) = 9948.633, $p < .001$) was significant, and the Kaiser-Meyer-Olkin factor test (MSA = 0.78) suggested a sufficient amount of common variance. A parallel scree plot analysis suggested a seven-factor structure. An oblique rotation was selected due to correlations among the factors greater than .20. After the exclusion of cross-loading items[8], the first iteration suggested a 24-item scale with six factors (see Appendix H). Upon examination of the final solution, it was noted that the social variations of the items appeared to be inflating some of the results. The factors were dominated by the specific interaction and all the social variations loaded together. Their respective loadings were all very similar. This suggested that the social variations were performing identically and were inflating the importance of the specific interaction. Therefore, we decided to remove these items from the item pool and run the analysis again, including only the basic form of the interaction (e.g., I went for a hike in nature) without the social variations (e.g., I went for a hike in nature, with friends/family).

For the second iteration of the analysis, a parallel scree plot analysis initially suggested a six-factor structure. An oblique rotation was maintained. After the exclusion of cross-loading items, the second iteration suggested a 20-item scale with five factors (see Appendix H). Upon examination of this solution, it was noted that some of the awareness variations of items were performing identically, as indicated by loading on the same factor and very similar factor loadings with small differences. It was determined that for these items the syntax manipulation did not have the intended effect, and the items were therefore capturing the same construct. When considering which of the awareness variations to remove,

[8] Problematic cross-loading items were identified by the following rules: (1) if the secondary loading is more than half the value of the primary loading, and (2) if the secondary loading was greater than .35.

we chose to retain the item with the higher factor loading. Therefore, we removed 'I did work or activities near a window with a view of nature', 'I viewed trees through a window', 'I heard birdsong while in nature', 'I noticed the smell of wildflowers while in nature' and 'I spent time in nature exercising' items from the item pool.

For the third iteration of the analysis, a parallel scree plot analysis initially suggested a five-factor structure. An oblique rotation was maintained. After the exclusion of cross-loading items, the third iteration suggested a 14-item scale with four factors (see Appendix H). Upon examination of this solution, the reliability indices were low but still acceptable (α = .76). We decided to proceed with a fourth iteration to observe if the addition of 14 items from the open responses would improve the scale.

For the fourth iteration of the analysis, we sought to test if any of the examples elicited from participants would perform above and beyond the items included in the third iteration. A parallel scree plot analysis initially suggested a four-factor structure. An oblique rotation was maintained. After the exclusion of cross-loading items, the fourth iteration's final solution suggested a 15-item scale with two factors (Table 2). We expected to find a two-factor, intentional/incidental structure. In looking at the rating means by the factors, we observed that the final scale does not distinguish between intentional and incidental. The factor 1 (M = 4.53, SD = 1.87) and factor 2 (M = 4.19, SD = 2.14) rating means are not significantly different from each other on the level of intent ($t(66) = 1.6865$, $p = 0.096$). Therefore, the final solution offered captures only intentional activities.

Upon examination of this solution, the first factor appears to capture active or engaged interactions with nature. These items appear to be interactions or activities that often involve going out of one's way to perform (i.e., I fed bird or other wild animals in nature) or arriving at a particular destination (i.e., I went hunting in nature). The second factor appears to capture passive interactions with nature. These items are dominated by noticing nature (i.e., I saw or noticed plants while indoors) and include activities that may not be straightforwardly connected with nature (i.e., I socialized in nature). Interestingly, this preliminary solution appears to be dominated by the vision sense; there are no examples of interactions that include olfactory or hearing. Reliability estimates demonstrate very good reliability for the total scale (α = .84), as well as the individual factors (Table 7.2).

Table 7.2. Study 1 Exploratory Factor Analysis Final Solution

			Intent Ratings	
	F1	F2	M	SD
Factor 1 – Engaged Interactions with Nature				
I viewed fish in an aquarium	0.63		4.27	2.14
I visited an aquarium	0.66		4.00	2.10
I went hunting in nature	0.76	-0.25	2.75	2.08
I walked in nature as part of my commute	0.58	0.25	3.79	2.00
I went for a picnic in nature	0.64	0.25	4.64	2.14
I went swimming in nature	0.66		3.81	2.31
I fed birds or other wild animals in nature	0.52	0.22	5.04	2.22
I walked the dog in nature	0.53	0.21	4.61	2.30
I went wildflower picking in nature	0.84		4.12	2.35
Gardening either at home or a local plot	0.23		4.78	1.78
Factor 2 – Passive Interactions with Nature				
I socialised in nature		0.82	4.96	1.80
I ate outside in nature (e.g., lunch, dinner, coffee etc.)		0.78	4.63	1.92
I saw (or noticed) the sun rise in nature		0.68	3.93	1.92
I saw (or noticed) the sun rise while indoors		0.83	4.34	1.92
I saw (or noticed) plants while indoors	-0.32	0.67	4.87	1.74
SS Loadings	4.08	3.19		
Proportion of Variance	0.27	0.21		
Cumulative Variance	0.27	0.48		
Coronach's Alpha	0.84	0.82		
Omega	0.84	0.83		

Note. F = factor. Overall reliability: $\alpha = 0.84, \omega = 0.83$. Correlation between F1 and F2 = .23.

7.3 Study 2: Confirmatory Factor Analysis

7.3.1 Aims

Study 2 aimed to test the Experience with Nature preliminary scale using an Exploratory Factor Analysis to test if we would find the same factor structure observed in Study 1. The aim was to test the final item selection from Study 1 with another sample by eliciting intention ratings to replicate and confirm the scale structure.

7.3.2 Methods

7.3.2.1 Study Design

We presented participants with an online questionnaire. The questionnaire included the preliminary Experience with Nature scale, one open-response item to measure face validity, one open-response item to measure user experience, and lastly three demographic questions. This second round of intent ratings for the preliminary scale was evaluated using an Exploratory Factor Analysis (EFA). Responses to the open-response items will indicate if the scale items reflect the domain of interest (i.e., face validity) from the participant's perspective and if there are any concerns in understanding the syntax.

7.3.2.2 Participant Sample and Recruitment

Our total sample consisted of 127 participants. Table 1 shows demographic details. A total sample of 127 allowed us to observe a reasonable amount of variation in responses sufficient to perform the confirmatory factor analysis (CFA). The sample size determination follows the same reasoning as Study 1. Only residents of the United Kingdom who were the age of majority were recruited. Participants were recruited through Prolific and were compensated monetarily.

7.2.2.3 Materials

All questionnaire items were not mandatory; participants were free to decline to answer any item.

Closed-response items. Participants were presented with 15 closed-response items identified from Study 1 (see Table 2). These items were presented with the stem: "Please rate the following examples of interactions with nature on a scale ranging from 1 (low intent) to 7 (high intent). Please respond based on your personal experience," and included the definitions of low and high intent.

Open-response items. Participants were then asked two open-response questions. The first question assessed face validity: "In your opinion, what concept or behaviour were the previous questions intended to measure? In other words, what do you think we are asking you about?". To measure user experience, the second question asked, "Please offer any additional comments regarding the previous questions you answered (e.g., any difficulty in understanding meaning, or if some questions weren't applicable to you, etc.)." For both open-response questions, participants were given two lines to input their response.

Demographic items. The same demographic questions used in Study 1 were presented (see Section 2.2.3 above).

7.2.2.4 Procedure

The questionnaire was presented using Qualtrics software. After giving their informed consent, participants were presented with the preliminary scale of 15 items and asked to rate these items for the level of intent based on their experience. The items were presented in random order. Following this, they were asked two open-response questions designed to measure face validity and user experience. Lastly, they answered a few demographic items. At the end, they were thanked for their participation. The average completion time was 10 minutes.

7.3.3 Results

All analyses were completed with R software.

7.3.3.1 Face Validity

We examined 127 open responses measuring the face validity of the scale. There was a range of responses, including 19 reported comments regarding connectedness with nature (i.e., “How much people want to connect with nature”), 10 reported comments on general enjoyment (i.e., “Enjoyment of certain things in nature and indoors”), and 14 reported comments regarding the perceptions around nature (i.e., “What people perceive as nature […] perhaps only some people are able to view nature in any environment). Most responses (n = 56) were regarding intentions/motivations for interacting with nature (i.e., “I believe it was to measure whether I do those activities simply for my own enjoyment or interest or to see if I do those things to interact with nature), and interactions in a general sense (n = 23) which were in line with the study aims.

7.3.3.2 User Experience

We examined 127 open responses measuring the user experience of the scale. Many participants did not indicate any concerns about understanding the items or any possible misinterpretation. Most indicated that the survey was easy to understand or simply responded ‘none’. There were a few mentions of concerns regarding hunting and not having a dog. Some felt strongly against hunting as an example of interacting with nature, referencing that they perceived hunting as harming nature. These concerns reflect previous discussions we had during the project. In Study 1, the intention ratings regarding hunting were low (M = 2.78, SD = 2.23); however, the hunting item proved to be a strong item during the factor analysis. In fact, the reliability indices did not indicate an improvement could be achieved by dropping the item. Hunting and its reliability as an item may need to be re-examined in future developments of the scale.

7.3.3.3 Exploratory Factor Analysis

The EFA analysis was completed with R software using the package 'GPArotation'

Table 7.3. Study 2 Exploratory Factor Analysis 15-item

			Intent Ratings	
	F1	F2	M	SD
I viewed fish in an aquarium	.54	.24	4.62	2.32
I visited an aquarium	.54	.31	4.76	2.32
I ate outside in nature (e.g., lunch, dinner, coffee etc.)	.80		6.34	1.55
I walked in nature as part of my commute	.52		5.28	1.97
I went for a picnic in nature	.65	.24	6.29	1.69
I socialised in nature	.64		5.90	1.63
Gardening either at home or a local plot	.53		5.61	2.05
I saw (or noticed) plants while indoors	.72	-.38	5.24	1.99
I saw (or noticed) the sun rise in nature	.69		6.16	1.89
I saw (or noticed) the sun rise while indoors	.57	-.42	5.18	2.28
I fed birds or other wild animals in nature	.34	.58	5.93	2.14
I walked the dog in nature		.54	5.28	2.51
I went wildflower picking in nature	.23	.65	5.16	2.48
I went swimming in nature	.23	.64	5.05	2.43
I went hunting in nature	-.22	.72	2.78	2.23
SS Loadings	4.22	2.61		
Proportion of Variance	.28	.17		
Cumulative Variance	.28	.46		

Note. F = factor. Overall reliability: $\alpha = 0.86, \omega = 0.88$. Correlation between F1 and F2 = .24.

(Bernaards et al., 2015). We followed the same approach to the EFA as with Study 1; the aim was to observed if the structure of the items found in Study 1 could be replicated in a second sample. A parallel scree plot analysis of the items suggested a two-factor structure. An oblique rotation was maintained due to the correlation among the factors being greater than .20. The initial solution, without removing any items, suggested a high degree of overlap between the two factors (Table 7.3). This might suggest that the better solution is a one-factor structure. In fact, reliability indices indicated that the 15-item scale, with a one-factor structure, demonstrated good reliability ($\alpha = 0.846$) in this sample. The results further suggest that the factors previously identified as 'passive' and 'engaged' in Study 1 were not observed in Study 2. Therefore, the factors and any potential use as subscales should be interpreted with caution.

In continuing with a data-driven approach, we excluded cross-loaded items following conventional rules (see section 2.3.2). The final solution offered a one-factor, 12-item solution (Table 7.4). Three items were removed: 'I fed birds or other wild animals in nature', 'I saw (or noticed) the sunrise while indoors' and 'I saw (or noticed) plants while indoors'.

