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Developing planning tools to overcome barriers to environmental behaviour

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June 2022

Thesis submitted to the University of Nottingham to obtain the degree of Doctor of Philosophy

Abstract

Responding to climate change has been challenging for everyone. While people express concerned about the environmental issue, yet they often fail to act on these concerns Research on pro-environmental behaviours and climate change has identified public perceptions and intentions as relevant determinants of behaviour, yet people do not always act on their intentions. This thesis aims to address the intention-behaviour gap between pro-environmental intentions and behaviour by examining the barriers to pro-environmental behaviours and using these to inform behavioural strategies using implementation intentions (Imps) to reduce the gap.

The first study of this thesis explored the perceived barriers to pro-environmental behaviours, at the individual and collective level. Based on a classification of barriers by Gollwitzer and Sheeran (2006) a conceptual framework of barriers to goal completion was proposed. Findings indicated that, problems with remembering to act, and changing habits were highly prevalent within the barriers for individual pro-environmental behaviours. Whereas barriers related to differences of opinion and transferring guilt to others (e.g., others unwilling to change habits, favouring convenience) were the most common barriers to collective pro-environmental behaviours. Additionally, the classification of barriers indicated that for both individual and collective action, the main problems were related to the first engagement stage: getting started. The findings indicated that collective and individual behaviours face different barriers. The implications of the first study was the need for behavioural strategies to help people remember to engage with pro-environmental behaviours, one way to achieve this can be using planning tools such as implementation intentions (Imps). Thus, within this thesis three studies were developed (study two, three, and four) exploring the use of (Imps) to promote pro-environmental behaviours. Study two assess the use of visual imagery cues to make Imps memorable. Findings indicated that Imps had no impact on behaviour,

but the presentation of images did make people reflect on whether pro-environmental behaviours could be part of their habitual life. Study three and four assessed the use of a new form of collective Imps, different from the one standardly assessed in the literature, to promote pro-environmental behaviours. In the experiments the Imps groups had if-then plans to help them engage with the goal-directed behaviours (e.g., If I encounter X, then I will do Y). Study three assessed the use of collective Imps (e.g., "If we notice our laptops are fully charged, then we will unplug them, and we will remind others to do the same") to promote energy saving behaviours and study four used Imps formatted with shielding if-then action plans (e.g., "If I have leftovers, then I will try to eat them within the next two days and I will discuss my efforts with others") to promote the reduction of food waste in households. Results indicated no effect of Imps on behaviour but showed behaviour changes over time in all experimental groups. For the literature on Imps, this implies that Imps may not effectively promote certain behaviours. Findings also indicate that the mere information about what behaviours can lead to the desired pro-environmental goal can impact behaviour change.

For policymaking, results suggest that understanding people's perceptions of barriers to sustainable behaviours are relevant for developing optimal policies. While Imps are not effective, just having people reflect on pro-environmental behaviour is effective in occasioning positive behaviour over time. Furthermore, encouraging habit-formation strategies that aim not only to start but also maintain engagement with pro-environmental behaviours could contribute to the battle against environmental issues.

Acknowledgements

Firstly, I want to thank my extraordinary and dedicated supervisor Alexa Spence who encouraged me to believe in myself and helped me develop (as well as enjoy) my PhD studies. Thank you for being such a great role model and sharing all your wisdom and energy.

Many thanks to my second supervisor Eamonn Ferguson for all the insightful conversations and nice words. I also would like to thank CONACYT for funding my PhD studies. To my friends, inside and outside the PhD bubble, who were there to hear me out and celebrate all my achievements. Special thanks to Mairi and Julia for putting up with me throughout and for all the great advice.

Eternal gratitude to all my family - my mum Lula, my dad Mario and my sister Fer -, no matter how far we may be, I always have you in my heart. Furthermore, I want to thank my life partner Nick who was my rock in all the moments of doubt and despair. Finally, I would like to thank to all the staff members at the University of Nottingham that cross paths with me making me feel at home and helping me to make the most of my university experience.

Gracias, totales!

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Executive summary

At COP26, leaders stated that we cannot afford not to act against the threat of climate change(COP26, 2021). The UK set ambitious targets to reduce greenhouse gas emissions to 'net zero' by 2050 (CCC, 2019). Most interventions aiming to reach the global emission reduction targets require some behavioural changes from the general public. Research on environmental behaviours and climate change identifies public perceptions and individuals' intentions as relevant determinants of behaviour (Bamberg, 2013; Stuart Capstick, Whitmarsh, Poortinga, Pidgeon, & Upham, 2015; Pietsch & McAllister, 2010). As such, this thesis focused on understanding individuals' perceptions of barriers to pro-environmental behaviours. In addition, I assessed individuals' intentions around environmental actions and why they often fail to act according to their pro-environmentally intentions: the intention-behaviour gap.

Chapter 1 introduces to the research on goal attainment and intentions, addressing the substantial gap often observed between intentions and behaviour, both in general and for pro-environmental behaviours. Furthermore, I explored the potential barriers that may cause this gap based on the conceptual framework barriers that prevent goal attainment proposed by Gollwitzer et al. (2006). Additionally, I assess self-regulatory strategies that could help address the intention behaviour gap for pro-environmental behaviours. Specifically, I explored the use of implementation intentions and related applications in promoting environmental behaviours.

Implementation intentions (Imps), sometimes known as 'if-then' action plans, aimed to link environmental cues – the 'if' - to cognitive or behavioural responses – the 'then' - to aid goal attainment. In terms of pro-environmental behaviours, Imps have been successfully used to promote recycling behaviours with plans stating when, where, and how to recycle paper and plastic cups (Holland, Aarts, & Langendam, 2006); and promote the use of bus routes and purchase of organic

food (Bamberg, 2000, 2002). However, to the author's knowledge, Imps have not been used to promote other pro-environmental behaviours. Therefore, I was interested in using Imps to promote other pro-environmental behaviours.

Moreover, chapter 1 will provide an assessment of the literature on public perceptions and their relevance in the study of pro-environmental behaviours and actions for climate change mitigation (Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011; Spence, Poortinga, Butler, & Pidgeon, 2011; L. Whitmarsh & Capstick, 2018), as well as the barriers individuals perceive when engaging with pro-environmental behaviours and climate change mitigation actions.

Chapter 2 presents Study 1 to assess public perceptions about the barriers faced when undertaking actions to be environmentally friendly on the individual and collective level. I assessed the perceived barriers to individual and collective pro-environmental behaviours using the conceptual framework of barriers to goal attainment proposed by Gollwitzer et al. (2006). These barriers are categorised as *i)* failing to get started; barriers to goal initiation; *ii)* getting derailed; barriers to goal shielding; *iii)* not calling a halt to problematic behaviour; barriers to goal disengagement; and *iv)* overextending oneself. This conceptual framework is a novel approach to understanding the type of barriers people report facing when engaging with pro-environmental behaviours. In addition, no research has made the comparison of individual and collective barriers to pro-environmental behaviours. Understanding potential differences in barriers to collective and individual behaviours can help develop of optimal behavioural strategies.

Findings indicated that, for individual behaviours, people perceived more problems shielding their environmental behaviours (e.g., forgetting). In contrast, when asked about collective behaviours, barriers centred around failing to start the pro-environmentally friendly behaviours, e.g., due to differences of opinion within the people in their group. These findings help understand

are the type of barriers people face when attempting to undertake pro-environmental behaviours, which may help in developing strategies to overcome these barriers. In addition, this study highlights the differences in the barriers to behaving collectively and individually, indicating the potential utility of using different behavioural strategies to promote each type of behaviours. This is consistent with the literature on barriers to engaging with environmental behaviours (R. Gifford, 2011; Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007). The implications of these findings for policymaking could be encouraging more community action when talking about environmental behaviour since, according to the results, collective behaviours are easier to maintain and make part of people's habits.

In chapter 3 I present Study 2, exploring how to promote the avoidance of the usage of plastic bottles and the purchase of eco-friendly products using Imps strategies. Imps aim to activate the mental representation of environmental cues to automate the response to these cues. I considered it relevant to test a potential enhancement of these with visual imagery, making Imps more salient and easier to recall. Research indicates that mental imagery can help Imps be more vivid and salient for individuals (Knäuper et al., 2011). However, the adaptation of Imps with images has not been studied before in the Imps literature. Findings indicated no effect of the imps on pro-environmental behaviours with or without the visual imagery cues; however, I found using images could contribute to self-regulating strategies promoting pro-environmental behaviours. I consider the environmental cues used for the imps may not be salient or relevant for the individuals' context and thus reduced the salience of the image and the effect of imps. Another potential reason for imps not working could be that imps were not addressing the barriers preventing individuals from attaining their pro-environmental goals. Hence, the relevance of understanding what barriers the public perceives when engaging with environmental behaviours and actions for climate change mitigation. Implications of this research are that images could help individuals change and adapt

sustainable behaviours to their habits. In addition, this study indicates Imps may be ineffective in promoting certain behaviours. This is consistent with findings of some studies that point imps cannot impact certain behaviours (DeWitte, Verguts, & Lens, 2003; Gollwitzer & Brandstätter, 1997)

In chapter 4, I present a study assessing the impact of collective implementation intentions on environmental behaviours (study 3). In Study 3, the use of collective Imps was explored to promote energy-saving behaviours. Literature on collective imps suggests a change of pronouns to the standard form of imps designed primarily for individual behaviour (If *I* encounter X, then *I* will do Y) to address more than one person (If *we* encounter X, then *we* will do Y). This thesis proposed a format of collective Imps different from the previous format in the literature, adding a collective section to the proposed phrasing of intentions (If we encounter X, then we'll do Y, AND we will remind others to do Y); the rationale behind this is to increase the impact of collective imps on behaviour engagement and promote collective behaviours.

I assessed the impact of collective imps on energy-saving goals. The results indicated that even though individuals reported a reduction in their energy consumption; this change was present across all our experimental groups and no greater for those presented with either individual or collective versions of imps. This study faced several limitations regarding recruitment and platforms used to ensure the collective groups' communication and cohesions. Due to the difficulties of this study and the insights acquired from the previous studies on barriers, we decided to assess the impact of individual and collective imps shielding behaviours on behaviour.

While most of the research on imps has focused on facilitating the initiation of the goal-directed behaviours, Study 4 presented in chapter 5 assesses the impact of implementation intentions on helping individuals shield goal-directed behaviours. While there is some literature

assessing goal shielding imps (Achtziger, Gollwitzer, & Sheeran, 2008; Parks-Stamm, Gollwitzer, & Oettingen, 2010), to the author's knowledge, there is no literature available regarding the use shielding Imps to promote environmental behaviours, specifically reduction of food waste in the household. Furthermore, there is no evidence in the literature on the use of collective Imps to shield goal-directed pro-environmental behaviours.

I examined the impact of individual and collective if-then plans for shielding environmental goals on the behaviour of avoiding food waste in the household, since the literature considers this behaviour as one relevant contributor to carbon emissions (Ivanova et al., 2020). Contrary to the standard form of imps that helps to support the initiation of a goal (e.g., If I prepare food, then I'll make sure I eat all of it), the shielding imps consider the problems that may cause the individual to deviate from their environmental goal (e.g.," *If I have leftovers, then I will try to eat them within the next two days*"). The collective form of the imps included a collective component where individuals discuss their efforts with others, in the same form as that used in Study 4. This collective component aimed to impact behaviour engagement and communication with others to promote collective sustainable behaviours.

Results indicated that Imps did not affect on the reported levels of food waste. However, participants reported reduced food waste levels across our experimental groups between the times I examined. This could be attributed to the instructions given to all participants, promoting the formation of self-regulating strategies by itself. In addition, the collective form of imps did not increase communication with others about their efforts to avoid food waste. This thesis results indicated that shielding strategies could help to maintenance of engagement with pro-environmental goals, I consider this could be assessed further to contribute to the development of interventions promoting sustainable behaviour change. Findings on Imps suggest these may not be effective for promoting certain behaviours.

Chapter 6 summarizes the evidence reported in this thesis and discusses the advantages and limitations of using public perceptions to understand people's behaviour towards pro-environment and climate change, and for exploring the barriers that cause the intention-behaviour gap in order to direct interventions to support pro-environmental behaviours; the contributions to the literature on implementation intentions and the application of Imps to promote pro-environmental behaviours. Findings in this thesis indicated no impact of Imps in supporting the environmental behaviours assessed in this thesis compared to simply advice provided in control conditions.

The implications of this research for policymakers involve the need to encourage community action to promote pro-environmental behaviours, and make the distinction between individual and collective environmental actions. Understanding people's perceptions about barriers to climate change action, what behaviours they consider relevant, and their perception of other behaviours are relevant for developing optimal policies and promoting people's engagement and cooperation to mitigate climate change.

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Chapter 1.

1 General introduction

1.1 Climate change and environmental behaviours

Climate change has been one of the most defining issues of our time. It is a complex problem due to its multidimensional challenges. Climate change is considered a phenomenon difficult to identify by the general public through conventional tools of observation and inference thinking (Weber, 2010). Anthropogenic climate change is the product of billions of acts and daily consumption (Liverani, 2009). As a consequence of climate change, global temperatures have increased dramatically, as well as the number of droughts. (Fischer & Knutti, 2015). Glaciers are melting, and sea levels are rising, causing flooding (IPCC, 2014a). As climate change impacts society, it makes more evident the inadequacy of our infrastructures to face these impacts. The disruptions of climate change can impact industrial systems leading to significant economic impacts (Clayton & Manning, 2018). Food insecurity is another predicted disruption of climate change; food scarcity can cause malnutrition and ultimately result in approximately half a million deaths across the globe (Clayton & Manning, 2018; Springmann, Godfray, Rayner, & Scarborough, 2016). Climate change can also affect human health, leading to deaths and illness due to extreme weather events (e.g., heatwaves, storms, floods). Overall, climate change threatens our health, security, scarcity of resources, and lifestyle, among others. Responding to climate change has been one of the most defining challenges of our time.