The final solution demonstrated good reliability indices as well (α = .85). Considering that

Table 7.4. Study 2 Exploratory Factor Analysis 12-item solution

		Intent Ratings	
	F1	M	SD
I viewed fish in an aquarium	.67	4.62	2.32
I visited an aquarium	.72	4.76	2.32
I went hunting in nature	.26	2.78	2.23
I walked in nature as part of my commute	.59	5.28	1.97
I went for a picnic in nature	.77	6.29	1.69
I went swimming in nature	.62	5.05	2.43
I walked the dog in nature	.43	5.28	2.51
I went wildflower picking in nature	.60	5.16	2.48
Gardening either at home or a local plot	.57	5.61	2.05
I socialised in nature	.67	5.90	1.63
I ate outside in nature (e.g., lunch, dinner, coffee etc.)	.74	6.34	1.55
I saw (or noticed) the sun rise in nature	.67	6.16	1.89
SS Loadings	4.66		
Proportion of Variance	.39		

Note. F = factor. Overall reliability: $\alpha = 0.85, \omega = 0.85$.

the final solution was a one-factor structure it could be argued that the exclusion of the three items did not improve the fit of the scale. It's worth noting a marginal difference in reliability indices. Fit indices also suggest a marginal difference as indicated by RMSR (15-item = 0.12, 12-item = 0.11), and the diagonal correlations (15-item = 0.87, 12-item = 0.89). Therefore, it was decided to continue with the next studies comparing both the 15-item and the 12-item scale.

7.4 Study 3: Frequency Scale Pre-testing

7.4.1 Aims

Study 3 aimed to test the Experience with Nature preliminary scale using a frequency response scale. It was the aim to design the final scale using a frequency response scale to capture how often individuals do each activity, in line with how contact with nature has been measured in the literature. Measures of exposure tend to capture the amount of contact, such as the frequency and duration (Bratman et al., 2019; Frumkin et al., 2017; Marselle et al., 2021; Shanahan et al., 2015). Measuring behaviour frequency would allow the scale to quantify the amount of intentional contact individuals have with nature and to be able to observe variations among individuals that may be relevant for predicting outcomes (Boateng et al., 2018). We aimed to observe differences in the frequency of contact reported, stratified by demographic variables.

7.4.1.1 Exploratory Hypotheses

We aimed to observe differences in responses comparing gender, age, and community type. The literature suggests that men have more contact with nature than women (Boyd et al., 2018). However, some studies have suggested that women tend to prefer walking as opposed to other types of exercising or playing sports (Hillsdon et al., 2005). It is possible that measuring specific activity frequencies will help further understand gender differences; perhaps men and women spend a similar amount of time outdoors but tend to prefer different activities that are not adequately captured by the measurement. The literature also suggests that contact with nature decreases with age, with declines in frequency observed at around 45 years of age (Boyd et al., 2018; Schipperijn et al., 2010). Lastly, it has also been widely reported that individuals living in rural areas tend to have more contact with nature than those living in urban areas (Boyd et al., 2018; Colley & Craig, 2019; Lee & Maheswaran, 2011; Schipperijn et al., 2010). We sought to observe if the responses to the Experience with Nature scale were in line with previous research.

7.4.2 Methods

7.4.2.1 Study Design

We presented participants with an online questionnaire consisting of the 15-item Experience with Nature scale. For this study, the items were paired with a frequency response scale. The responses were then analysed descriptively, stratified by demographic variables, and compared to findings from the literature.

7.4.2.2 Participant Recruitment and Sample

Our total sample consisted of 235 participants. Only residents of the United Kingdom who were the age of majority were recruited. Table 7.1 shows demographic details.

7.4.2.3 Materials

All questionnaire items were not mandatory; participants were free to decline to answer any item. The questionnaire was presented using Qualtrics software. We presented participants with 15 items identified from Study 1 (see Table 7.2). These items were presented with the stem: “Please tell us how often you have done the following activities in the last year. We’d like you to answer on a scale of 1 to 7, where 1 is “never”, and 7 is “regularly”. Please respond based on your personal experience.” Participants then responded to the same three demographic questions (see Section 2.2.3; gender, age, and community type) and were debriefed and thanked for their participation.

7.4.2.4 Procedure

After signing up for the study, participants were directed to the online questionnaire page. After giving their informed consent, they were presented with 15 items, which were presented in random order, and lastly, they answered a few demographic items. At the end, they were thanked for their participation. Participants were recruited through Prolific and were compensated monetarily. The average completion time was 10 minutes.

7.4.3 Results

All analyses were completed using R software. Results indicated that, on average, participants did not report a lot of interactions with nature (15-item: $M = 2.90$, $SD = 0.97$; 12-item: $M = 2.72$, $SD = 0.98$). In examining the frequency results by gender, we observed that women ($M = 3.01$, $SD = 0.93$) tended to report more frequent interactions with nature than men ($M = 2.87$, $SD = 1.00$), although this difference was not significantly different ($t(229) = 1.634$, $p = .104$) for the 15-item scale[9]. This contrasts with what is found in the literature that men tend to report more frequent interactions than women (Boyd et al., 2018). This small difference observed may be due to the passive interactions included in the scale. Recall in Study 1; we identified some interactions as 'engaged' examples of experiencing nature (i.e., I fed bird or other wild animals in nature) and some interactions as 'passive' examples of experiencing nature (i.e., I saw or noticed plants while indoors). The results in Study 4 suggest a small difference in engaged interactions between men and women for both the 15-item ($M_{difference} = .13$) and the 12-item ($M_{difference} = .11$) scale, in comparison to the passive interactions (15-item: $M_{difference} = .35$; 12-item: $M_{difference} = .50$). This may suggest that by asking participants to report their frequencies of passive interactions with nature we may capture differences in the way individuals interact with nature not captured by current measures of exposure to nature. These differences may be important in understanding the way gender interacts with contact with nature.

In examining the frequency results by age, we observed that more frequent interactions tended to be reported as age increases, with a peak at 55-64 years of age and then decreasing afterwards (Table 7.5). This trend holds for both the 15-item and the 12-item scale. The literature also suggests that contact with nature decreases with age; however, declines in frequency are observed at around 45 years of age (Boyd et al., 2018; Schipperijn

[9] Similar results for the 12-item scale: women ($M = 2.83$, $SD = 0.92$) tended to report more frequent interactions with nature than men ($M = 2.62$, $SD = 1.03$), although this difference was not significantly different ($t(229) = 1.63$, $p = .105$).

et al., 2010). The current study's results suggest that contact with nature decreases at a later age than previously reported. Again, this may suggest an advantage of capturing experiences with nature. It is possible that when responding to an item that asks about contact with nature in general terms, participants do not consider passive types of experiences with nature when responding.

The results stratified by the community type are in line with the literature (Boyd et al., 2018; Colley & Craig, 2019; Lee & Maheswaran, 2011; Schipperijn et al., 2010). We observed that individuals who reported living in a rural or countryside area reported more frequent interactions with nature for both scales. This effect also appears to be driven by higher frequencies of passive activities. In fact, this difference is greater for the 15-item scale (of which there are two additional passive items) compared to the 12-item scale. Our findings in Study 3 add support to the utility of not only including items that capture frequencies of specific interactions with nature but also the frequencies of passive types of interactions that individuals may not consider when responding to questionnaires referencing contact with nature in general terms.

Table 7.5. Experience with Nature descriptive statistics by demographic variables

	15-Item			12-Item		
	Total	Passive	Engaged	Total	Passive	Engaged
Age						
18 - 24	2.69 (0.98)	3.62 (1.33)	2.22 (0.92)	2.56 (0.99)	3.52 (1.62)	2.24 (0.90)
25 - 34	2.85 (0.91)	3.79 (1.20)	2.38 (0.94)	2.70 (0.94)	3.63 (1.34)	2.39 (0.95)
35 - 44	2.96 (1.18)	3.66 (1.40)	2.61 (1.18)	2.81 (1.22)	3.57 (1.47)	2.56 (1.23)
45 - 54	2.80 (0.76)	3.59 (1.11)	2.41 (0.74)	2.56 (0.74)	3.33 (1.15)	2.31 (0.72)
55 - 64	3.47 (0.88)	4.81 (1.59)	2.79 (0.74)	3.11 (0.82)	4.74 (1.53)	2.57 (0.74)
64+	3.03 (0.86)	3.78 (1.10)	2.65 (0.85)	2.74 (0.79)	3.82 (1.00)	2.38 (0.87)
Gender						
Woman	3.01 (0.93)	3.97 (1.32)	2.52 (0.90)	2.83 (0.92)	3.92 (1.38)	2.46 (0.90)
Man	2.80 (1.00)	3.62 (1.26)	2.39 (1.01)	2.62 (1.03)	3.42 (1.43)	2.35 (1.02)
Non-binary/Third Gender	2.73 (0.19)	3.50 (0.14)	2.35 (0.35)	2.67 (0.12)	3.17 (0.71)	2.50 (0.39)
Prefer not to say	2.60 (1.79)	3.70 (2.97)	2.05 (1.20)	2.25 (1.30)	3.33 (2.36)	1.89 (0.94)
Community						
Urban/city center	2.82 (1.04)	3.59 (1.31)	2.43 (1.03)	2.70 (1.07)	3.46 (1.44)	2.45 (1.06)
Suburban	2.87 (0.90)	3.83 (1.31)	2.39 (0.88)	2.68 (0.90)	3.72 (1.43)	2.33 (0.86)
Rural/Countryside	3.14 (1.01)	4.09 (1.25)	2.66 (1.03)	2.86 (1.01)	3.89 (1.36)	2.52 (1.03)

Note. Means are reported with standard deviations in brackets.

7.5 Study 4: Scale Validation

7.5.1 Aims

The fourth and final study aimed to validate the Experience with Nature preliminary scale by testing for convergent and divergent validity (Boateng et al., 2018). For convergent validity, we aimed to test the degree to which responses to the Experience with Nature scale were related to theoretically relevant constructs (Raykov & Marcoulides, 2011), such as well-being and connectedness with nature. For divergent validity, we aimed to test the degree to which responses to the Experience with Nature scale are differentiated from other constructs (Raykov & Marcoulides, 2011), such as nature exposure to test, if the two constructs are, in fact, distinct. Lastly, we aimed to compare the measures of exposure and the Experience with Nature scale to evaluate and compare how they are correlated with and predict pro-environmental behaviours (e.g. predictive validity).

7.5.1.1 Hypotheses

We expected that responses to the Experience with Nature scale would correlate with constructs such as connectedness with nature, and well-being. Contact with nature has been shown to be positively related to connectedness with nature (Martin et al., 2020; Mustapa et al., 2019). For example, Colléony et al. (2020) it found that instructing people to interact with nature in different ways (e.g., smelling flowers, touching natural elements, walking more slowly than usual) resulted in differences in nature-relatedness. Participants who experienced low psychological distance from nature (i.e., smell the flowers) reported greater nature-relatedness scores compared to those who experienced high psychological distance from nature (i.e., turn off your phone). Literature also suggests that contact with nature is moderately positively associated with well-being. The more contact with nature individuals report, the more they also report increased positive affect (Mintz et al., 2021), increased psychological well-being (Herzog & Strevey, 2008), and both eudaimonic and evaluative well-being (Martin et al., 2020). Studies focused on engagement activities also report greater well-being outcomes as measured by positive affect (Colléony et al., 2020) mental and physical health (Russell et al., 2013) and by qualitative self-reports (Hanna et al., 2019).

We also expected to find a small-moderate positive correlation with measures of nature exposure. Considering that measures of exposure still capture contact with nature, we expected to find a significant correlation; however, we expected that this correlation would be moderate due to differences in the underlying construct. Exposure to nature captures any interaction the individual may choose to think of when reporting their contact with nature. It is possible that individuals do not consider passive interactions when responding to exposure

items. Therefore, the Experience with Nature scale may capture interactions missed by exposure items, resulting in a small correlation.

Lastly, we expected to find that the Experience with Nature scale was more strongly related to pro-environmental behaviour frequency than nature exposure. Richardson et al. (2020) found that, in a stepwise regression analysis, predicting pro-conservation behaviour, significant predictors retained in the analysis were intentional direct activities such as (e.g., smelling wildflowers). Martin et al. (2020) also found that intentional contact with nature (i.e., visiting natural spaces at least once a week) was associated with higher household pro-environmental behaviours

Additionally, we aimed to explore differences between the 15-item and 12-item version of the scale. We conducted analyses for both versions with the aim of comparing validity and explanatory power.

7.5.2 Methods

7.5.2.1 Study Design

The questionnaire was presented using Qualtrics software. After informed consent, we presented participants with 15 items from the Experience with Nature scale and the nature exposure item. We then asked participants to respond to scales measuring well-being, connectedness with nature, pro-environmental behaviours and lastly, a few demographic items. Afterwards, participants were debriefed and thanked for their participation. The entire survey took, on average, 15 minutes to complete.

7.5.2.2 Participant Recruitment and Sample

Our total sample consisted of 301 participants. Only residents of the United Kingdom who were the age of majority were recruited. Table 7.1 shows demographic details. We aimed to collect data from as many participants as possible to allow for a reasonably representative sample. Schönbrodt and Perugini (2013) demonstrated that for expected correlations in the range of .70 or more, 136 participants would provide stable correlation coefficients at a 95% confidence value. Simulations suggest that at an 80% confidence level for an expected correlation of .70 with a small effect size, 65 participants would be sufficient (Schönbrodt & Perugini, 2013).

5.2.3 Materials

All questionnaire items were not mandatory; participants were free to decline to answer any item.

Experience with Nature. The Experience with Nature items presented were the 15 items identified in Study 1 (see Table 7.2). These items were presented with the stem, "Please tell us how often you have done the following activities in the last year," with responses measured on a 7-point frequency scale ranging from 1 (never) to 7 (regularly). Higher scores indicated more frequent contact with nature.

*Nature exposur*e. Nature exposure was measured with the single item, "In the last 12 months, how often, on average have you spent free time outside in green and natural spaces?" This item was adapted from the People and Nature Survey for England, PANS001, a national survey capturing long-term trends in nature access and use (England, 2020). Responses were measured on an 8-point scale ranging from 1 (never) to 8 (every day), with the option to select 'I don't know'. This measure captured direct contact with nature, with higher scores indicating more frequent contact with nature.

Wellbeing. Well-being was measured as a composite of two items: eudaimonic well-being, "Overall to what extent do you feel that the things you do in your life are worthwhile?" and evaluative well-being, "Overall how satisfied are you with life nowadays?" These items were adapted from the UK Office for National Statistics (Payne, 2017). Responses were recorded on 11-point scales ranging from 0 (not at all) to 10 (completely). Higher scores indicated higher levels of well-being. For the current study, well-being as a construct was used in analyses as the mean between these two items.

Connectedness to Nature. We included two measures of nature connectedness. The first was the Nature Relatedness short form scale NR-6 (Nisbet & Zelenski, 2013). This scale consists of 6 items, such as, "My relationship to nature is an important part of who I am", with a 5-point response scale ranging from 1 (disagree strongly) to 5 (agree strongly). Higher scores indicated higher levels of connectedness to nature. The second was the Inclusion of Nature in the Self (INS) scale (Schultz, 2002; Schultz, 2001), which consists of one graphically presented item in which participants were asked to indicate how much their self 'overlaps' with or 'includes' nature. The INS has been used extensively in previous research (Lumber et al., 2017; Mackay & Schmitt, 2019), and its advantages include the graphical format, meaning there are no language skill barriers; however, it is a single-item measure and, therefore, difficult to determine reliability. The INS is designed to capture how much individuals view themselves as a part of nature, whereas the NR-6 includes individuals' reflections about the environment and how much they notice the environment. The NR-6 may be more closely related to aspects of experience with nature that are captured by the Experience with Nature scale.

Pro-environmental behaviour. A measure of pro-environmental behaviour frequency was adapted from the Monitor of Engagement with the Natural Environment survey (a precursor to the People and Nature Survey)(England, 2012). It consisted of 11 items with two sub-scales for household (e.g., I usually recycle items rather than throw them away) and conservative behaviours (e.g., I volunteer to help care for the environment). Participants were presented with the stem: "How often have you done each of the following in the past year? We'd like you to answer on a scale of 1 to 7, where 1 is "never", and 7 is "regularly". Higher scores indicated more frequent performance of pro-environmental behaviours.

7.5.2.4 Procedure

The questionnaire was presented using Qualtrics software. After informed consent, we presented participants with 15 items from the Experience with Nature scale and one nature exposure item. These two measurements were randomly presented in the first block. In the second block, we measured well-being, connectedness with nature, and pro-environmental behaviour frequency. These measures were randomly presented within the block. In the last block, we asked participants to respond to face validity and user experience items, followed by three demographic questions. Afterwards, participants were debriefed and thanked for their participation. The entire survey took, on average, 15 minutes to complete.

7.5.3 Results

The means and standard deviations of all measures are presented in Table 7.6. The results indicate that, on average, participants reported 'rarely' to 'occasionally' performing the interactions on the Experience with Nature scale, whereas they reported spending 'once a week' to 'twice a week' of their free time in nature. Participants also reported, on average, that they 'occasionally' to 'sometimes' performed pro-environmental behaviours and a moderate-high level of well-being.

Table 7.6. Means and Standard Deviations for Constructs in Study 4

	M	SD
15-item score	2.87	0.85
12-item score	2.67	0.86
I viewed fish in an aquarium	2.01	1.27
I visited an aquarium	1.81	1.09
I went hunting in nature	1.27	0.90
I walked in nature as part of my commute	3.02	1.86
I went for a picnic in nature	2.85	1.49
I went swimming in nature	1.82	1.29
I fed birds or other wild animals in nature	2.84	1.77
I walked the dog in nature	2.72	2.18
I went wildflower picking in nature	1.78	1.31
Gardening either at home or a local plot	3.52	1.91
I socialised in nature	4.18	1.57
I ate outside in nature (e.g., lunch, dinner, coffee etc.)	3.84	1.45
I saw (or noticed) the sun rise in nature	3.24	1.61
I saw (or noticed) the sun rise while indoors	3.53	1.61
I saw (or noticed) plants while indoors	4.64	1.69
Exposure	5.78	1.76
Well-being	7.71	2.26
NR	3.67	0.87
INS	4.27	1.39
PEB	3.54	1.09
Household	4.35	1.28
Conservation	2.56	1.15

To compute the correlations between measures, we scaled the responses to have a mean of zero and a standard deviation of one. Centering variables in this way allows for valid comparisons across differing response scales (Dalal & Zickar, 2012). Correlations between all measurements are shown in Table 7.7. In line with previous research, we observed that the Experience with Nature scale was moderately correlated with well-being and nature connectedness (i.e., NR and INS) and was moderate-strongly related to pro-environmental behaviours. We did not observe large differences in comparing the 15-item and the 12-item scale.

Table 7.7. Pearson's R Correlations Among Constructs in Study 4

	2	3	4	5	6	7	8	9
1. 15-item EWN	.98	.43	.35	.45	.35	.57	.52	.50
2. 12-item EWN	-	.43	.34	.42	.33	.56	.50	.50
3. Nature Exposure		-	.24	.39	.44	.35	.36	.25
4. Well-being			-	.29	.31	.29	.29	.22
5. NR				-	.65	.65	.63	.50
6. INS					-	.46	.43	.40
7. PEB						-	.92	.85
8. Household							-	.58
9. Conservation								-

Note. $N = 301$. All correlations reported were significant $p < .001$.

The results indicated that the Experience with Nature scale and nature exposure were moderately correlated (r = .43). This result suggests a fair amount of overlap between the measures but still suggests a substantial difference. This is unsurprising as the frequency of direct contact captured by the exposure measure would also be captured by the Experience with Nature scale – but also encouraging as the moderate correlation might suggest that the passive interactions included in the Experience with Nature scale are meaningfully contributing to the overall measurement. We interpret this finding to mean that nature exposure and experiences with nature as quantified by the measures in this sample capture overlapping yet distinct constructs. Additionally, we observed that both the 15-item and the 12-item Experience with Nature scales were more strongly related to measures of well-being, nature-relatedness, and pro-environmental behaviour than the nature exposure item (Table 7.7). Notably, the difference between correlations regarding pro-environmental behaviours was large. Correlation estimates between the Experience with Nature scales and measures of pro-environmental behaviour were moderate-high (r = .57), whereas estimates between the exposure measure and the pro-environmental behaviour measure were small-moderate (r = .35). This pattern of results suggests that in capturing the frequency of the individual's experiences with nature, we were able to demonstrate a stronger relationship with pro-environmental behaviours compared to capturing the frequency of nature exposure alone.

It was also noted that the nature exposure measure appeared to be more strongly correlated with the INS compared to the Experience with Nature measures. It appears that the degree to which individuals feel a part of nature is better explained by how often they spend their free time in nature (i.e., exposure) rather than the frequency of specific interactions (i.e., experience).

To further compare the nature exposure measure and the Experience with Nature scale, we conducted multiple regression analyses. For each outcome measure (i.e., well-being, connectedness and pro-environmental behaviour), we first included nature exposure as a predictor and then included the Experience with Nature scale as a predictor in a stepwise manner. The amount of variance explained and the estimates were then compared to determine which of the two predictors was a greater contributor. For these analyses, only the 15-item Experience with Nature scale was included.

We observed that for all outcome variables when nature exposure was included as a predictor alone (i.e., Model 1), nature exposure significantly predicted well-being, nature relatedness, the inclusion of the self with nature and pro-environmental behaviour measures. However, when the 15-item Experience with Nature scale was included in the analysis (i.e., Model 2), we observed that for models predicting well-being, nature relatedness, and pro-environmental behaviour, the Experience with Nature scale was the stronger predictor. In fact, for the models predicting well-being and pro-environmental behaviour, the nature exposure measure was no longer a significant predictor. In particular, when considering pro-environmental behaviour as an outcome variable, the variance explained by nature exposure alone was quite small ($R^2 = .126$) compared to the variance explained after including both nature exposure and the Experience with Nature scale ($R^2 = .341$). These results suggest that the Experience with Nature scale is better able to explain the variance in these outcome variables compared to nature exposure.

Interestingly, nature exposure appears to better predict the Inclusion of Self with Nature scale compared to the Experience with Nature scale. In Model 1 ($R^2 = .195$), where nature exposure was the sole predictor, and Model 2 ($R^2 = .228$), where both nature exposure and the Experience with Nature scale were included as predictors, we did not observe a large change in variance explained. Additionally, while both predictors remained significant in Model 2, nature exposure was the stronger predictor ($b = .357$) compared to the Experience with Nature scale ($b = .199$). The concept of nature-relatedness and capturing how much an individual notices and reflects upon nature may be better explained by how an individual experiences nature, compared to the concept of how much oneself overlaps with or includes nature.

Table 7.8. Stepwise Multiple Regression Analyses

	Model Estimates			Predictor Estimates		
	F	p	R^2	b	t	p
Well-being						
Model 1	17.71	<.001	.056			
Nature Exposure				.237	4.21	<.001
Model 2	22.95	<.001	.133			
Nature Exposure				.105	1.76	.080
15-item EWN				.308	5.16	<.001
Nature Relatedness						
Model 1	53.36	<.001	.151			
Nature Exposure				.389	7.31	<.001
Model 2	50.51	<.001	.253			
Nature Exposure				.234	4.30	<.001
15-item EWN				.353	6.37	<.001
Inclusion of Self with Nature						
Model 1	72.51	<.001	.195			
Nature Exposure				.412	8.52	<.001
Model 2	43.9	<.001	.228			
Nature Exposure				.357	6.33	<.001
15-item EWN				.199	3.54	<.001
Pro-environmental Behaviour						
Model 1	43.00	<.001	.126			
Nature Exposure				.355	6.56	<.001
Model 2	76.91	<.001	.341			
Nature Exposure				.135	2.60	.009
15-item EWN				.513	9.85	<.001

Note. EWN = Experience with Nature Scale. Dependent variables are underlined.

7.6 General Discussion

The current project aimed to develop a measure of contact with nature that would capture the individual's experience. We aimed to improve upon measures of exposure in explaining variations in pro-environmental behaviours. This project demonstrated that by capturing the individual's experience, we were able to explain more variations in pro-environmental behaviours, well-being and connectedness compared to exposure to nature alone.

7.6.1 Experience with Nature Scale

This project took several steps to build a measurement tool that focused on capturing experiences with nature according to the four typologies presented by Marselle et al. (2021). We sought to identify interactions with nature that would allow us to capture intentional, incidental, direct, and indirect experiences with nature.