1.2 Public perceptions and pro-environmental behaviours

Public perceptions of pro-environmental behaviours are essential to assess because they support sustainable behaviour. They can help develop technology and policies that align with people's preferences and attitudes towards pro-environment behaviours. This can make people engage more effectively with pro-environmental behaviours. The Committee on the Human Dimensions of Global Change considers people's perceptions of global phenomena, such as climate change, as a crucial contributor to the understanding of environmental problems and a determining factor for the development of possible solutions (Stern, Dietz, Ruttan, Socolow, & Sweeney, 1997).

Pro-environmental behaviours are actions that harm the environment as little as possible or benefit the environment somehow (Steg & Vlek, 2009). Studies indicate there is a limited understanding from the public of the comparable impact of different activities on climate change (Whitmarsh & Capstick, 2018), especially within the domains of domestic energy use, meat consumption and production, and food waste (Attari, DeKay, Davidson, & De Bruin, 2010; Whitmarsh, 2011). Further to this, research has reported a general tendency from the public to discount personal contributions to environmental issues, for example, they consider that their contribution is not enough to make a change (also known as the drop in the ocean effect) (Whitmarsh, 2009; Whitmarsh & Capstick, 2018).

This thesis considers it relevant to identify and understand the determinants of individual behaviour concerning pro-environmental behaviours to address the climate crisis. Studies have suggested that behaviour change is vital for meeting the net zero world targets (Whitmarsh, Poortinga, & Capstick, 2021). The Committee of Climate Change (CCC) indicated that most of the interventions needed to reach the low-carbon emission targets require some behavioural change as well as the adoption of new technologies (Stark et al., 2019). Thus, this thesis focuses on the

assessing perceptions of barriers to pro-environmental behaviours that people face when attempting to engage with these behaviours.

1.2.1 Types of pro-environmental behaviours

Pro-environmental behaviours include a diverse range of behaviours, such as recycling (Fu & Liu, 2017; Zhang, Zhang, Yu, & Ren, 2016), transport use (Eriksson, Garvill, & Nordlund, 2008), waste management (Lobato, Villegas, & Mansur, 2015), energy management (Berardi, 2017), purchasing green products, and use of efficient electrical appliances (Li, Zhao, Ma, Shao, & Zhang, 2019). This behavioural diversity makes it challenging to support pro-environmental behaviour due to the different factors and changes in the context that can influence pro-environmental behaviours. One way to consider pro-environmental behaviours is to classify these into two dimensions: public and private sphere. Public sphere environmental behaviour includes actions that require cooperation or collective coordinated action, such as participation in demonstrations, environmental group membership, petition signing, activism, etc. In contrast, private sphere behaviours do not require coordinated action. Private sphere behaviour includes any behaviour that takes place in the individual´s everyday life and aims to reduce the negative environmental impacts (e.g., recycling, energy conservation, litter control) (Balžekienė & Telešienė, 2011; Li et al., 2019; Lu, Liu, Chen, Long, & Yue, 2017).

Environmental psychology literature indicates two different methodological approaches to assess pro-environmental behaviour: intent and impact-oriented behaviours. Intent-oriented behaviours explores individuals intentions to protect the environment (Moser & Kleinhückelkotten, 2018; Stern, 2011). Criticizing this approach, researchers have argued that impact-oriented research should focus on engagement with high-impact behaviour, measuring impact as the extent to which it changes the availability of materials or energy from the environment (e.g., reductions on people´s

carbon emissions) (Moser & Kleinhückelkotten, 2018). For example, changing purchasing behaviours generally will bring greater environmental benefits than reusing and recycling behaviours (Li et al., 2019). Research suggests the people's main environmental actions are recycling, and saving energy (Systems, 2018). The promotion of behaviours with high levels of engagement, such as energy-saving behaviours, is explored in this thesis (chapter four) to test if these behaviours can be formed into environmental habits to ensure engagement in the long term. However, there are other pro-environmental behaviours addressed in the literature that present low levels of engagement, such as avoiding single-use plastic bottles; and purchasing environmental products (Systems, 2018).

This thesis considers that reinforcing pro-environmental behaviours that people are already undertaking to some extent can contribute to increasing engagement more effectively. Furthermore, ensuring that pro-environmental behaviours are part of people's habits- even though they are considered low impact- can help promote acceptance of other pro-environmental behaviours that require a greater behaviour change (e.g., reducing car use, eating less meat). The British Waste and Resources Action Programme calculated the average carbon footprint of avoidable household food waste to be equal to 330 kg CO2 per person per year, which corresponds to one-third of the CO2 emissions attributed to household electricity use per person in the UK (T. Quested & Parry, 2011). Recent research on quantifying the potential for climate change mitigation of some consumption options suggests food waste reduction options could mitigate an average of 0.3 tons of CO2 equivalent per capita per year (tCO2 eq/cap), considered a substantial mitigation potential (Ivanova et al., 2020). Thus, this thesis also aims to explore promoting the behaviour of avoiding food waste in the household (chapter five).

1.2.2 Factors influencing pro-environmental behaviours

According to the goal-framing theory, motivations are not necessarily compatible with each other. Research indicates that individuals have focal goals which influence information processing, as well as other goals in the background that tend to moderate the strength of the focal goals. When the background goals align with focal goals, the focal goals are strengthened, but when these two are not compatible, the latter can be weakened (Lindenberg & Steg, 2007a).

The literature on pro-environmental behaviours have widely studied the factors that motivate and deviate the performance of pro-environmental behaviours. Steg and Vlek (2009) indicates that one of the main factors that could hinder or promote pro-environmental behaviours is costs. Another factor impacting pro-environmental behaviour is the presence of moral and normative concerns regarding the environment (Steg & Vlek, 2009). Research indicated that individuals with stronger values of self-transcendent, prosocial, altruistic, or biospheric values are more likely to engage in pro-environmental behaviour (DeGroot & Steg, 2007; Schultz & Zelezny, 1999).

Another factor that can influence the performance of pro-environmental behaviours is habitual behaviour. Habitual behaviour involves engaging with actions guided by automated cognitive processes rather than being guided by elaborated reasoning (Steg & Vlek, 2009). Habitual behaviour can be a factor that promotes or gets in the way of pro-environmental behaviours. Thus, the development of strategies to promote pro-environmental behaviours needs to consider whether there are habitual behaviours that could hinder or enhance the engagement with pro-environmental behaviours.

Based on goal-framing theory, it would be easy to assume that the way to promote pro-environmental goals is by incentivising them, which should be sufficient to ensure behaviour

adoption. However, it is important to consider that human behaviour depends not only on individuals' motivations, contextual factors can also drive behaviour. Contextual factors can influence environmental behaviours (e.g., facilitate them or constraint them), as well as individual motivations (e.g., costs) (Steg & Vlek, 2009; Thøgersen, 2005). Furthermore, the effects of contextual factors on behaviour may depend on personal factors (Geller 1995; Steg & Vlek 2009; Whitmarsh and Chapstick 2018). For example, recycling facilities may only promote recycling behaviours among individuals with high environmental concerns.

Li et al. (2019) classifies the determining factors of pro-environmental behaviours into external variables, and individual variables. The external variables include: social norms (e.g., social constructs influencing individual´s internal value system) (Schwartz, 1977), convenience (e.g., factors of distance and lack of facilities impacting on the engagement with recycling behaviours) (Zhang et al., 2016), and costs (Li et al., 2019).

As for the individual differences that impact individual´s pro-environmental behaviours, Li et al. (2019) classified them into demographic variables (e.g., women, highly educated people, and urban residents, have more environmental behaviours intentions), psychological variables (e.g., individual´s perception of the task driving their intentions and actions) (Li et al., 2019).

Furthermore, research on public perceptions of pro-environmental behaviours had also attempted to identify the psychological factors or barriers that hinder engagement in pro-environmental behaviours among the public. For example, low income can limit individuals' ability to purchase solar panels, or living in rural areas can force individuals to drive. The study of perceived barriers to engaging with climate action has been widely assessed within the public perception literature (Gifford, 2011; Gifford, Lacroix, & Chen, 2018; Gifford & Chen, 2017;

Kollmuss & Agyeman, 2002; Lorenzoni et al., 2007). This literature will be discussed further in chapter two.

Within the barriers to pro-environmental behaviour identified in the literature, there is the information deficit model, which indicates that the mere disclosure of information may not affect individual's behaviour (Blake, 1999). Although global awareness of environmental issues had constantly increased over the years, this has not necessarily translated into actions. In the UK, environmental awareness has been reported as relatively high while engagement with pro-environmental behaviours has been reported to be significantly lower (Park, Curtice, Thomson, Jarvis, & Bromley, 2002).

In order to understand what factors determine people's success or failure in achieving a particular goal- in this case, acting in accordance with pro-environmental goals-, it is also important to understand the concepts of goal attainment and the determinants of behaviour that are in play when engaging with a particular goal.

1.3 Goal attainment and intentions

The literature on goal pursuit considers that the strength of individuals' goal intentions (i.e., motivation) and the perceived ability to perform the goal (self-efficacy) are key determinants of goal achievement (Ajzen, 1991; Locke & Latham, 1990). Behavioural theories like the Reasoned Action Theory (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) and the Theory of Planned Behaviour (Ajzen, 1991) have studied the structure of intention formation. The Theory of Planned Behaviour (TPB) considers three determinants for an intention: attitudes, subjective norms, and perceived behavioural control. Attitudes involve the individual's response towards the display of the behaviour, either positive or negative (e.g., for me performing this behaviour would be bad/good). Subjective norms consider the individual's perception of other people's conception of

his behaviour or any pressure to perform the behaviour; and perceived behavioural control refers to the perception of how difficult it is to perform the behaviour (Orbell, Hodgkins, & Sheeran, 1997). Moreover, the Theory of Planned Behaviour (TPB) considers individuals' intention to perform a given behaviour as a central factor (Ajzen, 1991).

Theories on goal pursuit such as social cognitive theory (Bandura, 1991), goal setting theory (Locke & Latham, 1990), and TPB (Ajzen, 1991), consider goal intentions to be associated with motivational factors that influence behaviour engagement. These assume that intentions' strength is a good predictor of intention realization (Gollwitzer & Sheeran, 2006).

Over the last few decades, research on human behaviour has stated that individuals tend to fail to act according to their intentions, indicating that strength of intention only explains 20-35% of the variance in goal achievement (Gollwitzer & Sheeran, 2006). These findings highlight a substantial gap between intentions and actions as one of the numerous problems of goal striving that needs to be addressed. This gap is known as the intention-behaviour gap, also known as the value-action gap (Blake, 1999; Flynn, Bellaby, & Ricci, 2009; Gollwitzer & Moskowitz, 1996; Gollwitzer & Sheeran, 2006; Sheeran & Orbell, 2000). This intention-behaviour gap has been identified within the literature on health, financial, and political, among others (Conner, 2018; Nickerson & Rogers, 2010; Sheeran & Orbell, 2000); as well as within the environmental sector (Bamberg, 2000, 2002; Gollwitzer & Sheeran, 2006).

Sheeran (2002) reported the division of the intention-behaviour relation in terms of a two (goal intention: consider to act vs. consider not to act) by two (goal achievement: acted vs not acted) matrix. (Orbell et al., 1997; Sheeran, 2002) This distinction identifies people who intend to act and subsequently act, known as inclined actors. The people who do not intend to act and do not act are disinclined abstainers. The intention-behaviour relations consistently predict these two

categories. The discrepancies between intention-behaviour relations are associated with individuals who intend to act but do not act, described as inclined abstainers(Gollwitzer & Sheeran, 2006). Moreover, people who do not intend to act and end up acting are described as disinclined actors. Sheeran (2002) indicated that inclined abstainers are those principally responsible for the intention-behaviour gap.

Within goal theories, it is assumed that setting any goal is the first step toward goal attainment (Bandura, 1991; Locke & Latham, 1990). According to the model of action phases, there are four different sequential action steps to take in order to form a goal intention (Gollwitzer & Moskowitz, 1996; Gollwitzer & Sheeran, 2006). The first is known as *pre-decisional*; it consists of the individual's task of selecting the options on their choice sets that is both desirable and feasible to turn them into binding goals. The model suggests that even when individuals have set their goals, goal attainment is not yet secured; the second phase is the *pre-actional or post-decisional,* consisting of initiating goal-directed behaviours. If the behaviours are routinized, then this phase is relatively easy for the individual. However, there are more complex situations when people ignore goal-directed actions and their connection with the contexts. In this situation, forming plans that set the when, where, and how to implement the goal-directed behaviours can contribute to people overcoming obstacles for them to get the actional phase started. The *actional* phase is the third phase of the model of action, it consists of continuing to perform the goal-directed behaviours and shielding them from the contextual threats or obstacles that could prevent goal striving (Gollwitzer & Sheeran, 2006). The final action phase, *post-actional*, consists of the assessment of the goal achievements in terms of the degree and quality of attainment of the pursuit outcome. An additional phase to the model of action, Gollwitzer (1999) considers the *post-decisional* or the implemental phase, which would come after the pre-actional phase. This post-decisional phase is based on the distinction between a state of willingness when the outcome of performing the behaviour is desired,

as well as a state of planning when the individual specifies the steps that will lead them to a particular outcome or end of state. The behavioural strategy focused on this implemental phase is called *implementation intentions* (Gollwitzer, 1999).