In Study 1, we asked participants to offer examples of their intentional and incidental interactions with nature. Interestingly, we observed interactions such as 'walking the dog', 'having a picnic', and 'walking' were cited as examples of both intentional and incidental contact. As well as interactions such as 'going to the beach' cited as incidental interactions. Additionally, in Study 1, we compiled a list of 66 interactions with nature from the literature and asked participants to rate these examples on a scale of low intent to high intent. The results of intent ratings demonstrated that many items were rated as either high intent or low intent in line with the four typologies (Marselle et al., 2021). For example, 'I spent time at a lake or beach' (M = 5.38, SD = 1.70) and 'I saw a video of an aquarium/fish tank while in a waiting room' (M = 2.62, SD = 1.81), respectively. Contrary to expectations, 'I socialised in nature' (M = 4.92, SD = 1.62) was also rated unexpectedly high in intent; based on the four typologies (Marselle et al., 2021), this item was expected to be rated as incidental – socialising being the primary motive. Taken together, the results from the open-response items and the rating items suggest a nuanced picture of individuals' experiences with nature and the motivations behind them. Richardson et al. (2020) also questioned the true 'intentionality' behind some of the activities captured in their study, suggesting that activities such as listening to nature programs may be related to intentions regarding relaxing rather than intentions to seek nature. The results of the current study demonstrate that while frameworks are useful for researchers as they generate hypotheses, there is still a need to confirm with participant data the motivations behind interactions with nature.

In Study 1, the ratings also indicated that our social hypothesis was largely unsupported. From the literature, it has been suggested that if an individual is interacting with nature in a social context, then that interaction is considered incidental – their primary motivation is to be social. Carrus et al. (2015) suggest that environment-oriented activities in restorative environments may increase the perception of the restorative properties of the environment and, consequently, the self-reported benefits. They assert that this effect may not be observed for socially oriented activities, perhaps due to the lack of focus on the environment. The current study found that the social variations of the same interaction did not reliably produce meaningful differences in intent ratings with respect to the aim of building a measurement scale. This was reflected in the exploratory factor analysis (EFA), where the social variations loaded on the same factor with similar magnitude in loadings, suggesting they were measuring the same underlying construct. In fact, an inspection of the ratings (see Appendix G) demonstrates that ratings were very similar across social variations. These results suggest that while solitary interactions with nature produce greater effects on

outcomes (e.g., restorativeness) (Carrus et al., 2015; Staats & Hartig, 2004), from the individual perspective, motivations with respect to a particular interaction with nature remain relatively stable with or without a social element. Thus, if an individual is being social during an interaction, researchers should not interpret the interaction as void of intention to have contact with nature. One can imagine that if an individual would like to go for a hike in a natural area, they may prefer to go with a companion for safety reasons rather than going alone. However, this does not automatically mean that their intention to seek nature is reduced simply because another individual is present – some research suggests that individuals are more motivated to seek contact with nature if there is a social element (Hynds & Allibone, 2009). A consideration of social elements regarding interactions with nature would depend on the study outcomes: if an inspection of intentions is the focus, the effects of social compared to solitary interactions may not be meaningful in certain cases, whereas effects on outcomes that may depend on attentiveness to nature (e.g., restorativeness) social elements could prove to be distracting (Hynds & Allibone, 2009) and reduce the effects.

Additionally, the awareness hypothesis was partially supported. Some research suggests that engagement activities produce greater effects when in nature than controls (Pasanen et al., 2018). For example, Duvall (2011) found that only participants in their engagement condition (e.g., noticing and paying attention to nature) reported significant improvements in psychological well-being. In the current study, we removed the awareness variations of some of the same interactions because, in the EFA, these items loaded on the same factor with similar magnitude in loadings, suggesting they were measuring the same underlying construct and did not contribute any meaningful additions to a potential scale. Some of the items which were specifically constructed to capture a degree of awareness (e.g., I saw [or noticed] …) were retained. In fact, three items in the final solution of the EFA were in this syntax. Our results appear to suggest that noticing nature, in general, is an interaction with nature that should not be discounted and may still contribute to the effects on beneficial outcomes observed in the literature; however, direct comparisons between attention to nature (e.g., listening) and noticing nature (e.g., heard) may not offer meaningful distinctions when comparing the same interaction or activity.

From Study 1, the preliminary scale produced was an intentional scale only. The results from the EFA did not include any interactions that were rated as incidental. We expected to develop a two-factor scale with one factor capturing intentional interactions and the second capturing incidental interactions. Instead, the results of the EFA suggested a scale capturing high intent with two factors since the overall mean of the two factors was not

statistically different from each other, with mean ratings above four. We interpreted the two factors as passive (e.g., I ate outside in nature) and engaged interactions (e.g., I went wildflower picking in nature). Furthermore, the two factors were unbalanced (factor 1 = 10 items, factor 2 = 5 items), and the scale did not include all the senses. The scale nevertheless demonstrated good reliability. Thus, it was decided that the preliminary Experience with Nature scale would be suitable to demonstrate the potential benefits of capturing experiences with nature compared to exposure to nature.

In Study 2, we conducted a confirmatory factor analysis (CFA) on a third sample of participants. The results of the CFA suggested that the best fit for the data was a one-factor structure rather than a two-factor structure. These results suggested that caution should be taken when interpreting the individual factors, we identified as 'passive' and 'engaged' experiences with nature in Study 1. The factors should not be considered as true subscales at this stage and further testing is required to develop reliable subsets of items. The CFA analysis also suggested that three items could possibly be removed with little effect on reliability (15-item α = .85, 12-item α = .85). Therefore, we proceeded with further analyses comparing both the 15-item scale and the 12-item scale.

Lastly, in Study 3, we asked participants to respond to the 15 items identified in Study 1 on a seven-point frequency-based response scale, with the aim of observing if the trends in responses were in line with the literature. The literature suggests that men tend to have more contact with nature than women (Rosa et al., 2023), however, we found that women reported greater frequencies to the Experience with Nature scale than men. The literature also suggests that men and women tend to have different preferences in their preferred experiences with nature: women tend to prefer activities such as walking, whereas men tend to prefer activities such as exercising or playing sports (Hillsdon et al., 2005). Thus, our findings that women have more frequent contact with nature than men may be due to the fact that the scale captures a variety of experiences – experiences that some individuals may not consider when responding to traditional measures of nature contact. Thus, traditional measures of contact with nature may underestimate the actual contact of women. However, the Experience with Nature scale in the current study does not include an item referencing exercise, which may underestimate activities typically performed by men as well.

We also found that contact with nature increased with age, on average, in line with the literature (Boyd et al., 2018). However, we observed a decline after 55-64 years of age rather than after 45 years of age (Boyd et al., 2018; Schipperijn et al., 2010). Again, this may suggest that it is advantageous to consider experiences with nature. In capturing a variety of

activities, we can gain a better picture of how the individual interacts with nature and, in some ways, are closer to capturing their true frequency of contact. Lastly, we found that when considering frequencies by community, the results stratified by the community type were in line with the literature (Boyd et al., 2018; Colley & Craig, 2019; Lee & Maheswaran, 2011; Schipperijn et al., 2010). We observed that individuals who reported living in a rural or countryside area reported more frequent interactions with nature.

6.2 Exposure, Well-being, Connection with Nature, and Pro-environmental Behaviors

We conducted analyses to test if capturing experiences with nature would predict outcome measures associated with contact with nature better than an exposure measure. While some research has indicated that certain interactions with nature were shown to be related to increased frequencies of pro-environmental behaviour, these studies did not explicitly measure intentions (Alcock et al., 2020; Whitburn et al., 2019). One study by Richardson et al. (2020) found that, in a stepwise regression analysis predicting pro-conservation behaviour, significant predictors retained in the analysis were intentional direct activities such as (e.g., smelling wildflowers). In the current project (Study 4), correlation analyses suggested that the Experience with Nature scale was more strongly correlated with well-being, the Nature Relatedness scale, and pro-environmental behaviours compared to exposure to nature. Additionally, we observed that when the 15-item Experience with Nature scale was included in the multiple regression analysis with nature exposure, we observed that for models predicting well-being, nature relatedness, and pro-environmental behaviour, the Experience with Nature scale was the stronger predictor. For models predicting well-being and pro-environmental behaviour, the nature exposure measure was no longer a significant predictor. For the model predicting pro-environmental behaviour as an outcome variable, the variance explained by nature exposure alone was small compared to the variance explained after including both nature exposure and the Experience with Nature scale. These results suggest that the Experience with Nature scale is better able to explain the variance in these outcome variables compared to nature exposure.

It's important to note that nature exposure appeared to better predict the Inclusion of Self with Nature scale compared to the Experience with Nature scale. These results suggest that depending upon the researchers' conceptualisation of nature connectedness (i.e., Nature Relatedness vs. Inclusion of Self with Nature), a measure of nature exposure may be more relevant, in terms of explaining variance, than a measure of experiences with nature.

Overall, the results of Study 4 suggest that by capturing experiences with nature we were better able to explain variations in pro-environmental behaviour compared to measuring nature exposure alone.

6.3 Limitations and Future Directions

By building a measurement scale focused on capturing experiences with nature, the current project demonstrated that considering experiences with nature helped to explain more variance in pro-environmental behaviours compared to nature exposure. However, the Experience with Nature presented can only be considered a preliminary scale. There are some limitations to consider before using the scale in future studies.

The current project was not able to replicate the factor structure found in Study 1. The CFA analysis in Study 2 suggested a one-factor structure. The implication is that we cannot interpret the factors identified as engaged and passive interactions as true subscales. It would be ideal to have reliable subscales that captured different types of interactions (such as passive and engaged) to allow pointed hypotheses about the differing effects of these types of contact. Future research would be required to further develop the scale to reliably capture differences between different types of experiences and the possible differential outcomes associated.

Additionally, the Experience with Nature scale was tested using a 12-month time reference. This was chosen to be in line with other similar measures, such as the nature exposure measure (England, 2020) and the pro-environmental behaviour measure (England, 2012) selected. Given that some interactions with nature could be limited depending on the season and weather conditions, it would be advantageous to have a longer time frame to allow for the possibility of these various interactions (e.g., picking wildflowers) to occur. However, there is a concern that a 12-month time reference could limit the validity of the measurement due to concerns about recall biases (Te Braak et al., 2023). Participants may not accurately recall their behaviour frequencies over the last year. Further development and testing for the effects of different time references is needed.

We also observed that when offering examples of interactions with nature, it was common for participants to mention a specific place for intentional examples of interactions compared to incidental examples. For example, mentions of walking and an intentional example often included places such as, ‘in a natural path’ or ‘hillwalking’ or ‘through the woodlands’. The relevance of place may be an important theme to explore in the future development of the scale. Gosling and Williams (2010) found that emotional associations with nature places were significantly related to an expanded sense of self as well as pro-

environment behaviours. Expanding the scale to include considerations of emotional attachment to place may help to improve the measurement and explain more variations in pro-environmental behaviours.

Lastly, further testing of the scale with a community sample population would be beneficial to increase generalizability. The current project used an online recruitment resource. While this resource gives a wide range of participants access to the study, it is possible there are some underlying biases involved. Perhaps there are some important differences in the type of individual who signs up through Prolific compared to the type of individual who does not.

Overall, the Experience with Nature scale could be a useful addition to both experimental and observational studies and wide-scale surveys. In developing the scale, we sought to include interactions that could be applicable to the average individual. By considering behaviour frequencies of different types – supported by participant data – researchers would be able to consider the effects of experience on the relevant outcomes of interest. The development of the Experience with Nature scale is an initial step in testing hypotheses from frameworks on the differing effects of contact with nature on individuals (Keniger et al., 2013; Marselle et al., 2021), such as whether direct contact demonstrates greater influence compared to indirect contact and whether these effects hold after controlling for intentions.

Chapter 8

Dissertation Discussion

This dissertation contributes to the broader understanding of how different motivational constructs explain variations in pro-environmental behaviour (PEB), aligning with existing literature while offering some novel insights. The findings we present not only shed light on new avenues of research for promoting PEBs but also on the advantages and disadvantages of each approach.

8.1 Chapter 4 Findings

In Chapter 4, the study "Reduce, Reuse, Recycle, Repeat: The curious role of outcome-related feedback in the continued performance of recycling behaviours", tested how outcome-related feedback influenced recycling behaviour across familiar and unfamiliar contexts. We used a computerized task to simulate recycling behaviours and examined feedback's role in maintaining these behaviours. The use of the computerised task allowed us to capture a behaviour that poses challenges in doing so through observational or self-report methods.

In aiming to study the continued performance of recycling behaviour across familiar and unfamiliar contexts, being able to observe individuals directly posed logistical and practical challenges. Additionally, self-report measures come with their own set of advantages and disadvantages. Asking individuals to report how frequently they perform an action is a straightforward approach; however, by asking individuals, you also allow for the introduction of certain biases such as, social desirability, acquiescent responding, and recall biases (Shaver & Wrightsman, 1991). Recycling may be particularly prone to such response biases. The social norms around recycling today generally support recycling as a good action(Pensini & Caltabiano, 2012); individuals may not feel comfortable openly admitting that they do not recycle as often as society tells them they should. Considering the study would necessarily be open to its aims (i.e., investigating both how often people recycle and how often they do not recycle), there is also the concern individuals may simply agree with all items (i.e., acquiescently) presented in a self-report measure (Paulhus & Vazire, 2007). Lastly, since recycling is a behaviour that likely occurs throughout the day, in small snippets, without the benefit of an experience sampling approach, individuals may not be able to accurately report their recycling behaviour depending upon the reference time frame and may inflate their behaviour upon recall (Demiray et al., 2018).

The approach selected was to design a measure that would quantify behaviour maintenance and use this method to compare behaviour across contexts. Therefore, in order to reliably capture differences between contexts, we opted for a computerised approach in an effort to have as precise and accurate estimates as possible. By using a computerized task, we were able to precisely measure the number of trials or times each participant recycled; we also were able to measure reaction times and accuracy, all while controlling for possible confounding variables such as the number of waste bins provided. We could then compare performance across contexts reliably because the visual elements involved were kept constant.

Across three studies, the results showed that outcome-related feedback generally influenced participants to complete additional trials, which is how we operationalised behaviour maintenance. This result was in line with previous research. Harkin et al. (2016) found that feedback can support goal motivation by providing participants with information that allows for self-monitoring and adjustment, which can increase continued engagement in tasks. However, the current study found differing effects of feedback depending on context. In unfamiliar settings, feedback appeared to lead participants to stop the task sooner. Some previous findings may help to understand this unexpected result. For example, Miao and Wei (2013) discussed how contextual changes, such as vacations, can lower individuals' motivation to engage in pro-environmental behaviours due to the hedonic nature of the setting. Yet, these findings may be explained by some limitations of the task itself. It's possible that by asking participants to first complete the task in a familiar setting and then complete the task in an unfamiliar setting, this order resulted in unintended learning goals. Participants may have viewed the second round of the task as simply a new set of sorting rules to learn and then felt free to stop sorting once they felt they had performed sufficiently.

This is part of the concern when designing a computerized task as a proxy for actual behaviour. Computerised tasks have the difficulty of justifying whether performance during the task is predictive of behaviour in the real world (Holleman et al., 2020). We found that the number of additional trials performed on the task was significantly correlated to the self-report past performance of high-frequency PEBs (i.e., recycling), which may suggest the task did tap into some aspects of real-world behaviour, although this relationship was weak. The task included design elements to have as much ecological validity as possible – images were selected to represent real-life objects, the sorting system rules were selected to match the target population, and we used a drag-and-drop motion to mimic a 'placing in the bin' action

¬– questions of if performance on the task can be generalized to real-life settings are still present (Andrade, 2018).

Considering the pattern of results, it is possible that rather than the task capturing real-world recycling behaviour, the task captured recycling knowledge. We found that accuracy on the task was significantly correlated to the self-report past performance of high-frequency PEBs (i.e., recycling), which may suggest the task did tap into some aspects of real-world behaviour but could also suggest the 'true' measure of the task was knowledge of recycling which may or may not extend to actual recycling behaviour.

The current study concluded that feedback helped to maintain recycling in familiar contexts, but rule changes may play a more significant role when switching to unfamiliar contexts. Future research should disentangle motivational effects from environmental barriers, particularly across different settings. This study used a vacation scenario within the task; however, it is often the case that recycling sorting rules change from city to city or town to town. It's not uncommon that an individual faces a new sorting system when at work compared to when at home (Gallardo et al., 2010). This study's unique contribution is its focus on context-specific behaviours, suggesting that recycling habits might break down when external conditions, such as unfamiliar sorting rules, change. Future interventions may need to balance behavioural guidance and the adaptability of sorting systems to unfamiliar contexts.

8.2 Chapter 5 Findings

In the Chapter 5 study, "*The dynamic interplay between goals and pro-environmental behaviours: Examining recycling and sustainable consumption*", we aimed to use several constructs, namely pre-volitional constructs, to examine variations in recycling and sustainable consumption behaviour. While the computerized task proved to be advantageous in precisely quantifying several aspects surrounding recycling behaviour and then allowing us to make valid comparisons between contexts, the approach raised questions surrounding the ecological validity of the task and, consequently, the results. In this chapter, we aimed to adopt an ecologically valid approach to investigating the influences of motivations on pro-environmental behaviours (PEBs), while considering the possible limitations of self-report behaviours. To this end, we captured recycling and sustainable consumption behaviour through a daily diary sampling method. By using a daily diary method we aimed to capture an accurate representation of participants behaviours (Niemi, 1993).

The time-series modelling approach allowed us to observe the relationship between behaviours and goals that wouldn't otherwise be possible. We observed a unique effect: previous behaviour occurrence influenced subsequent goals for recycling behaviour. The pattern of results suggests that the behaviour itself may be an important driver across days. This result may be interpreted to mean that for recycling behaviour, previous behaviour occurrences influence subsequent goals. We interpreted this result in light of the moral licensing effect. What is sometimes seen in behavioural spill-over research is that an individual performs one type of PEB but does not perform other PEBs after, with the idea that their previous act 'makes up for' the possible negatives associated with not doing the other PEB (Gholamzadehmir et al., 2019; Maki et al., 2019). It is possible that the same effect but in the opposite direction and within the same behvaiour may have occurred in the current study. One can imagine that an individual may have failed to recycle the previous day and then endeavors to 'make up for it' the following day, strengthening the relative goal. Further research would be needed to confirm this assertion, but it is in line with goal-setting theories. The goal-setting literature suggests that previous behaviours may impact future goals through self-monitoring. Individuals likely monitor and evaluate their behavioural outcomes, which, in turn, provides motivational incentives to continue (Locke & Latham, 2002, 2013, 2019). This monitoring may help the individual feel as if they are 'on track' with their goals. It is possible that individuals who fail to recycle previously make up for it in subsequent days to get back on track with their goals.

Additionally, we observed a significant negative effect of pro-environmental identity on the pathway representing the effect of behaviours on subsequent goal importance ratings for sustainable consumption behaviours. For individuals with high pro-environmental identity, previous behaviours were related to a decrease in the importance of reasons (i.e., goal importance rating) not to perform sustainable consumption behaviours the next day. For individuals high in pro-environmental identity, not doing goal importance rating were not the stronger predictor of sustainable consumption behaviours. In the doing goal model, we did not observe this effect; the influence of doing goals remained independent of pro-environmental identity. We interpret these findings in light of a possible 'updating' effect of current goals based on previous behaviours related to Perugini and Bagozzi (2001)'s explanation of anticipated emotions. They suggest that an individual's anticipated emotions, with respect to the performance of a particular behaviour, captures the individual's appraisal of goal achievement and goal failure (Perugini & Bagozzi, 2001). Considering that anticipated emotions change from time to time and depending on the context, it is possible

that individuals incorporate their reaction to a previous failure into their anticipated future reactions with respect to goal achievement. The way in which past behaviour has an effect on future goals may work through this construct.

To our knowledge, these results are the first of their kind and they have demonstrated the utility of considering PEBs as goal-directed behaviours. Our results may also apply to other goal-directed behaviours as well. We discussed the possibility of constructs such as anticipated emotions as a possible explanation, yet further research is needed to replicate these findings and to further tease apart the effects.

8.3 Chapter 6 Findings

Using a pre-volitional framework, the study aimed to develop a model explaining variations in pro-environmental behaviours, particularly recycling and sustainable consumption. Drawing on pre-volition frameworks such as the Theory of Planned Behaviour (TPB; Ajzen (1991)) and the Reasoned Action Approach (RAA; Fishbein and Ajzen (2011)) and the Extended Model of Goal-directed Behaviour (EMGB; Perugini and Conner (2000)) as a base model, we additionally explored goal content, the incremental validity of 'not doing' constructs while making comparisons on the differences between the two types of PEBs. Recycling and sustainable consumption behaviours were measured over a three-week period using a daily diary method – participants responded to daily questionnaires asking them to respond to several yes/no behaviour indicators.

Regarding goal content, participants tended to choose different goals for engaging in (i.e., 'doing) and not engaging in (i.e., 'not doing') the behaviours. Recycling was mainly motivated by normative goals (e.g., to protect nature; 80% of participants chose this type of goal), while non engagement goals often stemmed from gain- or hedonic-related goals. In contrast, sustainable consumption only about 47% of participants chose a normative goal as a reason to engage in the behaviour with about 10% of participants choosing gain goals as a reason not to engage.

The base pre-volitional model explained a substantial amount of variation in intentions (77% for recycling and 85% for sustainable consumption) but less for actual behaviour (11% for recycling and 7% for sustainable consumption). We then tested for incremental validity by including the not doing constructs. For recycling behaviour, we found that not doing behaviour desire explained an additional 2% of unique variance in intentions

and that not doing intentions explained an additional 3% of unique variance in actual behaviour. These findings suggest that for recycling behaviour, considerations of not doing constructs may help to explain variations in intentions and actual behaviour, and perhaps more focus should be placed on the execution of the behaviour itself. Incremental validity testing for sustainable consumption behaviour showed that only not doing goal desire contributed to an additional 3% of unique variation explained in behaviour desire. This finding suggests that motivations for not doing the behaviour are particularly relevant early in the model or before individuals form their intentions. We put forth that perhaps sustainable consumption behaviour is different from recycling in that reasons for not performing such behaviours are considered more heavily during the planning and elaboration phase of considering how to execute one's desires (Perugini & Bagozzi, 2004a) and are less relevant in forming intentions or executing behaviour directly.

The important note to highlight from this study is the intention-behaviour gap we observed. In the current study we explained a substantial amount of variation in intentions (77% for recycling and 85% for sustainable consumption) but less for actual behaviour (11% for recycling and 7% for sustainable consumption). This result appears to be consistent with intention-behavior gap present in research (Armitage & Conner, 2001; Yuriev et al., 2020). Generally speaking, there is a lack of studies which use behavioural intentions as part of their research, that extend their findings to actual behaviour (Andorfer & Liebe, 2012; Hassan et al., 2016). Nevertheless, the studies that include actual behaviour often report very small estimates. For example, Rhodes and Dickau (2012) conducted a meta-analysis on the intention–behaviour relationship focusing on exercise behaviours and found the relationship to be too weak to be of any practical value. In Hassan et al. (2016)'s case study, where they specifically sought to try and close the intention-behaviour gap as much as possible, they were only able to explain 11% of the variations in ethical consumption behaviour, despite explaining 28% of the variations in intentions. Additionally, in a meta-analysis (Kormos & Gifford, 2014) report a 79% of variance in self-report measures unexplained by objective measures in the pro-environmental beaviour domain.

Furthermore, Ajzen (2011) argued that a low intention-behaviour relation may be indicative of the limitations of using the reasoned action approach for that domain. Therefore, while work with pre-volitions has been useful in many domains, it may not be appropriate for examining actual behaviour and/or sustainable behaviours. This point is in line with some of the conclusions made about the current study's results.