1.4 Implementation intentions

Implementation intentions (Imps) are self-regulation strategies stating if-then action plans that connect opportunities to act with cognitive or behavioural responses that lead to goal achievement. This planning form is considered a good strategy to bridge the intention-behaviour gap. For the formation of Imps, the individual needs to identify a response that will promote goal attainment and anticipate the occurrence of practical situations that can help initiate the response.

Whilst goal intentions' structure specifies only the outcome to achieve (i.e., "I intend to reach B"), Imps create a direct mental link between the critical future situation or environmental cue along with the planned behaviour specifying when, where, and how one intends to achieve the outcome ("If X happens then I will do Y"). For example, in the health sector, researchers asked people to write down when and where they intend to get a flu shot; when people did this, they were more likely to get their flu shots (Payaprom, Bennett, Alabaster, & Tantipong, 2011).

By selecting suitable opportunities to enact goal-directed responses, individuals anticipate situations in which it would be fitting to execute them. Implementation intentions can link intentions with environmental cues bringing chronic or postponed intentions back to memory and leading to goal initiation. The selection of cues to link the goal-directed responses to can be either internal (e.g., a feeling) or external (e.g., a place, object, point of time, or person); they can be either related to good opportunities for action or anticipated barriers that may prevent goal striving (Orbell et al., 1997; Orbell & Verplanken, 2010). For the selection of an effective goal-directed behaviour; the theory of goal systems suggests that, for any given goal, various routes can lead to goal

attainment (Kruglanski et al., 2002). Therefore, the "then" component can be formulated in many forms. It can specify one behaviour leading to goal attainment and suppress responses or specify ignoring stimuli that can prevent individuals from not attaining the goal (Gollwitzer & Sheeran, 2006, 2009).

Empirical evidence has demonstrated the power of forming Imps in the process of converting goal intentions into actions to help goal achievement (Gollwitzer & Brandstätter, 1997; Orbell et al., 1997; Prestwich, Sheeran, Webb, & Gollwitzer, 2015; Sheeran & Orbell, 2000; Webb & Sheeran, 2004). Additionally, research has indicated that the effects of Imps seem to persist over time. For instance, Orbell et al. (1997) indicated that behavioural intentions of performing breast self-examination promoted by Imps were more likely to be enacted after one month from the Imps formation. Furthermore, Orbell et al. (1997) proposed that, even though goal or behavioural intentions can be good predictors of behaviour, using Imps can improve the prediction of behaviours; for example, this could be true in the case of chronic and postponed intentions. Chronic intentions refer to decisions the individual made of pursuing specific goals but did not act upon them (e.g., "I intended to learn another language but haven't looked out for classes"); postponed intentions refer to the decisions to act on at the unspecified point of time in the future (e.g., "I intend to get fit sometime next year") (Orbell et al., 1997).

1.4.1 Component processes of Implementation intentions

Imps are theorized to create a mental link that helps facilitate goal attainment by considering psychological processes related to the selected critical future situation individuals anticipate with the specified response. This selected situation is assumed to activate a mental representation in the individual, readying the individual's response to the situation (Gollwitzer, 1993, 1999; Webb & Sheeran, 2004). Research considers that individuals who form Imps should display increased accessibility of the critical cue compared to others. Webb and Sheeran (2004) examined the

performance of participants who had formed goal intentions and Imps strategies versus those who had formed simple goal intentions on a cue detection task. The task consisted of counting instances of the letter "F" in a paragraph. The researchers reported an improvement in performance when individuals formed Imps strategies. In addition, they suggest that this improved detection of the critical cue - the letter "F"- did not lead to false alarms (i.e., consider other letters that may look similar to the critical cue) or reduced performance to identify non-critical stimuli (Webb & Sheeran, 2004).

Within the if-then Imp, it is theorised that by specifying in the then-component that the individual will perform the goal-directed response, a strategy of effortful action control is set. The rationale behind this implies that the formation of Imps can help delegate the control of the behaviour to the situational cue, as opposed to controlling this themselves, and this can directly elicit the action (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006). The formation of the Imps means that the individual has committed in advance to act as soon as the situation is encountered. This should help individuals proceed to the initiation of the action in an effortless manner (Gollwitzer & Sheeran, 2006). Thus, it is considered that the execution of the behaviour promoted by Imps could exhibit automatic features (i.e., immediacy, efficiency, lack of conscious intent) (Bargh, 1994; Gollwitzer & Sheeran, 2006). In fact, researchers studying the impact of Imps consider that habits and Imps could be similar since they instigate automatic responses, whether they are the result of repeated actions (i.e., habits), or conscious planning (i.e., Imps) (Aarts & Dijksterhuis, 2000).

1.4.2 Implementation intentions and habitual behaviour

Habits development happens when people repeatedly perform a specific behaviour in the presence of a situation to pursue their goal (e.g., taking a pill with breakfast every morning). This co-occurrence between the situational context and the behaviour can contribute to create a mental association between the situation and the behaviour. This association strengthens over time until the

behaviour automatically follows the situation unintentionally and efficiently (Aarts & Dijksterhuis, 2000; Verplanken & Aarts, 1999).

Habits can be a great tool to help individuals effortlessly perform their daily routines as habits are effectively cued by the environment and require minimal decision-making (Verplanken & Wood, 2006). Furthermore, the performance of habits tends to have a minimal demand on people's capacities for self-control. For these reasons, habits tend to overshadow alternative actions and can be difficult to change at the same pace as individuals' intentions change. For these reasons, individuals often fail to act upon conscious intentions that go against their habits; due to the need to suppress habits to carry out alternative behaviours that require guidance and deliberative actions from the individual (Verplanken & Wood, 2006). The habits that get in the way of intentions have also been described as counter-intentional habits (Verplanken & Faes, 1999). Counter-intentional habits are challenge factors that interfere with attitudes, intentions, and behaviours for a particular goal that involves changing established behaviours (Verplanken & Faes, 1999). For example, counter-intentional habits could be short-term hedonistic-driven behaviours that get in the way of attaining valued goals that convey long-term benefits (Mittal, 1988; Verplanken & Faes, 1999). Counter-intentional habits are reported to compete with actions promoted by Imps (Gollwitzer & Oettingen, 1998; Verplanken & Faes, 1999). Research indicates that the relation between intention and behaviour can be strongly moderated by habitual control over behaviours, making this factor especially difficult to self-regulate (Aarts & Dijksterhuis, 2000; Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011; Gollwitzer & Sheeran, 2006; Verplanken & Aarts, 1999).

Habits are considered automatic acts that operate outside the individuals' awareness and are cognitively efficient (cf. Bargh, 1994). Whereas, Imps are considered cognitive and deliberative exercise focused on the execution of the relevant actions ay the right time at the right place (cf. Verplanken & Faes, 1999). Researchers consider that since both Imps and habits involve an

automatic cue-response link, Imps could be used to break existing unwanted habits (Verplanken & Faes, 1999). It is suggested that Imps could do this by linking a new, wanted behaviour to the situational cue that triggered the habitual behaviour beforehand (Adriaanse et al., 2011; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland et al., 2006; Verplanken & Aarts, 1999). However, it is essential to consider that the mere formation of Imps is insufficient to replace a habit. Repetitive use of the if-then plans may be required to replace the old habits. Holland et al. (2006) reported that, with the use of Imps, individuals were able to break existing recycling habits (i.e., throw plastic cups and old paper in regular bins) and create new ones (i.e., throwing plastic cups and old paper in recycling bins).

Although there is a vast amount of literature reporting a medium to large effect in the sectors of health (Conner, 2018; Milne, Orbell, & Sheeran, 2002; Orbell et al., 1997; Rise, Thompson, & Verplanken, 2003); vaccination intake (Payaprom, Bennett, Alabaster, & Tantipong, 2011); and voting (Nickerson & Rogers, 2010), there are limited studies that explore the impact of Imps on collective behaviours (Thürmer, Wieber, & Gollwitzer, 2015, 2017). This literature will be discussed further in chapters four and five. Moreover, limited studies assess the impact of Imps to help promote pro-environmental behaviours and climate change mitigation actions.

1.4.3 Implementation intentions and environmental behaviour.

Climate change is considered distant both in space and time. This contributes to the individual's inability to link their behaviour with its environmental consequences. As a result, it becomes a challenge for people to start behavioural changes to tackle environmental issues (Flynn, Bellaby, & Ricci, 2009a). Gollwitzer's (1993, 1999; 1996) suggestions of employing the formation of Imps to develop self-regulatory strategies for goal attainment had been tested before within the environmental sector (Bamberg, 2000, 2002, 2013; Holland et al., 2006).

Bamberg (2002) reported the use of Imps to promote the use of public transport by asking participants to state when and where the intended behaviour would be performed. In addition, the researchers tested the use of Imps to encourage the purchase of organically produced food by simply making participants decide the day and time they would perform the behaviour (Bamberg, 2002). It is important to note that, in the study reported by Bamberg (2002), the control group was not provided with instruction on goal-directed behaviours to achieve their goal intentions (i.e., use a bus route and purchase organic food). Moreover, Bamberg (2013) assessed whether goal intentions, Imps, and behavioural intentions impact individuals' car use behaviours. The researchers indicated that Imps helped better mediate the association between the self-reported car use reduction intention and the frequency of reported public transport use (Bamberg, 2013). The effect of Imps has also been tested to change bad recycling habits and instigate good recycling habits (Holland et al., 2006). The researchers successfully attempted to disrupt previous recycling habits and create new habits by setting if-then plans stating when, where, and how to recycle items (Holland et al., 2006).

Furthermore, a meta-analysis of the effect size of Imps on different areas of study reported a large effect of Imps on environmental behaviours (d=1.12) (Gollwitzer & Sheeran, 2006). However, the number of studies that have applied Imps to promote pro-environmental behaviours is minimal, and the number of pro-environmental behaviours tested within these studies (Bamberg, 2000, 2002, 2013; Holland et al., 2006). Imps have appeared to have had some success in promoting environmental behaviours, and it is considered that there may be different formulations of Imps that might increase their impact further: this is discussed further in chapters three, four, and five.

1.5 Behavioural spillover and pro-environmental behaviours

While the literature on Imps has reported the effectiveness of this self-regulation strategy on environmental behaviours and disrupting habits, little is known on whether the formation of Imps to enhance one behaviour could influence the performance of other behaviours in the same or different domain (Shreedhar & Galizzi, 2021). This is known as behaviour spillover, which describes that adopting one behaviour can increase or reduce the likelihood of performing another behaviour in the same domain, or even other similar domains (Lanzini & Thøgersen, 2014; Thøgersen, 1999).

Within the pro-environmental behaviour literature, behavioural spillover has been broadly studied for the last two decades or so, understanding how to promote, describe, and test behavioural spillover (Stuart Capstick, Whitmarsh, Nash, Haggar, & Lord, 2019; L. Evans et al., 2013; Lanzini & Thøgersen, 2014; Nash et al., 2017; Spence, Leygue, Bedwell, & O'malley, 2014; Thøgersen, 1999; Thøgersen & Crompton, 2009; Thomas, Poortinga, & Sautkina, 2016; Van Der Werff & Steg, 2018). L. Evans et al. (2013) reported in two laboratory experiments that people were more likely to recycle paper when faced with prior tasks making them reflect on the pro-environmental reasons for car-sharing behaviours. Interestingly this effect was not seen when participants reflect on the financial reasons for car-sharing behaviours. (L. Evans et al., 2013). This suggests that the reflection on environmental issues promoted by adopting one behaviour can influence adopting other environmental behaviours.

There are several theories proposed for the reasons underlying behavioural spillover. Consistency theory suggests that behavioural spillover is the result of individuals' attempt to act consistently across pro-environmental behaviours, avoiding cognitive dissonance (Thøgersen, 2004). Alternatively, evidence from learning theory suggests that engaging with pro-environmental behaviours may facilitate the uptake of other similar behaviours. This effect may be associated with

a perceived increase in capacities and self-confidence within the environmental field (Kollmuss & Agyeman, 2002). Research on behavioural spillover effects also indicates behavioural spillover effects could be mediated by environmental self-identity (Van der Werff, Steg, & Keizer, 2014). The researchers suggest that specific past pro-environmental behaviours can influence individuals' self-identity, which may impact judgments and intentions of other pro-environmental behaviours (Van der Werff et al., 2014). It is unclear which of the previously mentioned theories explains better the behavioural spillover effects, or whether more than one theory might be valid. Therefore, behavioural spillover is considered difficult to predict and quantify.

Regarding the assessment of spillover effects within the Imps literature, there is little evidence exploring the behavioural spillover effect of these planning tools on other behaviours. Shreedhar and Galizzi (2021) assessed the impact of Imps framed differently (i.e., personal, and planetary health benefits of sustainable eating habits) on other domain behaviours (e.g., charitable donations). The researchers reported spillover effects on other behaviours when participants were presented with Imps highlighting both personal and planetary health benefits in comparison to the control group and Imps highlighting just planetary or personal benefits (Shreedhar & Galizzi, 2021). This thesis aims to assess if the Imps strategies used to promote pro-environmental behaviour are effective in promoting the target behaviour and whether these may impact behaviours beyond the target behaviour. To the author's knowledge, there is no research assessing the behavioural spillover effect of Imps on other behaviours of the same domain.

So far, this chapter has described the formation of intentions is not enough for goal achievement and introduced a self-regulatory strategy called implementation intentions (Imps) that helps enhance goal attainment. Furthermore, the chapter has explained the use of Imps, how they work on the promotion of new behaviours, habits disruptions, its applications within the environmental literature, and the assessment of its behavioural spillover effects on other behaviours.

This thesis also considers relevant understanding public perceptions of barriers to pro-environmental behaviours as a key factor for the development of strategies that help enhance engagement with pro-environmental behaviours and climate actions.

1.6 Summary of research opportunities

This review highlighted the gaps in the literature on environmental behaviours, Imps, barriers to pro-environmental behaviours, and collective behaviour. Research has found that Imps do impact pro-environmental behaviours. However, the number of environmental behaviours impacted by Imps has been limited (i.e., recycling behaviours, use of public transport, consumption of organic food). I propose to use Imps to promote pro-environmental behaviours that have not been examined previously, i.e., energy-saving behaviours, avoiding plastic bottles, purchasing environmental products, and avoiding food waste, which will further speak to the generalizability and utility of Imps in bridging the intention – behaviour gap. First, this thesis aims to understand the perceived barriers to individual and collective pro-environmental behaviours. Second, this thesis attempts to develop behavioural strategies to tackle these barriers and ensure sustainable behaviour change.

In terms of the first aim, the thesis objectives are to contribute to the literature on public perceptions of barriers to engagement with environmental behaviours and climate change. Although barriers to engagement with pro-environmental behaviour have been examined extensively empirically, there is little about exploring barriers in a conceptual way based on exploring at what stages of engagement barriers affect behaviour. This thesis tests the conceptual framework of barriers (Gollwitzer & Sheeran, 2006) to classify barriers, perceived by the public for individual and collective behaviours (chapter two).

In addition, I highlight that it may be possible to improve upon Imps in their current form. I propose the use of strategies that could help enhance the effectiveness of Imps such as the inclusion of visual imagery (chapter three) and tailoring the Imps to the specific barriers observed concerning the targeted behaviour (chapter four). I also propose the use of collective Imps to help promote pro-environmental behaviours (chapters four and five); this has not yet been explored before within the literature on Imps and pro-environmental behaviours. This is important since it is considered that collective behaviours have a greater impact on environment; somewhat this approach has been neglected within the literature on Imps and environmental behaviours.

Chapter 2- Perceived barriers to individual and collective pro-environmental behaviours.

Abstract

This chapter highlights the relevance of understanding what barriers individuals face when attempting to engage with pro-environmental behaviours by themselves or in a collective way. The study presented in this chapter (study 1) examined the specific nature of barriers people perceived for individual and collective pro-environmental behaviours. Study 1 examines the different themes that surge when people reflect about barriers for individual (e.g., turning off lights when not in use) and collective (e.g., setting the heating temperature with housemates) pro-environmental behaviours. Additionally, this study suggests the use of the conceptual framework of barriers to goal attainment proposed by Gollwitzer et al (2006) as a tool to classify the perceived barriers. This conceptual framework comprises four types of barriers: barriers to initiating the goal (goal initiation), shielding the goal-directed behaviours (goal shielding), disengaging from unattainable goals (goal disengagement), and attempting to achieve multiple goals (overextending oneself). The application of this conceptual framework of barriers could help understand at what stage of engagement the intention-behaviour gap impacts when the public attempts to attain pro-environmental goals. Findings suggest that themes related to needing reminders, difficulties changing habits and convenience are the key barriers for pro-environmental behaviours. On the other hand, the most common problems for collective pro-environmental behaviours were related to differences of opinions within the group and others' behaviours getting in the way (e.g., unwillingness to change habits). The differences in the barriers to behaving collectively and individually indicate the need for different behavioural strategies to promote environmental behaviours on an individual and collective level. The

implications of these findings for policymaking could be the need of encouraging more community action when talking about pro-environmental behaviour, and the use of planning tools when promoting individual pro-environmental behaviours to try embed these behaviours as part of their daily lives.

2 Study 1- Assessment of perceived barriers to individual and collective pro-environmental behaviours

2.1 Introduction

Individuals within every society are starting to change their behaviour and encourage others to change in response to climate change. While humans have changed some behaviours, in the aggregate, we continue to contribute to the production of greenhouse gases (IPCC, 2014b), e.g., industrial habits and farming. Entire societies report being deeply concerned about environmental issues; however, the level of engagement with pro-environmental behaviours still needs to match the level of concern individuals claim to have for the environment (R. Gifford, Lacroix, & Chen, 2018). The inability to match actual behaviours to intentions is known as the intention-behaviour gap. The intention-behaviour gap suggests that the single willingness to form a goal intention is insufficient to ensure goal achievement (Gollwitzer & Sheeran, 2006; Sheeran, 2002).

In order to understand this gap between intentions and actual behaviour, environmental psychologists have focused on assessing individuals' knowledge, concern, and awareness of environmental issues and found a weak correlation between these and the engagement with pro-environmental behaviours (Chaiken & Stangor, 1987; Gifford et al., 2018). Hines, Hungerford, and

Tomera (1987) reported weak correlations between intentions for actual engagement and pro-environmental behaviours.

2.1.1 Barriers to pro-environmental behaviour

Environmental psychologists have explored ways to identify the causes for the intention-behaviour gap between people's concerns about environmental issues and their actions. Blake (1999) suggests that the complexity of the intention-behaviour gap can include more than just the result of an "information deficit" (e.g., individuals not having access to information on how to be environmentally friendly). This research evaluated perceptions about sustainable community projects in the UK and the barriers public reported to engaging with environmental actions. Blake (1999) classified barriers to engagement with sustainable programmes into three different types: intrapersonal (e.g., attitudes and temperament get in the way of behaviour), lack of felt of responsibility (e.g., people do not consider their contribution to environmental issues), and practicability (e.g., lack of money, facilities, and information).

Lorenzoni et al. (2007) report the identifying two primary levels that perceived barriers hinder behaviour according to UK public members: the individual and societal levels. The individual level comprises a perceived lack of knowledge, competing motivations, values or needs, and psychological barriers (e.g., temporal discounting). As for the barriers identified within the societal level, the researchers found a perceived lack of political action on climate and a lack of action by governments, businesses; free riding (e.g., policy preference for voluntary actions), social norms expectations (e.g., for changing consumption), and a lack of enabling initiatives and facilities (e.g., accessible public transport) (Lorenzoni et al., 2007). Lorenzoni et al. (2007) interpret many of the barriers found within the public's perceptions of barriers as mechanisms of denial (e.g., blaming others, denying personal contributions to climate change, pointing to government inaction) to cope

with the internal discrepancies between the demands to engage with climate change and their actual personal engagement.

Research has also described some structural barriers to sustainable behaviour, meaning engagement is beyond an individuals' reasonable control (e.g., financial constraints limit individuals' ability to purchase eco-friendly products) (Gifford et al., 2018). Although this could transfer the blame to local or national governments for not tackling these structural barriers, many individuals not affected by these structural barriers do not act pro-environmentally or do very little compared to what they can do (Gifford et al., 2018). The lack of engagement without structural barriers getting in the way suggests that structural barriers are not the only thing hindering engagement with pro-environmental behaviours.

Additionally, Gifford (2011) proposes seven categories that comprise some psychological barriers to pro-environmental behaviours: limited cognition, ideologies, sunk costs, discredence, perceived risk, and limited behaviour. The first category is limited cognition, including lack of knowledge, perceived uncertainty around environmental issues, and people undervaluing the risks due to their proximity to the problem. This limited cognition can make individuals less motivated to change and improve their environment (judgmental discounting) (Gifford et al., 2009; Uzzell, 2000). Lack of perceived behavioural control is considered another psychological barrier in this category; since *climate change* is defined as a global problem, individuals consider their sole individual actions ineffective against the problem (Gifford, 2011; Kaiser & Gutscher, 2003).

The second category comprises ideologies, such as political worldviews (e.g., supporting capitalism and the greater greenhouse emissions that come with it); system justification (e.g., defending the societal status quo); and techno-salvation (e.g., technology innovations will tackle the environmental issues). The third category is the comparison with others and involves individuals

judging their actions by comparing these with what others do. They then adjust their behaviour to comply with the social norms (e.g., family and friends not acting pro-environmentally) (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). Perceived inequity is also another barrier within this category, suggesting that individuals justify their inaction when they notice an unfair difference between their choices, behaviours, and outcomes with those of others (Gifford, 2011).

The fourth category is sunk costs. Sunk costs refer to the prior investments (e.g., time, money, effort) that may not be recovered, so they are difficult to abandon. Individuals may not want to give up harmful environmental financial investments, behavioural habits (Aarts & Dijksterhuis, 2000), goals that are incompatible with the environment, or unattainable environmental goals (Lindenberg & Steg, 2007b). The fifth category of discredence includes general disbelief and distrust in experts and authorities (Gifford, 2011; Opotow & Weiss, 2000). The sixth category relates to the perceived risk associated to environmental behaviour changes (e.g., lack of infrastructure for electric vehicles). The seventh barrier category is limited behaviour, considering the adoption of environmental behaviours that involve inadequate impacts (Gifford, 2011; Gifford et al., 2018; Gifford & Chen, 2017).

Although there is a rich literature assessing the barriers that prevent individuals from engaging in pro-environmental behaviours; this thesis considers the need for a theoretical approach to understanding how barriers impact the stages of engagement, forming the intention-behaviour gap. This may help understand when and how to direct supportive behaviour interventions.

2.1.2 Barriers to pro-environmental behaviours.

Gollwitzer and Sheeran (2006) propose a conceptual framework that describes four potential types of barriers that prevent people from reaching their goals. These are goal initiation, goal disengagement, goal shielding, and overextending oneself. The first problem defined in the

conceptual framework is failing to get the goal started or the goal initiation barrier. Indeed, one of the main factors reported that prevents individuals from starting their goal involves individuals' ability to remember to act on their goal. When the intended behaviour is not part of the individual's routine, situational demands can drag the individual's attention away from their goals (Einstein & McDaniel, 1996), especially when the behaviour is new or unfamiliar (Gollwitzer & Sheeran, 2006). Another factor preventing people from starting their goals is the failure to seize the opportunity to act; this happens when the time window for performing the intended behaviour is short or the opportunity to act presents briefly. As a result, people miss the right time to get started on their goal.

Even though individuals may be able to form and remember their goal intentions and recognize the opportune moment to act, they can also face another problem that prevents them from getting started with their goal: the initial reluctance to start the behaviour. The problem of initial reluctance is likely to occur when the behaviour involves a trade-off between attractive long-term consequences versus less attractive short-term consequences (e.g., setting the alarm to wake up early tomorrow and- when the moment arrives- we ignore the alarm and stay in bed) (Gollwitzer & Sheeran, 2006; Oettingen, Hönig, & Gollwitzer, 2000)

Secondly, when it has become unproductive, not disengaging from goal striving is another barrier to achieving that goal, known as goal disengagement. Disengagement can be very straightforward when this is followed by satisfactory progress, either from another goal or using different means to reach the same goal. However, disengaging from an ongoing goal pursuit when self-defensive concerns are activated can be very difficult (Gollwitzer & Sheeran, 2006). Research on goal disengagement has been broadly studied under different names, such as sunk costs (i.e., the costs that have already been incurred and cannot be recovered) (Garland & Newport, 1991),

escalation of commitment (i.e., remaining committed to past behaviours even if they do not have desirable outcomes) (Ting, 2011).

Goal shielding barriers, also known as problems getting derailed, occur when individuals already engage with the behaviour. When pursuing a goal, individuals must suppress unwanted attention responses and other behavioural responses (Gollwitzer & Sheeran, 2006). Studies indicate that if the unwanted behaviour is an automated behaviour then individuals may have some difficulty controlling them (Sheeran, Webb, & Gollwitzer, 2005; Verplanken & Aarts, 1999). Other circumstances where individuals can be derailed from their goal intentions involve unanticipated and unwanted influences from within the self. For instance, self-states, such as mood, can threaten goal attainment. A good mood can signal to the individual that their current situation is unproblematic, forming stereotypical impressions, which lead to less elaborate information processing compared to situations when they are in a bad mood (Gollwitzer, Bayer, & McCulloch, 2005; Gollwitzer & Sheeran, 2006).

The fourth obstacle to goal completion is overextending oneself, which often happens when individuals pursue multiple goals. When pursuing multiple goals, the risk of jeopardizing the achievement of one of the subsequent goals is considerable because the individual may not have the time or provide the attention necessary for the desired goal (Austin & Jeffrey, 1996; Gollwitzer & Moskowitz, 1996; Gollwitzer & Sheeran, 2006).

The identification of these different barriers to goal attainment has helped in the development of self-regulatory strategies, such as, implementation intentions (Imps). A meta-analysis suggests that these strategies, tackling problems associated with initiating the goal, shielding goals, and disengaging from failing goals, have a medium to large effect on behaviour change (Gollwitzer & Sheeran, 2006). However, it is important to note that most studies promoting

behaviour change for goal-striving with Imps have focused on problems initiating goal striving (Gollwitzer & Sheeran, 2006).

This study defines as individual pro-environmental behaviours as any behaviour protecting the environment, or mitigating environment damage, that is performed individually (e.g., turn off the lights that are not in use). In contrast, I define collective pro-environmental behaviour as any behaviour protecting the environment, or mitigating environment damage, that is performed in conjunction with one or more other people (e.g., setting a heating temperature established with housemates). The differences between individual and collective goal attainment have been explored within environmental behaviour (Spence et al., 2018; Van Zomeren, Postmes, & Spears, 2008). The literature on Imps has also explored the impact of collective Imps versus individual Imps in physical tasks (Thürmer et al., 2017). Even though there are differences in the performance of collective and individual goals, it seems plausible that collective goal striving and the barriers that prevent goal striving could be assessed with the same conceptual framework used for identifying individual barriers to goal striving. This thesis considers that the barriers classification for individual goal striving could also occur within collective goal striving. The classification of barriers to collective behaviours can also be helpful to identify the collective intention-behaviour gaps and potentially support collective actions. Moreover, studies indicate that perceptions of the efficacy of collective actions can be associated with greater outcomes and support for environmental policies. This is also the case when the policies may involve a financial cost for individuals (Thaker, Howe, Leiserowitz, & Maibach, 2019).