In comparing the two behaviours, sustainable consumption may be better understood as a reasoned, intentional process than an incidental decision-making process (Gawronski & Bodenhausen, 2007; Richetin et al., 2007). This means that individuals tend to weigh the potential benefits and costs considerably before forming their intentions for sustainable consumption behaviours. This is, of course, the case for several types of pro-environmental behaviours (Follows & Jobber, 2000); however, our results indicate this may be particularly true for our sample of sustainable consumption behaviour. In our sample, correlational analyses indicated that only not doing intentions (compared to doing intentions) were significantly correlated with sustainable consumption behaviour. This contrasts with recycling where only doing intentions were significantly correlated with behaviour. Motivations to not perform the behaviour appear to be more strongly implicated in sustainable consumption, suggesting that the behaviour may be better characterized as deliberative. Recycling has been talked about as a pro-environmental behaviour for several years now (Derksen & Gartrell, 1993), and it is possible that recycling behaviour may have already been somewhat habitual for participants – in fact, in the base pre-volition model, negative (and not positive) anticipated emotions was a significant predictor of behaviour desire for recycling, whereas both positive and negative anticipated emotions were significant predictors of behaviour desire for sustainable consumption. Although pre-volition models may not be equipped to disentangle fully incidental behaviour from deliberate behaviour (Richetin et al., 2008), the pattern of results found in the present study was able to capture several differences between recycling and sustainable behaviour, and points to this distinction as a possible direction for future research.

Another possible explanation for the intention-behaviour gap is the limitations associated with self-report measures. Self-reported measures have the potential to inflate estimates of behaviour. This may be due to response biases such as social desirability bias or recall bias. Contamination of social desirability bias in self-report responses is when individuals tend to respond in such a way as to present themselves in a favourable light, in accordance with social norms and standards (Zerbe & Paulhus, 1987). Social desirability responses are thought to be particularly likely when dealing with sensitive topics (Charles & V. Dattalo, 2018). As such, responses to represent oneself favourably may not necessarily be a deliberate act of deception but could also represent a type of optimism upon reflection of one's actions (Paulhus & Vazire, 2007) (Fisher & Katz, 2000). Put simply; recall bias describes the contamination of self-report response data due to the participants' inaccurate or incomplete recollection of the behaviour or event in question (Sudman & Bradburn, 1974).

This can happen in response to certain cues, causing participants to recall events in line with the information currently presented to them (Page & Henderson, 2008) and may also be a result of the length of time that has passed, with events further away in time being more difficult to remember accurately (Rubin & Baddeley, 1989). Some research has also suggested that social desirability may play a small part in recall bias as well – participants sometimes (non-intentionally) inflate or deflate their responses in line with current desires and/or social norms. These effects have been demonstrated in a self-report dietary intake study (Ventura et al., 2006), in studies about self-report sexual behaviour (Graham et al., 2003) as well as a study investigating self-report income (Prati, 2017).

Additionally, some have argued that self-reported behaviour, given its explicit nature, better maps onto the explicitly reported pre-volitions (Conner et al., 1999; Mcauley & Courneya, 1993; Richetin et al., 2008), thus improving prediction. These assertions are in line with the literature surrounding response biases in self-reports. It is possible that when reporting their behaviour, individuals are non-intentionally contaminating their reports of behaviour in line with their current intentions regarding the behaviour. Therefore, perhaps if our measure of behaviour was a retrospective self-report measure (i.e., asking participants to recall their behaviour from 3 weeks prior) and not a daily diary measure, the percent of variation explained could have been more substantial.

Nevertheless, the current study highlights the potential need for tailored interventions for different types of pro-environmental behaviours. For recycling, focusing on execution barriers and context (e.g., infrastructure) could be more effective. In contrast, interventions for sustainable consumption should focus on decision-making processes before intention formation, such as knowledge and attitudes, which align with research advocating for information-based interventions in consumption behaviours (Follows & Jobber, 2000).

8.4 Chapter 7 Findings

In the Chapter 7 study, "*Capturing experiences with nature: Development of an Experience with Nature scale to explain pro-environmental behaviours*", we aimed to develop a measure of nature contact that captures individuals' experiences, including distinctions between intentional and incidental contact with nature. After expanding from solely considering the dynamic nature of goals in Chapter 5 to considering relevant antecedents of behaviours alongside goals, such as behavioural intentions in Chapter 6, we

sought to further explore the role of intent in explaining variations in PEB. Greve (2001) suggested that there is a logical connection between an individual's intentions and their behaviour, thus, to gain an accurate picture of goal-directed behaviours, such as pro-environmental behaviours (PEBs) (Kaiser & Wilson, 2004), researchers must strive to understand the intentions behind the behaviour rather than simply its face-value.

The literature surrounding contact with nature and its effects on the individual outlines the possible role of intentional contact with nature having an effect on several beneficial outcomes, including the performance of PEBs. It has been theorized that direct, intentional contact with nature would show the greatest effects in terms of beneficial outcomes compared to indirect, incidental contact (Keniger et al., 2013; Marselle et al., 2021). Beneficial outcomes include, increased nature connectedness (Martin et al., 2020; Mustapa et al., 2019), place attachment (Colley & Craig, 2019), well-being (Beyer et al., 2016) and health (Irvine et al., 2013; Mansor et al., 2012; Martin et al., 2020), restorative effects such as stress reduction and cognitive improvements (Meredith et al., 2020; Ulset et al., 2017), pro-environmental stewardship (Chan et al., 2016), and pro-environmental behaviour (Alcock et al., 2020; Martin et al., 2020; Whitburn et al., 2020). By direct, we refer to contact with nature where the individual is in close physical proximity to nature (e.g., walking or swimming); consequently, indirect is when the individual is not in close proximity to nature (e.g., watching a nature video). By intentional, we refer to contact with nature where nature is part of the central focus of the interaction or activity; individuals generally have these interactions because they seek to have contact with nature. Whereas for incidental contact, contact with nature is typically a by-product of the activity and not the focus. We adapt these definitions from the frameworks presented by Marselle et al. (2016) and Keniger et al. (2013). However, the distinction between intentional and incidental contact and the differing effects on outcomes has not yet been conclusively shown.

In exploring this line of research, we identified an opportunity to develop a measurement scale. Common methods of measuring contact with nature tend to focus on exposure and do not capture experience. In many studies, contact with nature has been measured with an item such as "… how often, on average, have you spent free time outside in green and natural spaces" (England, 2020). This approach to measuring contact with nature allows the individual to imagine different types of interactions with nature that are applicable to them. One benefit is that the individual is not limited to specific types of interactions with nature, and the item is therefore applicable to a wide range of individuals. However, this measure is not sensitive to the 'experience' aspect of contact with nature and does not allow

for conclusions about motivations such as intent. It is also subject to a high degree of interpretation from the responder. Lange and Dewitte (2019) warn researchers that when responding to self-report surveys, participants are likely to have their own interpretations of the concepts presented to them, potentially limiting the validity and/or the reliability of the item or measurement scale (Kormos & Gifford, 2014). It is possible that individuals do not consider the entirety of their interactions with nature when responding to items focused on nature exposure and that items designed to capture experience (i.e., intentional, incidental, direct and indirect interactions with nature) may provide more nuanced results. Thus, we designed a scale to measure contact with nature that would be sensitive to experiences with nature as well.

The 'Experience with Nature Scale' was developed through multiple studies, starting by identifying interactions with nature based on four typologies: intentional, incidental, direct, and indirect experiences (Marselle et al., 2021). Participants provided examples of intentional and incidental interactions, such as walking or going to the beach. Study 1 revealed that intent was often nuanced; for example, "socialising in nature" was unexpectedly rated as a high-intent activity, although it was expected to be incidental. This aligns with Richardson et al. (2020), who questioned the intentionality behind some nature-related activities, suggesting activities like watching nature programs might serve relaxation purposes rather than a deliberate connection with nature.

Study 4 confirmed that the Experience with Nature scale better predicted well-being, nature-relatedness, and pro-environmental behaviors compared to nature exposure measures alone. This supports earlier research indicating that intentional, direct activities (e.g., smelling flowers) have strong predictive power for pro-environmental behavior (Richardson et al., 2020). Interestingly, while nature exposure better predicted the "Inclusion of Self with Nature" scale, the Experience with Nature scale was a stronger predictor for other variables, highlighting the importance of experience over mere exposure.

While the scale demonstrated good reliability, further testing is needed to develop reliable subscales, such as distinguishing passive from engaged experiences. Additionally, a longer time frame could address potential recall biases. The role of place attachment to places in nature should also be explored, as it may influence pro-environmental behaviours (Gosling & Williams, 2010). Finally, generalizability needs improvement by testing the scale in more diverse populations. The development of an Experience with Nature scale is a significant contribution to the literature on environmental psychology. Previous research has primarily focused on measuring exposure to nature (Collado & Corraliza, 2015), yet this dissertation

highlights the importance of capturing the quality and type of interactions individuals have with nature. By distinguishing between intentional vs. incidental and direct vs. indirect experiences, the scale aligns with theories positing that meaningful contact with nature enhances environmental concern and PEB (Nisbet et al., 2009). This novel measure provides a more nuanced tool for predicting PEB and related psychological benefits, suggesting that future studies should explore the depth of human-nature interactions rather than simple exposure metrics. This study also demonstrated the utility of considering intentional actions in understanding PEBs expanding on the literature of intentions.

8.5 Conclusions

Overall, this dissertation has contributed to the broader understanding of how different motivational constructs explain variations in pro-environmental behaviour (PEB). We adopted the understanding of PEBs as an intentional goal-directed behaviour (Kaiser & Wilson, 2004; Stern, 2000). Across four projects, we examined different constructs' explanatory power in explaining the variation of PEBs while commenting on different methodological approaches as well. We examined how feedback might support behaviour maintenance using an experimental approach, the predictive power of goal importance ratings on daily behaviours with the use of dynamic multi-level modelling, the limitations of pre-volitional models in explaining the variance in actual behaviour with a daily diary method, and lastly, how intentional contact with nature can help explain variations in PEBs by developing a measurement scale. Our results suggest that considering PEBs to be goal-oriented behaviours proved to be fruitful in understanding new avenues of research.

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Appendices

Appendix A

Figure A.1. Single and multiple-items trial in the CRT

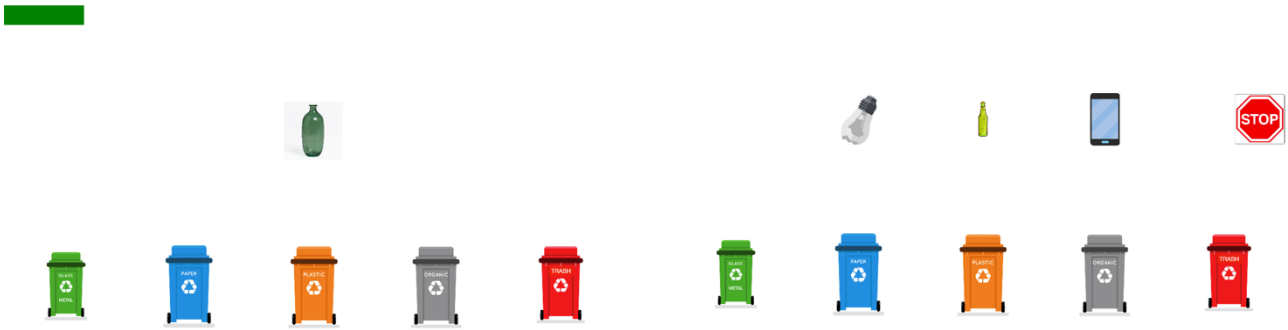

Figure A.2. Example of progress bar (left) and an additional trial

Appendix B

Table B.1. Moderation analyses of individual differences on the effect of Feedback (control vs. every trial) on performance measures, Study 1

	Model		Main Effect (Scale)		Main effect of Feedback		Interaction Effect		Simple Slope -1 SD		Simple Slope +1SD	
	R^2	F	B	t	B	t	B	t	B	t	B	t
Trial Number												
Low frequency	0.48	**17.112**	0.611	0.509	0.634	**3.408**	0.072	0.358				
Med frequency	0.48	**17.219**	0.030	0.238	0.566	**2.561**	0.147	0.620				
High frequency	0.49	**18.192**	0.038	0.364	1.477	**2.071**	0.791	1.10				
Consumer	0.52	**19.868**	0.120	0.994	1.016	**2.902**	0.321	0.867				
Identity	0.499	**18.611**	0.200	1.610	0.084	0.126	0.607	0.909				
Attitude	0.52	**19.911**	0.195	1.613	0.751	1.300	0.043	0.074				
Accuracy												
Low frequency	0.166	**3.721**	0.2429	0.663	0.034	0.145	0.190	0.450				
Med-frequency	0.158	**3.508**	0.746	1.992	0.331	1.176	0.485	1.064				
High frequency	0.123	2.610	0.878	**2.083**	1.386	1.476	1.549	1.454				
Consumer	0.151	**3.323**	1.050	**2.778**	0.982	**2.119**	1.366	**2.160**	0.148	1.691	-0.112	1.381
Identity	0.019	0.369	0.362	0.898	0.706	0.859	0.743	0.792				
Attitude	0.051	1.009	0.352	0.887	0.422	0.460	0.368	0.378				
Reaction Time												
Low frequency	0.019	0.368	0.113	0.284	0.090	0.354	0.010	0.023				
Med frequency	0.084	1.714	0.381	0.975	0.020	0.069	0.139	0.293				
High frequency	0.047	0.926	0.13	0.307	0.643	0.657	0.8166	0.736				
Consumer	0.054	1.060	0.521	1.306	0.655	1.339	1.041	1.560				
Identity	0.030	0.573	0.323	0.806	0.383	0.412	0.503	0.510				
Attitude	0.040	0.778	0.037	0.092	0.351	0.432	0.494	0.533				

Note. Df = 3, 56. Significant effects ($p < .05$). are formatted in bold.

Appendix C

Table C.1. Means, Standard Deviations and Reliability for all constructs measured

	Recycling					Sustainable Consumption			
	Mean	Standard Deviation	Alpha	Items		Mean	Standard Deviation	Alpha	Items
Goal Desire, D	5.71	1.03	.92	2	Goal Desire, D	5.91	1	.91	2
Goal Desire, ND	4.18	1.69	.89	2	Goal Desire, ND	4.98	1.53	.95	2
E Attitudes, D	5.94	0.91	.70	3	E Attitudes, D	6.07	0.86	.70	3
I Attitudes, D	5.98	1.04	.68	3	I Attitudes, D	6.12	1.02	.80	3
E Attitudes, ND	2.06	0.89	.38	3	E Attitudes, ND	2.39	1.05	.72	3
I Attitudes, ND	1.80	0.77	.58	3	I Attitudes, ND	2.22	1	.75	3
Intentions, D	6.23	0.96	.91	2	Intentions, D	5.03	1.32	.91	2
Intentions, ND	1.59	0.90	.80	2	Intentions, ND	2.77	1.23	.72	2
PBC Cap, D	6.18	1.02		1	PBC Cap, D	5.12	1.34		1
PBC Aut, D	5.95	1.02		1	PBC Aut, D	4.69	1.46		1
PBC Cap, ND	2.28	1.46		1	PBC Cap, ND	4.08	1.63		1
PBC Aut, ND	4.45	1.91		1	PBC Aut, ND	3.16	1.64		1
Behaviour Desire, D	6.04	1.07		1	Behaviour Desire, D	5.35	1.24		1
Behaviour Desire, ND	1.49	0.79		1	Behaviour Desire, ND	2.03	1.23		1
Injunctive Norms	6.20	1.12		1	Injunctive Norms	5.90	1.16		1
Descriptive Norms	5.23	1.18		1	Descriptive Norms	4.47	1.35		1
PAE	5.83	0.97	.92	3	PAE	5.98	0.97	.90	3
NAE	4.41	1.39	.86	3	NAE	3.92	1.49	.87	3
Perceived Wealth	2.81	1.32	.79	4	PBF	3.07	0.57	.88	29
Perceived Busy	4.63	1.24	.88	4					

Note. $N = 153$. Significant correlations ($p < .05$) are reported in bold. D = doing. ND = not-doing. PBC = perceived behaviour control. Cap = Capability. Aut = Autonomy.

Appendix D

Table D.1. Goal selection frequencies

	Doing				Not Doing			
	Recycling		Sustainable Consumption		Recycling		Sustainable Consumption	
	N	%	N	%	N	%	N	%
To do the right thing	45	29.4	0	0	0	0	18	11.8
To save, protect and respect nature	77	50.3	0	0	0	0	59	38.6
To protect my future	14	9	0	0	0	0	37	24.2
To save the ecosystems and preserve the fauna	17	11	73	47.7	9	5.8	24	15.7
To save	0	0	36	23.5	72	47.1	13	8.5
To simplify my life	0	0	22	14.4	27	17.6	0	0
To focus myself on other things	0	0	21	13.7	44	28.8	1	.6
To save time	0	0	1	.6	1	.6	1	.6

Note. $N = 153$.

Appendix E

Table E.1 Sustainable Behaviors Daily Diary Measures

Stem: Please indicate which of the following you did today:	
Recycling	
At Home	
1	Recycled paper
2	Recycled plastic
3	Recycled metal
4	Recycled organic material
5	Recycled glass
6	Reused item/s instead of throwing them away
7	Recycled batteries
8	Recycled medicine
9	Recycled corks
10	Recycled oil
11	Donated clothes
12	Recycled electronics
While outside the home	
13	Recycled paper
14	Recycled plastic
15	Recycled metal
16	Recycled organic material
17	Recycled glass
18	Reused item/s instead of throwing them away
19	Picked up litter that wasn't your own
Sustainable consuming/shopping behavior	
20	Purchased eco/green labeled items
21	Purchased fresh food items with less packaging
22	Purchased pantry items with less packaging
23	Purchased seasonal fruits/vegetables
24	Purchased organic items

25	Purchased plastic items (e.g., plastic cups, bottled water)
26	Purchased individually packaged items (e.g., juice boxes)
27	Purchased reusable items (e.g., containers, portable water bottle, cups)
28	Used a reusable shopping bag
29	Bought second-hand items (e.g., clothing, electronics)
Yes/No response scale	

Appendix F

Table F.1. Pearson's R Correlation Matrix focusing on Perceived wealth and Perceived busyness and pre-volition constructs

	Recycling			Sustainable Consumption	
	Wealth	Busy		Wealth	Busy
Goal Desire D	.08	.14	Goal Desire D	.00	.13
Goal Desire ND	-.02	.07	Goal Desire ND	-.02	.08
PBC Cap D	.07	.03	PBC Cap D	.03	.08
PBC Aut D	-.02	-.04	PBC Aut D	-.02	.00
PBC Cap ND	.00	.03	PBC Cap ND	-.04	.07
PBC Aut ND	.05	-.07	PBC Aut ND	-.02	-.04
Experiential Attitudes D	-.06	.10	Experiential Attitudes D	-.08	**.23**
Instrumental Attitudes D	-.01	.09	Instrumental Attitudes D	.04	.15
Experiential Attitudes ND	-.03	-.03	Experiential Attitudes ND	-.09	.02
Instrumental Attitudes ND	.03	-.07	Instrumental Attitudes ND	-.02	.04
Behaviour Desire D	.03	.09	Behaviour Desire D	-.02	.14
Behaviour Desire ND	.00	-.01	Behaviour Desire ND	-.01	-.12
Intentions D	.01	.04	Intentions D	-.01	.10
Intentions ND	-.04	.01	Intentions ND	-.01	-.03
Injunctive Norms	-.02	**.19**	Injunctive Norms	.05	**.17**
Descriptive Norms	-.12	.09	Descriptive Norms	.00	.06
Positive Anticipated Emotions	.07	**.27**	Positive Anticipated Emotions	-.05	**.25**
Negative Anticipated Emotions	.09	.09	Negative Anticipated Emotions	-.13	.08
Past Behaviour	.08	.05	Past Behaviour	.08	.05
Behaviour	.03	-.04	Behaviour	.07	-.06

Note. $N = 153$. Significant correlations ($p < .05$) are reported in bold. D = doing. ND = not-doing. PBC = perceived behaviour control. Cap = Capability. Aut = Autonomy.

Appendix G

Table G.1. Study 1 Questionnaire Items

Intent Open Response Items				
Please think of 1 (up to 3) activity, behaviour or interaction that you have done in the past, that is an example of high intentional contact with nature. By high intentional we mean that your primary reason for doing this activity is to have contact with nature (e.g., nature spaces). Please think of 1(up to 3) activity, behaviour or interaction that you have done in the past, that is an example of low intentional contact with nature. By low intentional, we mean that having contact with nature (e.g., nature spaces) is a secondary motive or not important at all for the activity.				
Intent Rating Stem				
Please rate the following examples of interactions with nature on a scale ranging from 1(low intent) to 7(high intent). Please respond based on your personal experience. By high intent we mean that your primary reason for doing this activity is to have contact with nature (e.g., nature spaces). By low intent, we mean that having contact with nature (e.g., nature spaces) is a secondary motive or not important at all for the activity.				
Frequency Rating Stem				
Please tell us how often you have done the following activities in the last year. We'd like you to answer on a scale of 1 to 7, where 1 is "never" and 7 is "regularly". Please respond based on your personal experience.				
			Intent	
			M	*SD*
1	I went for a hike in nature		5.56	1.83
	1b	I went for a hike in nature alone	5.37	2.11
	1c	With friends/family, I went for a hike in nature	5.12	1.79
	1d	I went for a hike in nature, with friends/family	5.17	1.85
2	I went for a walk in nature		5.92	1.41
	1b	I went for a walk in nature alone	5.89	1.61
	1c	I went for a walk in nature with friends/family	5.31	1.60
	1d	With friends/family, I went for a walk in nature	5.28	1.60
3	I went camping in nature		5.00	2.05
	3b	I went camping in nature alone	4.68	2.43
	3c	I went camping in nature with friends/family	4.75	1.95

	3d	With friends/family, I went camping in nature	4.58	1.94
4	I went hunting in nature		3.17	2.15
	4b	I went hunting alone in nature	3.25	2.27
	4c	I went hunting in nature with friends/family	3.09	2.06
	4d	With friends/family, I went hunting in nature	3.04	2.06
5	I went bird watching in nature		5.02	2.22
	5b	I went bird watching in nature alone	5.12	2.23
	5c	I went bird watching in nature with friends/family	4.59	2.17
	5d	With friends/family, I went bird watching in nature	4.52	2.21
6	I visited an aquarium		4.33	1.97
	6b	I visited an aquarium alone	3.92	2.10
	6c	I visited an aquarium with friends/family	4.16	1.95
	6d	With friends/family, I visited an aquarium	4.11	1.91
7	I spent time at a lake or beach		5.38	1.70
	7b	I spent time at a lake or beach alone	5.15	2.09
	7c	I spent time at a lake or beach with friends/family	5.05	1.64
	7d	With friends/family, I spend time at a lake or beach	4.96	1.66
8	I listened to birdsong while in nature		5.40	1.75
	8b	I heard birdsong while in nature	4.78	1.85
9	I listened to birdsong while inside		4.36	1.77
	9b	I heard birdsong while inside	3.89	1.90
10	I listened to a nature sounds soundtrack, playlist or podcast		3.85	2.12
	10b	I heard a nature sounds soundtrack, playlist or podcast while in passing	2.51	1.67
11	I smelled wildflowers while in nature		4.97	1.83
	11b	I noticed the smell of wildflowers while in nature	4.77	1.63
12	I viewed for cared for indoor plants		4.95	1.69
	12b	I saw (or noticed) plants while indoors	4.06	1.91
13	I watched nature programs		4.50	1.84
	13b	I saw (or noticed) a TV with a nature program on	3.57	1.91
14	I meditated outside in nature		4.45	2.29
15	I took a nap outside in nature		4.25	2.05
16	I went outside to sit in nature		5.82	1.42