2.1.3 Current study

Understanding the factors that make individuals fail to act upon their environmental goals is a fundamental concern in the search for feasible and successful interventions that promote environmental behaviours. The present study focused on classifying the reported barriers to pro-

environmental behaviours using the conceptual barriers framework of Gollwitzer and Sheeran (2006). The study aims to understand which stages of engagement with pro-environmental behaviours are interrupted by barriers promoting the intention-behaviour gap.

Within the research on barriers to engagement with environmental issues, there is no classification of barriers based on a theoretical conceptual framework of barriers. This study applies Gollwitzer and Sheeran's conceptual framework for classifying barriers to pro-environmental behaviours. Furthermore, to the author's knowledge, there is no previous research that classifies barriers to engagement with collective behaviours based on the conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006). This study aimed to identify and classify the barriers the public report when reflecting about the barriers to individual and collective pro-environmental behaviour.

2.2 Methods

2.2.1 Participants

A total of 153 undergraduate students from the School of Psychology at the University of Nottingham responded to the questionnaire. Participants were recruited through a university system that awards course credit for participation in research studies and through adverts posted on local social media. After removing twenty participants who incorrectly responded to an attention check question, the final sample was 133 participants. From the final sample, 104 were female, 28 were male, and one listed their gender as 'other'. The ages of participants ranged from 17-80 (Median age = 21).

2.2.2 Materials

This study used a previously collected dataset for a project focused on assessing individual and cooperative environmental behaviours (Spence, Leygue, & Ferguson, 2019). For this study, I only used one section of the questionnaire formed by the researchers that examined barriers to environmental behaviour. This section included two open-ended questions: "*Please list what barriers you anticipate from taking actions that are environmentally friendly on your own (e.g., turning off lights that are not in use, changing your diet, re-using bags at the supermarket)?*"; and *"Please list what barriers you anticipate from taking actions in order to be environmentally friendly with others (e.g., talking with others about environmental issues, setting a heating temperature with housemates, establishing and monitoring a recycling system in your household)?.*

2.2.3 Procedure

A total of 323 responses were received, 161 perceived barriers to collective behaviours and 162 perceived barriers to individual behaviours. It is important to note that 93 participants did not report any barriers to either individual or collective behaviours, and- from those who responded to the questions- only 39 participants reported both individual and collective barriers. In addition, the responses to the open-ended questions included one to four listed barriers per question; this means participants provided, in some cases, more than one answer to the open-ended questions. The analysis of the results was exploratory due to the low response rate and the fact that only a few participants entered a response to both questions. Barriers were classified into themes using thematic analysis. Thematic analysis is a method for identifying, analysing, and reporting patterns within data. In this case, I conducted the thematic analysis using an inductive approach which involves developing a theory based on limited information without trying to fit the data into a pre-existing coding frame (Braun & Clarke, 2006). This method was considered the most appropriate approach for the data to avoid bias from the researcher and assess if the analysis suggests different

patterns or themes from the themes reported in the literature. Following the thematic analysis, emergent themes were considered in relation to the conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006).

2.2.4 Data analysis

2.2.4.1 *Thematic analysis*

I developed a thematic codebook by exploring all participants' responses using NVivo software. After identifying all the possible themes, I conducted a second assessment of the themes to identify sub-themes within each classified theme. A second rater then used the codebook I developed in a training session to second code a quasi-random sample of 30 responses (15 individual, 15 collective) into themes. This method was quasi-random because we ensured that the sample contained at least one item belonging to each theme in the codebook. After the second rater and I compared our sample coding, we agreed on the final codebook and tested this independently with a different sample of 90 responses (45 individual, 45 collective). The inter-rater reliability Cohen's kappa test showed a substantial level of agreement (2 raters), $\kappa = 0.77$ (95% CCI, 0.66 to 0.87) $p \leq 0.001$.

2.2.4.2 *Classification of barriers*

After identifying the themes within the reported barriers for pro-environmental behaviours I examined the different themes. I classified the barriers within these based on the conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006). I developed the codebook for the analysis by adapting the conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006) to barriers to pro-environmental behaviours (see Table 1). Table 2 presents in the Type column the names of the types of barriers and the name I proposed for each barrier. The barriers from the conceptual framework were re-named in this thesis for better reference; the failing to get

started barrier is described as Goal Initiation (GI); getting derailed barrier is Goal Shielding (GS); not calling a halt barrier is described as Goal disengagement (GD) and overextending oneself (O). After this, I acted as a rater and coded the barriers to collective and individual pro-environmental behaviours based on the codebook. A second researcher acted as a second-rater and coded the barriers to individual and collective pro-environmental based on the codebook developed by the first rater. A reliability test was performed using Cohen's kappa test. This analysis showed a substantial agreement between the two raters, $\kappa = 0.76$ (95% CCI, 0.70 to 0.81) $p \leq 0.001$.

Table 1 Adaptation of conceptual framework of barriers from Gollwitzer & Sheeran (2006), for barriers to pro-environmental behaviours' classification.

Label	***Type***	***Description***
Goal Initiation (GI) *Failing to get started*	Difficulties with getting started	Reported the causes responsible for the failure to start goal-directed actions.
	Not seizing the suitable opportunity	Failing to notice the right time to act upon their intentions.
	Initial reluctance problem or hyperbolic discounting	Closer rewards, even if smaller, seem greater than larger but delayed rewards.
Goal Shielding (GS) Getting derailed	Other's behaviours, social interactions	Other people's actions affect personal actions derailing them from goal achievement. Situations that disrupt the individual's intentions.
	Self-states	The presence of emotions or states of mind that are not conducive to intention realization. People often talk about forgetting to act.
	Environmental goals being disrupted in the intention-behaviour phase	Any situational or social interaction that derails the environmental action should be considered an obstacle to goal shielding.
	Sunk costs	Unable to discard a goal when it has become unproductive
	Adopting the easier option	Go for the easier option available, even though is not optimal in the long run

Goal Disengagement (GD) Not calling a halt	Escalating of commitment	Incapable of stopping performing certain behaviours that obstruct the initiation of other optimal goals
Overextending oneself (O)	Multiple goals at once	The pursuit of multiple goals can jeopardize the achievement of subsequent goals. When individuals report to try and perform the action but then failing to keep up to it.
NA	Not Applicable	In cases when the individuals did answer according to the topic, but answers are open to interpretation and further assumptions. For example: a "forgetting" statement does not provide information of whether the individual cannot start the behaviour (GI) or started it and got derailed from it (GS).

2.3 Results and Discussion

2.3.1 Thematic analysis

2.3.1.1 *Individual barriers*

Of the 162 responses to the question of barriers perceived by participants for individual pro-environmental behaviours, 130 (82%) were barriers. The other 32 entries did not respond to the question correctly: these responses often described environmental activities or efficiency measures rather than barriers (e.g., *"Living in a house with solar panels, insulating and recycled grey water"; "Reducing water waste, i.e. turning off taps when brushing teeth"*). Since this thesis focused on barriers, the non-barriers were removed from the analysis. Results indicated that the most prevalent theme among the barriers perceived for individual pro-environmental behaviours were themes related to themes like *Need of constant reminders* (23%) (e.g., "*Barrier to re-using bags at the*

supermarket is that they are so easy to forget"), *Difficulties changing habits* (20%) (e.g., *"Buying new products all the time instead of re-using things as soon as they get* temperamental*"*). *Convenience* (15%) (e.g., *"Choosing to value taste/convinence over helping the environment"* (sic)), and *Money constraints* (11%) (e.g., *"Financial and time costs involved in a diet change*") were also present across the data but in a lesser extent. These themes are consistent with the literature suggesting that costs and convenience are barriers to pro-environmental behaviours (Steg & Vlek, 2009; Li et al., 2019). Other themes that were present in a lesser extent within the barriers for individual pro-environmental behaviour were *Blame of the socio-economic and political context*, *Lack of information*, and *Futility efforts of individual actions*. These themes have been present in the literature of barriers as transfer of guilt (Gifford, 2001; Gifford et al., 2018), and lack of information and a drop in the ocean effect (Lorenzoni et al., 2007), respectively. The full table is available in Appendix 8.1.1.

Findings in this thesis on the barriers to individual pro-environmental behaviours are relevant to the literature since the main obstacles to pro-environmental behaviours reported in the literature are convenience and costs (Steg & Vlek, 2009). Findings in this study indicated that- although barriers involving costs and convenience are present within the barriers reported by individuals- they are not the main obstacles that prevent engagement with individual pro-environmental behaviours. This study indicated barriers related to not remembering to act according to the pro-environmental (i.e., need of reminders) and problems changing habits that are not pro-environmental behaviours. The barriers identified as need for reminders could be more related to the findings reported by Lorenzoni et al. (2007), indicating that competing motivations, values, or needs get in the way of behaviour.

2.3.1.2 *Collective barriers*

Of the 161 responses to the question of barriers perceived by participants for collective pro-environmental behaviours, 133 (82%) were barriers. Within the identified barriers for collective pro-environmental behaviours the theme of *Blaming others* (42%) was the most prevalent. This theme included responses where individuals attribute the responsibility to others for their lack of engagement with collective pro-environmental behaviours. The theme of *Blaming others* is consistent with what is reported in the literature, suggesting a transfer of guilt from the individual to others within the group (Gifford et al., 2018; Gifford, 2011). Across the theme of *Blaming others*, I have identified different sub-themes. The most prevalent are *Unwillingness to change habits* (e.g., *"The heating temperature – is on a timer but is on is on very high and that is the way they want to keep it. They feel that because we don't let the house temperature to ever drop too low that we aren't using too much energy"*) and *Convenience* (e.g., "Housemates driving instead of walking into university") (Appendix 8.1.2).

Another relevant theme identified within the barriers to pro-environmental behaviours was *Differences of opinion* (27%) (e.g., *"There could be arguments over differing views and whether there is a need to make these changes"*). Other themes identified in the dataset, but to a lesser extent, were *Lack of interest, Money constraints, Time constraints,* and *Need for reminders.* Interestingly, although the literature considers costs as an important barrier to engagement with pro-environmental behaviours (Steg & Vlek, 2009), in this study, monetary constraints were not among the main barriers to engage with collective pro-environmental behaviours.

2.3.2 Barriers classification

I was also interested in classifying the different barriers to individual and collective pro-environmental behaviours based on the conceptual framework proposed by Gollwitzer and Sheeran

(2006), which proposes four different types of barriers that can hinder goal attainment. I classified each response within each theme into the different types of barriers. In cases where the reported barriers do not fit into any of the four barriers, the response was classified as non-applicable (NA).

2.3.2.1 *Individual barriers*

The barriers to individual pro-environmental indicated an overall high prevalence of GI barriers (41%), GD barriers comprised 24% of barriers, GS barriers formed 17% of reported barriers and the O barriers had very little presence within the individual barriers (3%). It is possible that the O barrier was not present due to a lack of insight that participants have of this barrier: reflecting on everyday activities and how pro-environmental behaviours are fitted within our daily routines may be a more cognitively complex task. A total of 29% of the reported individual barriers were identified as non-applicable (NA) due to limited information available to classify them into one of the different barriers (e.g., "Forgetting to turn off lights and electrical products," Remembering to act in an environmentally friendly manner, such as remembering to bring shopping bags or turn off appliances"). The theme of "Need of reminders" was the theme with most responses which remained unclassified according to conceptual barriers due to the presence of responses that could have been classified as more than one goal (e.g., GS or GI), but without enough information to accurately make the judgement.

Overall, GI barrier was present across all themes identified across the individual barriers, suggesting that problems getting started could be the main obstacle to engaging with pro-environmental behaviour. I found that different barriers (e.g., GS, GI) were related to different themes, and this relationship was stronger for some themes than others. For example, the themes of *Convenience, Money constraints, Lack of information, Others responsibility or blame* had more responses related to the barrier of GI than the rest of the themes. GD barriers were mainly related to

the theme of "Difficulties changing habits" taking over most of the responses classified within that theme. This could suggest that most of the difficulties in changing habits are related to removing non-environmental behaviours rather than difficulties introducing pro-environmental behaviours as part of their daily routines. The GS barrier was present across the vast majority of the themes but to a lesser extent (e.g., "need of reminders", "Difficulties changing habits", "Convenience"), (see Table 2). Although GS was not identified to a great extent, it is relevant to highlight that it was fairly distributed across the different themes. Maybe this is due to individuals having problems reflecting on the internal and external factors that prevent them from continuing engagement with pro-environmental behaviours. Furthermore, the similarities between GS and GI barriers make it challenging to classify reported barriers into these two types when individuals give very little information about the barrier. This may suggest that the framework would be useful when using different methods of recording people's perceptions of barriers (e.g., structured interviews, focus groups).

Table 2 Classification of barriers based on conceptual framework of barriers by Gollwitzer and Sheeran (2006) for the different themes (in bold) and sub-themes identified within the barriers for individual pro-environmental behaviours.