17	I socialised in nature	4.92	1.62
18	I ate outside in nature (e.g., lunch, dinner, coffee etc.)	5.08	1.58
19	I watched the sun rise in nature	5.60	1.74
	19b I saw (or noticed) the sun rise in nature	4.64	1.80
20	I watched the sun rise in nature while indoors	4.41	1.67
	20b I saw (or noticed) the sun rise while indoors	3.85	1.82
21	I looked at natural scenery from indoors or whilst on journeys	4.90	1.64
22	I drove along a country road	4.17	2.11
23	I watched the sky from a window to enjoy the view	5.21	1.71
	23b I watched the sky from a window to relax my eyes	4.23	1.88
24	I did work or activities near a window with a view of nature	4.36	1.90
	24b I did work or activities near a window	3.85	2.00
25	I viewed trees through a window	4.95	1.60
	25b I noticed trees through a window	4.29	1.88
26	I watched birds or animals from a window	5.17	1.60
	26b I saw (or noticed) birds or animals from a window	4.61	1.74
27	I spent time exercising in nature	4.80	1.79
	27b I spent time in nature exercising	4.85	1.80
28	I chose to walk to work/home in nature because it is a direct route	3.82	1.86
	28b I chose to walk to work/home in nature, even though it takes more time / less direct	4.85	1.91
29	I viewed fish in an aquarium	4.41	1.95
	29b I saw a video of an aquarium/fish tank while in a waiting room	2.62	1.81
30	Gardening either at home or a local plot	5.11	1.62
Added items from open responses			
31	I walked in nature as part of my commute	3.79	2.00
32	I went for a picnic in nature	4.64	2.14
33	I went swimming in nature	3.81	2.31
34	I fed birds or other wild animals in nature	5.04	2.22
35	I walked the dog in nature	4.61	2.30
36	I photographed nature	5.36	1.98
37	I went wildflower picking in nature	4.12	2.35
38	I watched birds or other wild animals in nature	5.24	1.91

39	I played sports or games in nature	3.64	2.06
40	I went to an outdoor event in nature	4.19	2.05
41	I did household chores outside in nature	3.69	2.07
42	I went hunting or fishing in nature	3.07	2.18
43	While driving, I saw nature along the roadside	4.25	2.07
44	I was in nature on my route to the shops	3.96	2.01

Note. Intention ratings: for items 1-30 $N = 130$. For items 31-38 $N = 67$.

Appendix H

Table H.1. Study 1 Exploratory Factor Analysis, First Iteration Solution

	F1	F2	F3	F4	F5	F6
I went hunting in nature	.99					
I went hunting alone in nature	.96					
I went hunting in nature with friends/family	.95					
With friends/family, I went hunting in nature	.96					
With friends/family, I went for a hike in nature		.91				
I went for a hike in nature, with friends/family		.87				
I went for a walk in nature with friends/family		.92				
With friends/family, I went for a walk in nature		.92				
I viewed fish in an aquarium			.78			.22
I visited an aquarium			.93			
I visited an aquarium with friends/family			.91			
With friends/family, I visited an aquarium			.91			
I did work or activities near a window with a view of nature				.87		
I did work or activities near a window				.82		-.22
I viewed trees through a window				.83		
I noticed trees through a window				.79		
I saw (or noticed) birds or animals from a window				.69		
I saw (or noticed) the sun rise in nature					.82	
I watched the sun rise while indoors					.85	
I saw (or noticed) the sun rise while indoors					.90	
Gardening either at home or a local plot						.64
I listened to birdsong while in nature						.75
I smelled wildflowers while in nature						.78
I noticed the smell of wildflowers while in nature						.73
SS Loadings	3.81	3.43	3.28	3.27	2.39	2.29
Proportion of Variance	0.16	0.14	0.14	0.14	0.10	0.10
Cumulative Variance	0.16	0.30	0.44	0.57	0.67	0.77
Coronach's Alpha	0.98	0.95	0.93	0.88	0.86	0.87
Omega	0.98	0.95	0.93	0.88	0.87	0.77

Note. F = factor. Overall reliability: $\alpha = 0.85, \omega = 0.86$.

Table H.2. Study 1 Exploratory Factor Analysis, Second Iteration Solution

	F1	F2	F3	F4	F5
I did work or activities near a window with a view of nature	.80			.29	
I did work or activities near a window	.84				
I viewed trees through a window	.83				
I noticed trees through a window	.85				
I saw (or noticed) birds or animals from a window	.70	.25			
I listened to birdsong while in nature		.87			
I heard birdsong while in nature		.76			
I listened to birdsong while inside		.66			
I smelled wildflowers while in nature		.73			
I noticed the smell of wildflowers while in nature		.73			
I heard a nature sounds soundtrack, playlist or podcast while in passing			.64		.27
I saw (or noticed) the sun rise in nature			.81		
I watched the sun rise while indoors			.84		
I saw (or noticed) the sun rise while indoors			.87		
I spent time exercising in nature				.87	
I spent time in nature exercising				.86	
I chose to walk to work/home in nature because it is a direct route	.20			.57	
I chose to walk to work/home in nature, even though it takes more time / less direct		.23		.69	
I viewed fish in an aquarium					.88
I visited an aquarium					.91
SS Loadings	3.42	3.08	2.62	2.58	1.81
Proportion of Variance	0.17	0.15	0.13	0.13	0.09
Cumulative Variance	0.17	0.32	0.46	0.58	0.67
Coronach's Alpha	0.88	0.85	0.81	0.77	0.81
Omega	0.88	0.85	0.83	0.80	0.81

Note. F = factor. Overall reliability: $\alpha = 0.83, \omega = 0.84$.

Table H.3. Study 1 Exploratory Factor Analysis, Third Iteration Solution

	F1	F2	F3	F4
I spent time exercising in nature	.78		-.24	-.26
I went for a walk in nature	.73			
I went outside to sit in nature	.75			
I socialised in nature	.72			.23
I ate outside in nature (e.g., lunch, dinner, coffee etc.)	.68			.25
I saw (or noticed) the sun rise in nature		.83		
I watched the sun rise while indoors		.92		
I saw (or noticed) the sun rise while indoors		.88		
I viewed fish in an aquarium			.88	
I visited an aquarium			.90	
I noticed trees through a window				.72
I saw (or noticed) birds or animals from a window		.25	.23	-.72
I saw (or noticed) plants while indoors				.73
Gardening either at home or a local plot				-.22
SS Loadings	2.77	2.46	1.85	1.84
Proportion of Variance	0.20	0.18	0.13	0.13
Cumulative Variance	0.20	0.37	0.51	0.64
Coronach's Alpha	0.81	0.86	0.81	0.50
Omega	0.82	0.87	0.81	0.56

Note. F = factor. Overall reliability: $\alpha = 0.78, \omega = 0.79$.

Supplementary Materials

Supplementary Materials S1

Study 1 Factor analysis

Since the pro-environmental identity scale consisted of only 4-items, and it is a well-used measure, it was decided that reliability testing would be sufficient in this case. The pro-environmental identity scale demonstrated moderate reliability (4 items; $\alpha = 0.61$). The scale likely demonstrated low reliability since the scales were presented in both English and Italian. Unfortunately, the sample size was not large enough to draw meaningful comparisons of language presentation. The recycling attitude scale demonstrated high reliability (15 items; $\alpha = 0.83$) in line with previous research. We ran a principal component analysis for the pro-environmental behaviour frequency scale because some items were modified for the purpose of this study. It was anticipated that some items might be problematic as some targeting the distractor stimuli are likely low in behaviour frequency to most participants.

The Barlett's Test of Sphericity indicated the items are sufficiently correlated among each other, X^2 (406, N = 130) = 3057.02, p = <.001. Considering the Kaiser-Meyer-Olkin (KMO) the overall MSA = 0.87, suggesting there was enough common variance to continue with the factor analysis. A scree plot analysis, the Mineigen values, and the parallel analysis all suggested a 4-factor solution. The initial PCA with Oblimin rotation explained 66% of the variance in the behaviour scale. The 4 factors were correlated (.11< r <.41). However, it was decided to remove 9 items due to concerns with low loadings (<.35) or high loadings on multiple factors. This iterative process continued for 3 rounds. The final PCA explained 70% of variance and from examination of the factor loadings it was determined sufficient to continue.

The first factor can be interpreted as measuring 'low frequency' pro-environmental behaviours (6 items; $\alpha = 0.90$). This factor consists mainly of items designed to measure behaviour frequencies for the distractor items (e.g., batteries, corks, medicine). These are items that the average person may not know how to dispose of properly, and often require additional effort. As such, it would be expected that individuals who perform these behaviours often would perform well on the CRT task. In fact, it is expected that responses to these items would be predictive of errors on the task.

The second factor can be understood as measuring 'high frequency' pro-environmental behaviours (4 items; $\alpha = 0.92$). These are items individuals typically encounter

every day and are expected to be of common knowledge of how to dispose of them properly, i.e., recycling plastic.

The third factor can be described as ‘medium frequency’ behaviours (4 items; $\alpha = 0.86$). While these items are also included as distractors in the CRT task, it is speculated that since they are often difficult to dispose of in household bins, e.g., furniture, individuals are forced to follow proper protocols. Additionally, these items are not items one would need to dispose of frequently on a day-to-day basis.

Lastly, the fourth factor (4 items; $\alpha = 0.89$) could be interpreted as responsible consumption behaviour (e.g., intentionally avoiding purchasing plastic). These items appear to tap into behaviour complimentary to recycling, such as shopping habits but also the conservation of resources. Scores in the factor were calculated for each factor to be used in subsequent analyses.

Table S1.1. Factor Loading for PCA of the behaviour frequency scale				
Item	Factor 1	Factor 2	Factor 3	Factor 4
Returned old medicines to pharmacies	.71			
Brought corks to specific recycling points	.85			
Brought paint to recycling sites	.74	-.25		
Brought garden waste to recycling sites	.83			
Brought spent lightbulbs to dedicated recycling sites	.81			
Brought batteries to supermarkets and recycling sites	.82			
Recycled cans or metal		.74		.24
Recycled glass		.90		
Recycled plastic		.91		
Recycled food waste		.84		
Donated clothes to charities or brought to recycling sites		.27	.76	
Gifted old clothing to friends, love-ones or neighbours			.78	
Arranged for household furniture or large household waste (e.g., a broken door) to be brought to appropriate recycling sites			.82	
Gifted or sold old furniture to others		-.20	.82	
Made an effort to conserve resources in your home, such as electricity, natural gas, and water for environmental reasons				.75
Intentionally avoided the use of disposable paper or plastic products for environmental reasons				.80
Intentionally avoided products with necessary packaging, for environmental reasons				.87
Intentionally purchased products manufactured or grown in an environmentally friendly manner			.21	.65

Supplementary Materials S2

Table S2.1. Pre-volition (doing) model for Recycling Behaviour

	Estimate	R^2	
Behaviour Desire		.641	
Goal Desire	**.227**		$X^2 = 19.606$
Experiential Attitudes	**.226**		$df = 17$
Instrumental Attitudes	-.043		CFI = .993
PBC Cap	**.195**		TLI = .987
PBC Aut	**.185**		RMSEA = .032
Injunctive Norms	**.131**		SRMR = .025
Descriptive Norms	.010		$N = 153$
PAE	.083		
NAE	**.155**		
Past Behaviour	.069		
Intentions		.772	
Behaviour Desire	**.549**		
PBC Cap	**.388**		
PBC Aut	.062		
Past Behaviour	-.028		
Mean Recycling Behaviour		.11	
Intentions	.143		
Past Behaviour	**.260**		

Note. Maximum likelihood estimation method used. Significant standardised estimates (< .05) are reported in bold.

Table S2.2. Pre-volition (doing) model for Sustainable Consumption Behaviour

	Estimate	R^2	
Behaviour Desire		.693	
Goal Desire	.074		$X^2 = 30.390$
Experiential Attitudes	**.283**		$df = 17$
Instrumental Attitudes	**-.134**		CFI = .972
PBC Cap	**.351**		TLI = .946
PBC Aut	.031		RMSEA = .072
Injunctive Norms	.065		SRMR = .029
Descriptive Norms	.037		$N = 153$
PAE	**.150**		
NAE	**.140**		
Past Behaviour	**.119**		
Intentions		.849	
Behaviour Desire	**.542**		
PBC Cap	**.309**		
PBC Aut	**.160**		
Past Behaviour	.036		
Mean Recycling Behaviour		.069	
Intentions	.093		
Past Behaviour	**.210**		

Note. Maximum likelihood estimation method used. Significant standardised estimates (< .05) are reported in bold.