Themes	*GI*	*GD*	*GS*	*O*	*NA*	*Total*
Need of reminders	**4**		**3**		**23**	**30**
Difficulties changing habits	**5**	**16**	**3**		**2**	**26**
Convenience	**9**	**3**	**3**		**4**	**19**
Money constraints	**11**		**2**		**2**	**15**
Blame it on the Socio economic and political context	**6**	**5**				**11**
Lack of information	**8**			**2**		**10**
Futility efforts of individual actions	**2**		**1**		**5**	**8**
Others' responsibility	**4**		**2**			**6**
Pressure from others			2			2
Lack of knowledge	4					4
Time constraints			**1**	**2**	**2**	**5**
TOTAL	**53**	**24**	**17**	**4**	**38**	**136**

2.3.2.2 *Collective barriers*

The classification of barriers to collective pro-environmental behaviours based on the conceptual framework of barriers (Gollwitzer & Sheeran, 2006) indicated that GI barriers were the most prevalent type within reported barriers (57%). Barriers preventing disengagement from non-environmental behaviours were found in 16% of the participants perceptions of barriers to collective pro-environmental behaviour. GS barriers were present in 11% of the barrier responses and the barrier of overextending oneself was found in 4.6% of the data. Finally, a total of 13% of the responses was not classified with any of the four barriers (NA) due to the lack of information to make an accurate judgement. Please refer to Table 3 for full information.

The different types of barriers were present in different levels across the themes previously identified. For example, the theme of *Differences of opinion* mostly appeared to relate to the GI barrier; whereas almost half of the responses allocated to the theme of *Others responsibility* were related to GI (26) barrier and the other half was distributed across GD (20) and GS barriers (7) this same type of barrier. Within the theme of *Others responsibility*, the sub-theme of 'Others unwillingness to change habits' (14 out of 30 responses), and the sub-theme of 'Others' non-acceptance of responsibility' (5 out of 6 responses) were mostly related to GI barrier (Table 3).

Furthermore, the GD barrier was related mostly to the theme of *Others responsibility*, specifically, within the sub-themes of 'Convenience' and 'Others' unwillingness to change habits. The barrier of GS was also found within the theme of *Others responsibility*, mainly within the sub-theme of 'Others unwillingness to change'; this type of barrier was also found in the *Need of reminders*. The barrier of overextending oneself was mostly found within the theme of *Time constraints.*

Table 3 Classification of barriers based on conceptual framework of barriers by Gollwitzer and Sheeran (2006) for the different themes identified within the barriers for collective pro-environmental behaviours.

Theme	*GI*	*GD*	*GS*	*O*	*NA*	***Total***
Others' responsibility	**26**	**20**	**7**		**3**	**56**
Others' unwillingness to change habits	14	9	6		1	30
Convenience	3	9	1		2	15
Others' non-acceptance of responsibility	5	1				6
Perceived lack of knowledge	3	1				4
Money Constraints	1					1
Differences of opinion.	**35**	**1**				**36**
No interest within the group	**3**				**7**	**10**
Money Constraints	**4**				**3**	**7**
Need of reminders			**4**		**3**	**7**
Time constraints			**1**	**6**		**7**
Blame the socio-political and economic context: context constraints	**2**		**3**		**1**	**6**
Futility efforts	**4**					**4**
TOTAL	**74**	**21**	**15**	**6**	**17**	**133**

2.3.3 Differences between barriers for collective and individual pro-environmental behaviours

The findings from the thematic analysis of individual and collective pro-environmental behaviours indicate that people perceived different kinds of obstacles when behaving individually than when behaving collectively. This is relevant for all agents that design and implement behavioural strategies for promoting pro-environmental behaviours, because it implies the need for different behavioural strategies to tackle different types of behaviours.

The barriers for collective pro-environmental behaviours were predominantly focused on transfer of guilt to others actions as the reason for the lack of engagement with pro-environmental

behaviour. This is consistent with the literature that explores the psychological barriers to pro-environmental behaviours (Gifford, 2011; Gifford & Chen, 2017). It is possible that the transfer of guilt was not that prominent within individual pro-environmental behaviours due to this study explicitly asking participants to reflect on individual behaviours.

Overall, both individual and collective pro-environmental barriers had a high prevalence of GI barriers, in other words, problems for starting the engagement with pro-environmental behaviours are highly present for both individual and collective pro-environmental behaviours. Problems for initiating individual pro-environmental behaviours are more related to monetary limitations, convenience and lack of information. This is consistent with the literature of barriers and pro-environmental behaviours (Steg and Vlek, 2009). As for the problems for initiating collective pro-environmental behaviours, this were more related to differences of opinion with others and others unwillingness to change resulting in a lack of engagement with behaviour. This suggest that in order to tackle barriers to start pro-environmental behaviours, researchers and policy makers have to consider different factors that hinder individual and collective behaviours in order to develop optimal interventions. In the case of promoting the start of pro-environmental behaviours, strategies considering economic and structural interventions could be useful, for example, pricing policies and change incentives for low carbon initiatives. (e.g., charging for using car, and giving incentives and facilitate walking and cycling). In contrast, strategies promoting the start of collective pro-environmental behaviours could include collective goal settings and planning tools that highlight the common interests within the groups and community.

It is important to note that although the theme of "Need of reminders" was predominant across the barriers for individual pro-environmental behaviour, the responses within this theme were difficult to classify into one of the different types of barriers due to the lack of information provided by the respondent. It is considered that the responses within this theme could be strongly

related to goal shielding barriers, since the theme of "Need of reminders" could refer to people engaging in some way with the desired behaviour and then forgetting it. However, this can also be classified as a goal initiation barrier, meaning people may have the intention to act but then forget about it. Difficulties in classification appears to be a limitation of the conceptual framework of barriers. However, it is relevant to highlight that in the case of the barriers for collective pro-environmental behaviours, the classification of barriers was more straightforward and had less reported barriers classified as not applicable. This suggests that people may be clearer in perceiving the stage of engagement in which collective pro-environmental behaviours are hindered for collective behaviours. Furthermore, this is the first study that has classified collective barriers based on the conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006). Other studies have used interventions tackling collective behaviours based on the different stages of engagement to encourage start and maintain engagement on a physical task (e.g., getting the goal started, shielding goals) (Thurmer et al., 2015; Thurmer et al., 2017). Exploring barriers to collective pro-environmental behaviours can help the development of evidence-based behavioural strategies aimed to tackle these barriers.

2.4 Discussion

Results indicated that different types of pro-environmental behaviour- individual and collective- are impacted differently by barriers preventing engagement with these. This makes the study relevant for the literature since, in the assessment of pro-environmental behaviours, there is little research comparing the barriers for individual and pro-environmental behaviours. Perceptions of barriers to individual pro-environmental behaviours included problems related to remembering to engage with pro-environmental behaviours; difficulties changing behaviours or removing habits that go against pro-environmental behaviours. On the other hand, collective pro-environmental

behaviours included differences of opinion within a group and transferring guilt to others for the lack of engagement with behaviour. The conceptual framework of barriers (Gollwitzer and Sheeran, 2006) was applied to individual and collective pro-environmental behaviours, finding that barriers for collective behaviours were easier to classify into the four barriers from the framework than the individual barriers.

The predominant barrier for individual and collective behaviours was related to problems getting the behaviour started (GI). In the case of individual behaviours, the barriers were primarily related due to money constraints and convenience. In contrast, for the collective behaviours the barriers to getting started were related to differences of opinion with others and others' behaviours getting in the way.

The barrier of overextending oneself did not have a high presence for either individual or collective pro-environmental behaviours. This could be due to individuals not reflecting on other activities- taken individually or collectively- that may interfere with people's engagement to pro-environmental behaviours

Findings from this study suggest that, although people may struggle to start both individual and collective pro-environmental behaviours the obstacles to these behaviours differ in nature. This implies that individual and collective pro-environmental behaviours should be addressed differently. This is consistent with the literature that differentiates perceived barriers to engaging with climate change into two different levels: individual and societal levels (Lorenzoni et al., 2007). Lorenzoni et al. (2007) identified that engagement to individual and societal climate actions faces different barriers. Whereas individual barriers to climate actions include a lack of knowledge, competing motivations, values or needs and psychological barriers, social barriers include a perceived lack of actions by governments and businesses, and social norms towards consumption

(Lorenzoni et al 2007). This thesis reported barriers to pro-environmental behaviours for individual and collective behaviours, where collective behaviour aligns with Lorenzoni et al.'s (2007) previous identification of social behaviour, and contributes to the literature reporting that different types of behaviour involve different barriers. This thesis suggests that perceived barriers to individual pro-environmental behaviours include problems remembering to engage with goal-directed behaviours, problems changing habits, and money constraints. On the other hand, the perceived barriers to collective behaviours include problems related to other people's behaviours and attitudes (e.g., unwillingness to change non-environmental habits); and differences of opinion about the pro-environmental behaviours to engage with as a group.

When individuals were asked about barriers to collective pro-environmental behaviours, the most common themes across all types of barriers were related to transferring responsibility and blaming others for the individual's inability to act. This is consistent with previous literature indicating that one of the barriers to engagement is that individuals do not accept responsibility for action (Blake, 1999; Gifford, 2011; Gifford et al., 2018; Lorenzoni et al., 2007) (Blake, 1999; Gifford, 2011; Gifford et al., 2018; Lorenzoni et al., 2007). One possible explanation for this transfer of guilt could be a perceived lack of control over collective behaviours that people may feel due to differences in habits and values people have compared to others. This is consistent with previous literature on psychological barriers to pro-environmental behaviours which suggests perceived behaviour control as a potential barrier to engagement (Gifford, 2011; Gifford et al., 2018; Kollmuss & Agyeman, 2002).

Since one of the barriers for collective pro-environmental behaviours was having different opinions around pro-environmental behaviours within a group. This thesis considers that, if individuals within a group or community have similar values and opinions about the environment, the initiation of pro-environmental behaviours may be easier in a collective level. Hence this thesis

considers relevant to encourage discussion about the environment. This is consistent with the literature proposing citizens' assemblies and juries, building a social mandate for climate actions (Howarth et al., 2020).

Furthermore, in the case of individual pro-environmental behaviours it is considered that strategies giving reminders to individuals to maintain pro-environmental behaviours and not engage with non-environmental behaviours could help promote sustainable behaviour change. One way to promote this could be using planning tools (e.g., implementation intentions (Gollwitzer & Sheeran, 2006)) that delegate the behavioural response to environmental cues, so the individual remembers forget to engage with the desired behaviour.

With regards to the implementation of the conceptual framework of barriers, proposed by Gollwitzer and Sheeran (2006), this thesis indicated that using the conceptual framework for the barriers' classification did not encompass all the perceived barriers to individual pro-environmental behaviours generated by participants. The perceived barriers to collective pro-environmental behaviours fitted into the classification of the conceptual framework of barriers better than barriers to individual pro-environmental behaviour. Findings indicated that goal initiation was one of the main barriers to both collective and individual pro-environmental behaviours. Interestingly, there was a high prevalence of themes related to the transfer of guilt and blame to others that were classified into the goal disengagement barrier across the barriers to collective pro-environmental behaviours. This is consistent with the literature suggesting that the public draw upon denial mechanisms to cope or avoid reflection on individual discrepancies between environmental concerns and personal actions (Gifford, 2011; Lorenzoni et al., 2007).

In contrast, for individual pro-environmental behaviours, the main barriers to not disengaging from non-environmental behaviours were personal difficulties in changing behaviour

due to convenience or habits. This suggests that, when acting individually, people may reflect more on their behaviours than when acting as part of a group. This phenomenon can be attributed to the possibility that, when acting collectively, people consider a shared responsibility and therefore reflect more on others' behaviours than their own, whereas when acting individually people pay more attention to personal behaviours.

The proposed application of the conceptual framework of barriers contributes to the literature on barriers to the classification of barriers based on their impact within the different stages of engagement with action. However, I recognise that the conceptual framework was not able to classify all reported barriers due to frequently incomplete information provided by respondents. Moreover, this study provided information about distinguishing between barriers to individual and collective pro-environmental behaviours. This suggests that different behavioural strategies may be needed when promoting behavioural change for individual and collective pro-environmental behaviours. This can pave the road for an optimal development of strategies aimed to overcome the barriers to individual and collective behaviours. Moreover, this study applied this conceptual framework for the classification of perceived barriers to individual and collective behaviours. Whereas this framework was used to develop behavioural strategies to tackle barriers to goal-directed behaviours, it has not been used for addressing collective pro-environmental behaviours. This is a novel approach to address collective pro-environmental behaviours, which could help develop of strategies to overcome the barriers that prevent individuals' engagement with these.

Limitations of the study include a relatively small sample size; a greater sample of participants would give us more confidence in the findings of this study. Furthermore, it is important to notice that the sample was limited to students. Students' perceptions of barriers to pro-environmental behaviours can differ from other groups. In addition, I highlight that the researcher prompted the perceived barriers mentioned in this data. Further studies should consider using

naturalistic data to help examine of spontaneously expressed barriers to pro-environmental behaviours. Improvements could have also been made to the study. For instance, a change in the design, to ensure all participants reflect on both individual and collective behaviour, by asking specifically about different barriers on both levels (individual and collective), and not depending on open-ended questions. This would have enabled predictions and helped to explore individual comparisons between the perceived barriers to individual and collective pro-environmental behaviours. Policies promoting environmental behaviours should consider the assessment of barriers to pro-environmental behaviour in order to have a greater impact on sustainable behaviour change.

2.5 Conclusion.

This study contributes to the literature on barriers to pro-environmental behaviours that indicates different levels of behaviour (individual and collective) are affected by different barriers. Furthermore, this research provides information about the public's perceptions of both barriers to individual behaviour (e.g., need of reminders, problems in changing habits) and collective pro-environmental behaviours (e.g., blaming others' inability to change habits, differences of opinions within a group). In addition, the perceived barriers were classified based on the conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006). Findings in this thesis suggest that the conceptual framework could be helpful to classify barriers to collective pro-environmental behaviours based on the stages of engagement where the behaviour is affected by the intention-behaviour gap but that classification of individual behaviours was difficult without further information. This research considers the implementation of a theoretical framework relevant to understanding where, within the stages of engagement with pro-environmental behaviours, barriers cause an intention-behaviour gap. By understanding this, we could optimize the development of

behavioural strategies (e.g., implementation intentions) to promote and maintain sustainable behaviours effectively.

Chapter 3- Visual implementation intentions to promote pro-environmental behaviours

Abstract

Implementation intentions (Imps) aim to activate the mental representation of environmental cues to automate the response to these cues. Chapter 1 shows a review of the applications of the generic form of Imps to promote behaviour change (If I encounter X, then I will do Y). The present study aimed to test a potential enhancement of Imps with the use of visual imagery, helping make Imps more salient and potentially easier to recall and helping promote pro-environmental behaviours more effectively. Results indicated no impact of visual Imps on the pro-environmental behaviours assessed here. However, the use of visual imagery of implementation intentions did not affect the pro-environmental behaviours' performance. Findings here imply that Imps may not impact certain behaviours.

3 Study 2- Visual Imps and pro-environmental behaviours

3.1 Introduction

3.1.1 Visual imagery and behaviour

Visual imagery is considered effective for communicating messages in fields of human activity ranging from commercial advertising to the media and political campaigns, facilitating the

quick transmission of complex issues (Pahl, Goodhew, Boomsma, & Sheppard, 2016). There are various cognitive advantages of visual information over written and verbal information; for example, the design of a building or an infographic representing the percentage of hunger in remote countries conveys the situation's complexity more clearly than just text (Sheppard, 2005).

Visual imagery can also be a powerful tool to reach people's emotional side and attract people's attention to the message we are trying to convey. Research has shown that emotions can generate more rapidly than higher-level conscious processes such as language. As a result, individuals tend to respond more quickly to information in visual rather than textual or verbal form (Holmes & Mathews, 2010).

Many studies have shown the strong relationship between imagery, especially visual imagery, and autobiographical memory. It is recognised that in cases of brain damage to the areas known to support visual imagery, it is common to find signs of retrograde amnesia as a secondary consequence. This is because memories that may be strongly related to images can no longer be consciously experienced (Conway, Meares, & Standart, 2004). These findings suggest that messages transmitted with images can aid better recall from memory than text or verbal.

Moreover, research in cognitive psychology indicates that mental images play a motivational role in goal striving (Kavanagh, Andrade, & May, 2005). This indicates that sensory images can be especially relevant in the elaboration of desire because they stimulate the sensory and emotional qualities of the object. The elements of an image include sensory information (e.g., the smell of bread coming out of the oven), generic characteristics (e.g., the colour of the bread), and specific episodes (e.g., how good bread tasted at a specific moment in the past), retrieved from long term memory which is controlled by executive processes of working memory (Rosen & Engle, 1997). Visuospatial and auditory subsystems of working memory serve as storage for the retrieved

information; the modality-specific of these mechanisms contribute to the individual's perception and performance (Kavanagh et al., 2005). Manipulation of this information through rehearsal processes and amodal central executive processes (stimulation of the visuospatial and episodic subsystems) can contribute to the experience of vivid, quasi-lifelike images (Kavanagh et al., 2005).

Since images promote a strong link between emotions and visual images, research on energy-saving shows how the use of thermal images can help attract householders' attention to complex issues concerning their energy use that otherwise may be difficult to communicate (Pahl et al., 2016). Pahl et al. (2016) investigated how to reduce energy demand by changing people's understanding of energy use through energy visualization. Researchers explained that householders seemingly paid more attention to the information shown in the images because of the emotions they evoked. This led to further elaboration and reasoning about the processes of heat and energy in the buildings and how householders' behaviour may impact these processes (Pahl et al., 2016).

The use of vivid imagery to communicate complex information has been used within different sectors, such as health and social psychology, suggesting a potential triggering of emotions motivating individuals to perform certain behaviours (e.g., smoking cessation, eating healthy, saving energy). For instance, in health psychology, there is growing evidence of the use of graphic pictorial images on tobacco warning labels to enhance the effectiveness of the warning and help to discourage smoking (Hammond et al., 2007). In 2006, Thailand implemented new warning labels, including graphic pictures across 50% of the front of the package. After the implementation, the levels of Thai smokers that reported reflecting on the health risks of smoking increased (Fong et al., 2006; Hammond et al., 2007).

The interactions between affective, cognitive, and behavioural responses can help explain how visual imagery may trigger behavioural responses. Slovic et al (2002) showed that more vivid

narratives associated with feelings rather than cognition tend to have a greater influence on risk behaviours. In other words, introducing compelling visual evidence which is easy to translate into personal risks or implications can have a larger effect on motivations to change behaviour than cognitive information.

3.1.2 Implementation intentions

The Imps are if-then action plans that connect a situational cue with specific cognitive and behavioural responses effectively accomplish a specific goal. In other words, Imps help automate goal-fulfilling responses by specifying when, where, and which actions should be taken to achieve the intended goal Imps delegate the control of behaviour from the self to specified situational cues that directly elicit an action (Gollwitzer, 1999).

Previous research on Imps has assessed the use of mental imagery to enhance the impact of Imps on goal attainment by activating mental representations relevant to the situation and behaviour (Hattar, Hagger, & Pal, 2015; Knäuper, Roseman, Johnson, & Krantz, 2009). Knäuper et al. (2009) gave if-then action plans to individuals to perform a task at a given time. These action plans were paired with instructions to vividly imagine when and where they will perform the task (day, time, and context: critical cue) and to imagine what they will do after the critical cue has arisen (cue-response link). Their findings indicated that using mental imagery when forming Imps plans can increase goal achievement (Knäuper et al., 2009). Mental imagery has also been used to enhance the effectiveness of Imps to promote adherence to diet and physical activity deadlines to help individuals to achieve weight loss (Hattar et al., 2015); and to promote greater intake of fruit(Knäuper et al., 2011). However, visual images have not previously been used to enhance Imps suggesting a gap between Imps and visual imagery literature. Including visual imagery within Imps, may help in the initial creation of mental representations of desired actions and responses.

Moreover, I also carefully considered which behaviours to promote with these strategies. Research suggests the main environmental actions people engage in are recycling, and saving energy (Systems, 2018). However, other environmental behaviours must be explored and encouraged to be part of people's daily lives. I chose to explore the use of Imps to encourage behaviours that people engage with but to a lesser extent: avoiding single-use plastic bottles; and purchasing environmental products (Systems, 2018). These behaviours have not been promoted with the use of Imps before. Furthermore, research indicates that promoting pro-environmental behaviours may encourage spillover effects and promote other environmental behaviours (Van Der Werff & Steg, 2018). As such, I considered it relevant to assess the influence of promoting these specific environmental behaviours with Imps, on the propensity to undertake other environmental behaviours.

3.1.3 Current study

This study aimed to assess the effect of Imps on specific environmental behaviours: avoiding single-use plastic and purchasing environmental products. In addition, this study explores how this effect could be enhanced by pairing text representations of Imps with visual images of the if-then plans. Since I was promoting behaviours that individuals were already engaging in or intended to engage with, I focused on these particular intention-oriented behaviours. Research on pro-environmental behaviours indicated that reduction of single use plastic bottles and purchasing pro-environmental products are among the behaviours people have intentions to engage but report low levels of engagement (Systems,2018). In addition, the study assessed potential behavioural spillover effects on other environmental behaviours and any differences between people presented with if-then action plans and no action plans.

I hypothesised that Imps paired with visual imagery representations of the if-then plans would help to promote avoiding the use of single-use plastic and purchasing environmental

products to a greater extent than the text-only representations of the Imps. It is expected to find greater engagement with the goal-directed behaviours from individuals presented with the Imps compared to the control group (no action plans), as the Imps literature has previously suggested. Furthermore, people presented with Imps and its visual representations could depict a greater level of engagement with the behaviours in comparison with the text-only representations of Imps. As for habits, I assessed if participants considered the behaviours could be part of their habits, I considered the Imps groups would report that the behaviours could fit as part of their habits compared to the control group since they are asked to reflect when where, and how to undertake the goal-directed behaviours.

3.2 Method

3.2.1 Participants

A total of 80 participants were recruited via the Prolific website. An a priori power analysis was conducted on the 2 (group: Imps and control group) x 2 (condition: visual + text representation vs text representations) design. Previous studies on Imps regularly consider a medium effect size (Gollwitzer & Sheeran, 2006). However, this study considered a lower-medium effect size ($\eta 2=0.04$). The power analysis indicated a sample of 72 participants was sufficient to achieve a power of 0.80 (Faul, Erdfelder, Lang, & Buchner, 2007). The sample was increased by about 10% considering the potential for participants dropping out (Kothe & Ling, 2019), having a total of 80 participants for this study. Out of the 80 participants recruited in part 1 of the study, five participants did not complete the questionnaire in part 2. The analysis was carried out with the data of the 75 participants that answered both parts of the questionnaire. Participants' distribution across the different groups and conditions was the following: control group N= 39 (text condition N= 22, visual + text condition N=17) Imps group N= 36 (text condition N= 18, visual + text condition

N=18). Participants' mean age was 31 (SD=9) years old, with 36 individuals reporting as female and 39 as male. 30% of the participants were from the UK, 21% from the US and Canada, 46% from a European country (Austria, Belgium, Poland, Italy, Greece, and Spain, among others), 3% from other countries (Australia and Chile).

3.2.2 Measures

Participants were asked about their perceptions and behaviours around pro-environmental behaviours, as well as levels of engagement with the pro-environmental behaviours assessed in this study (avoiding single-use plastic and purchasing environmental products), and engagement with other pro-environmental behaviours. These measurements used a seven Likert scale from *Rarely* to *Very often*. The goal of avoiding plastic bottles was assessed by asking participants how frequently they bought single-use plastic bottles, higher scores on this variable would indicate a high consumption of single-use plastic. This score was not reversed for the analysis (see Appendix 8.2.1 for the complete questionnaire). As for the goal of purchasing environmental products, participants were asked how often they looked for the environmental version of products and purchased environmental home products (e.g., detergent, cleaner). The Cronbach's alpha for the items assessing the purchasing of environmental products indicated the scale reached acceptable reliability of α=0.86.

To assess behavioural spillover, a series of questions were adapted from the environmental action scale (Alisat & Riemer, 2015) with items asking whether participants choose to eat vegetarian food and use public transport instead of driving, among others. It included reversed items assessing non-environmental behaviours. I considered relevant the assessment of non-environmental behaviours to assess whether the behavioural spillover effect impacted the reduction of behaviours that contribute to harming the environment. The behaviours assessed here were related to using single-use plastic containers, food waste, and energy consumption.

In addition, I was interested in assessing if individuals considered the behaviours could be part of their habitual life; I did this with the use of a habits scale, adapted from scales used for assessing habitual behaviours (Orbell & Verplanken, 2010), focused on assessing whether the goals fitted in their daily life. This was a seven-point Likert scale of agreement (*Strongly disagree/ Strongly agree*). A reliability analysis was conducted on the habits scale comprising five items per goal. The Cronbach's alpha showed the scale reached an acceptable reliability $\alpha = 0.863$.

Explicit attitudes were also assessed in part 2 of the study using a seven-point semantic differential scale with three main components: affective, evaluative, and cognitive. The differential scales aimed to assess the participant's impressions of the environmental behaviours (Crites Jr, Fabrigar, & Petty, 1994; Spence & Townsend, 2006). The measurements of habits and explicit attitudes were presented to participants only in the second part of the study.

3.2.3 Materials

The questionnaire was powered by Qualtrics (Qualtrics, 2013), it assessed participants' self-reports about carrying the targeted behaviours (purchase of bottled water, purchase of environmental products) and engagement with other environmental and non-environmental behaviours (e.g., food waste, energy-saving).

The framing of the goal-directed behaviours was different across groups. In the intervention groups, participants were shown if-then action plans to help them attain the given goals (e.g., "If I am going out, then I will take my water bottle with me for when I'm thirsty", "If I'm going to the supermarket, then I will try to purchase the environmental version of the product I need to buy"). Within the intervention groups, participants were allocated to two different conditions (text and visual + text implementation intentions) (Figure 1).

Figure 1

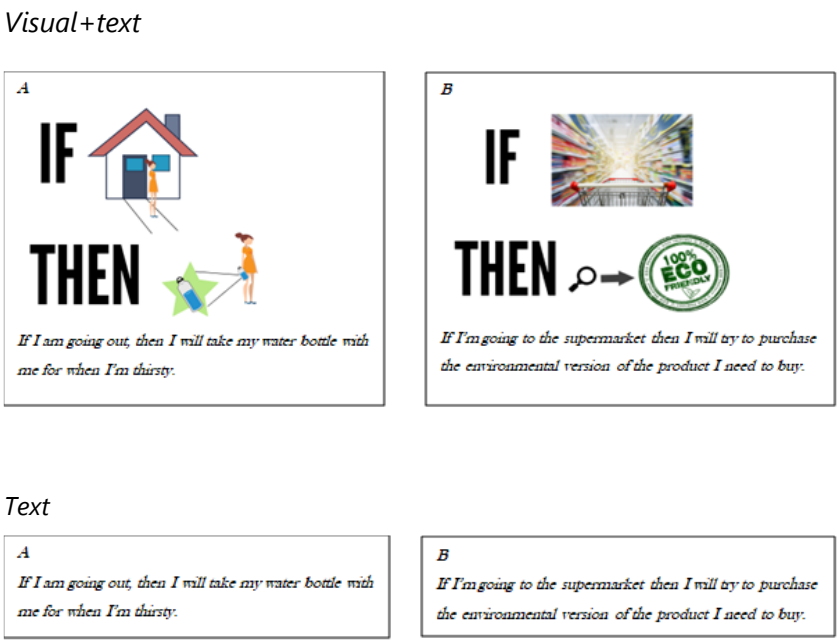

Figure 1 Representation of the Implementation intentions plans used to promote pro-environmental behaviours for the intervention group. The A panels are if-then plans to promote the avoidance of bottled water. The B panels show if-then plans for purchasing environmental products. The intervention group was split into two conditions (visual + text, and text only), conditions are shown at the top and bottom of the figure; the condition at the top includes the text representations of if-then action plans along with their visual representation. The condition at the bottom shows the if-then plans in a text-only form.

Within the control group, participants had information about the goals along with behaviours that could help them to attain the given goals. Similar to the intervention group, the control group was split into two conditions (text and visual + text). Participants in the text condition had text descriptions about the goal-directed behaviours to perform (e.g., A. "Use a water bottle", B. "Purchase the environmental version of the product"), whereas the visual + text condition had images and text representing the behaviours to perform (Figure 2).

Figure 2

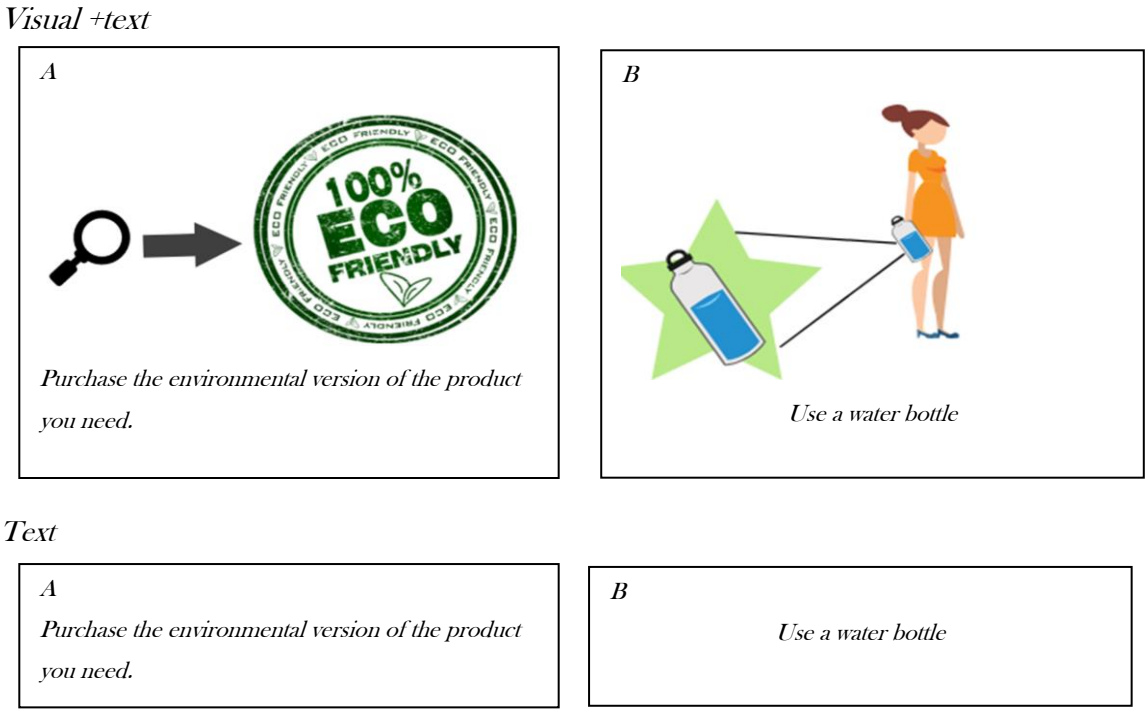

Figure 2 Representation of the goal-directed behaviours used to promote pro-environmental behaviours for the control group. The A panels are if-then plans to promote the avoidance of bottled water. The B panels show the goal-directed behaviour to purchasing environmental products. The control group was split into two conditions (visual + text, and text only), conditions are shown at the top and bottom of the figure; the condition at the top includes the text description of the goal-directed behaviours along with their visual representation. The condition at the bottom shows the goal-directed behaviours in a text-only form.

At the end of the first part of the study, all participants answered goal intention assessment questions such as: "I intend to carry the environmental behaviours over the next two weeks", "It is likely that I will avoid single-use bottles in the next two weeks", "It is likely that I will engage in buying environmental products in the next two weeks", and "I know in which situation I will perform these goals". The previous items were an adaptation of scales previously used to assess goal intentions (Gollwitzer & Sheeran, 2006; Sheeran & Orbell, 2000).

In the second part of the study, participants were asked about their behaviours and perceptions of the environmental behaviours assessed in part 1. The second part of the study also asked about the level of engagement with environmental and non-environmental behaviours that

were not promoted in the study to evaluate any potential behavioural spillover effect (Appendix 8.2.1).

3.2.4 Procedure

The study was advertised through the Prolific website as a two-part study that would ask participants to engage with pro-environmental behaviours. Upon participants' registration online, they were provided with a link that led to the questionnaire. All participants were randomly allocated to a 2 (control vs intervention) x 2 (visual + text vs text) factor design. After consenting to take part in the study participants were asked about their behaviours and perceptions regarding the behaviours of purchasing bottled water and purchasing environmental products. At the end of the questionnaire, participants were asked to commit to two goals. To avoid buying single-use plastic bottles, and to purchase environmental products All groups were provided with a knowledge and goals information to make sure that all participants understood environmental issues. (Appendix 8.2.2)

After the presentation of the knowledge and goals information, participants were provided with two environmental goals, "To avoid single-use bottles" and "To buy environmental products"; participants were asked to commit to these goals for the following two-week period. In addition, participants were given goal-directed behaviours to help them act in accordance with their intentions.

After the stimulus presentation, the intervention group rehearsed the if-then plans that were presented to them by answering a question that asked them to match the section of the Imps stating the context cues with the section stating the response once the cue appears. For example, locate the part of the sentence "If I'm going to the supermarket" and match it with "then I will try to purchase

the environmental version of the product I need to buy". The participants in the intervention group did this for each goal.

Two weeks after the first half of the study, participants were contacted through Prolific and invited to take part in the second half of the experiment. This consisted of a second questionnaire assessing participants' environmental behaviours, in the same way as part 1.

3.3 Results

Participants were asked whether the goals were memorable or not. Levels closer to 1 on this scale indicated the goals were not memorable at all, whereas levels close to 7 indicated the goals were highly memorable. Results indicated no differences in how memorable the goals were for the participants in the different groups and conditions. The overall mean of the reported memorable indicated that the goals were slightly memorable (M=3.9, SD= 1.64), this could have affected the levels of engagement with the environmental behaviours assessed in this study.

3.3.1 Goal- Avoid plastic bottles

A repeated measures ANCOVA was performed with the variable of avoiding plastic bottles with the within factor of time with two levels (time 1 and time 2) and two between factors: group with two levels (Control vs intervention group), and condition with two levels (visual + text vs text). The covariates of age and gender were considered in this analysis. Results indicated overall a significant difference in the reported levels of purchase of plastic bottles between time 1 and time 2 $F(1,71) = 19.41$ $p < 0.001$. In other words, people reduced their consumption of water bottles at time 2 in comparison to time 1 (see Table 4). In addition, results suggested the differences between times on the levels of purchased plastic bottles for the control group were greater for the visual + text in comparison to text condition (Figure 3). However, the analysis indicated no effect of the presentation of Imps, and conditions on the reported levels of purchased single-use plastic across

time F (1,71) =2.98 p=0.08. The covariates of age and gender did not affect the reported changes of the goal to reduce the purchase of plastic bottles across times, age F (1,71) =0.37 p=0.54, gender F (1,71) = 0.20 p=0.65.

Figure 3

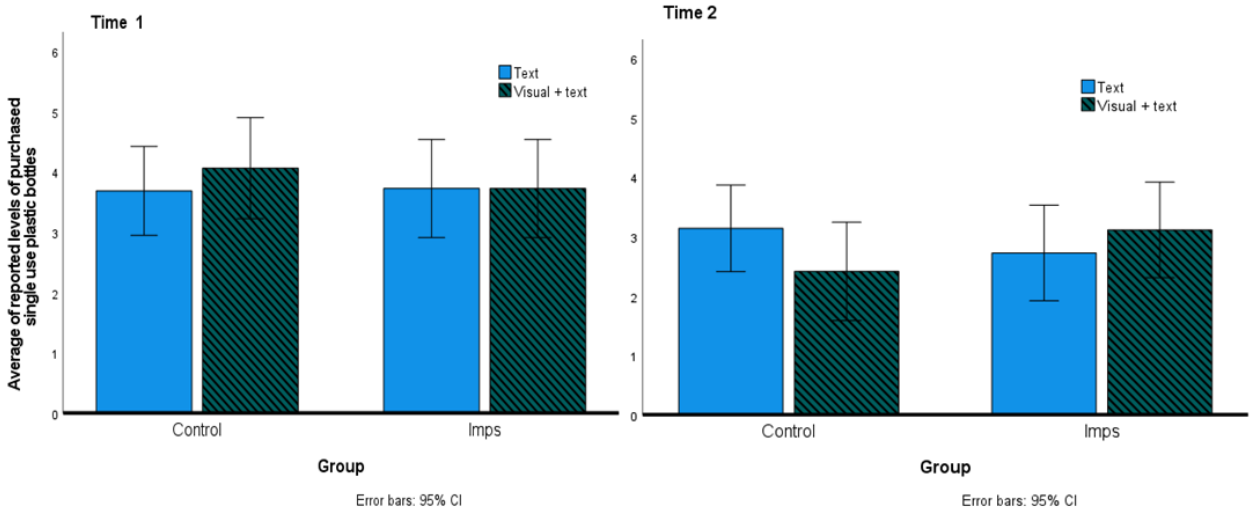

Figure 3. The means of the reported behaviour- "Bought bottled water" at times 1 and 2 in each condition. Time 1 is presented on the left panel and Time 2 on the right panel. The clear blue bars represent the reported behaviour for the individuals in the text-only condition. The green-stripped bars represent the reported behaviour for the individuals who were in the text only condition.

3.3.2 Goal - Purchasing environmental products

For the goal "To purchase environmental products" a repeated measures ANOVA was performed with the within factor of time with two levels (time 1 and time 2) and two between factors: group with two levels (Control, intervention group), and condition with two levels (visual + text, text). The covariates of age and gender were considered in this analysis. Results indicated a reduction of the levels of purchased environmental products at time 2 in comparison with time 1 F (1,71) =5.82 p<0.5 (see Table 4). A marginal effect of the factor condition on the reported levels of purchased environmental products across times was found F (1,71) =3.8 p=0.055. The post-hoc analysis for this interaction indicated that individuals with text-only descriptions reduced their

purchase of environmental products and individuals with visual + text descriptions maintain the same reported levels of purchased environmental products (Table 4).

Moreover, results indicated no effect of the interaction of Imps and condition on the reported behaviour of purchasing environmental products across time F (1,71) =0.008 p=0.93 (Figure 4). The covariates of age and gender did not have a significant effect on the reported purchase of environmental products, age F (1, 71) = 0.051 p=0.8, gender F (1,71) =0.16 p=0.68.

Figure 4

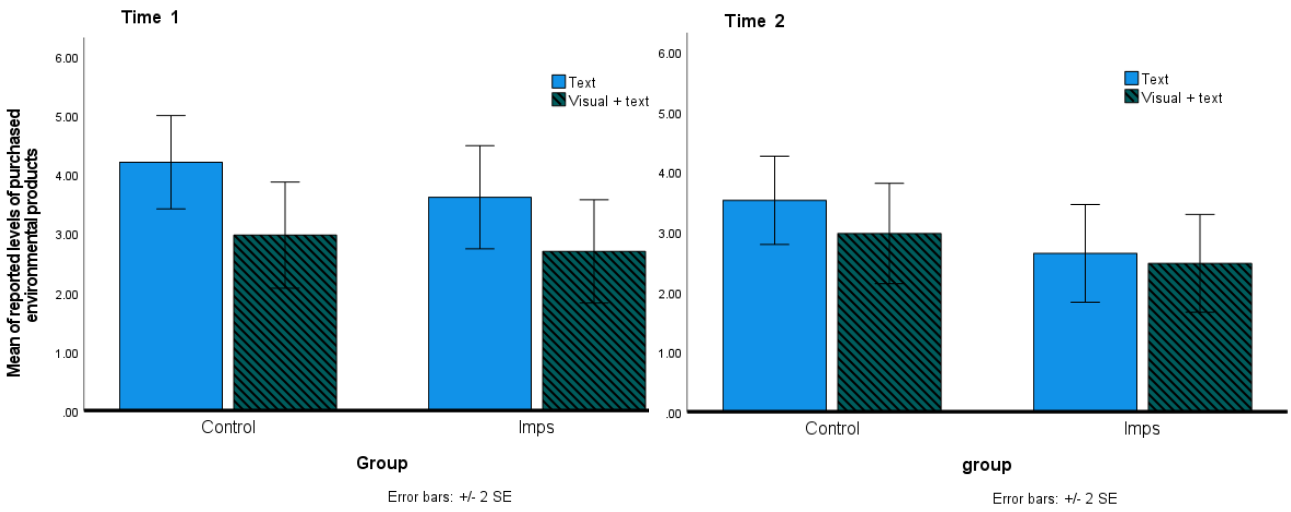

Figure 4. The means of the reported behaviour- "Look for environmental products" at times 1 and 2 in each condition. Time 1 is presented on the left panel and Time 2 on the right panel. The clear blue bars represent the reported behaviour for the individuals in the text condition. The green-striped bars represent the reported behaviour for the individuals who were in the text-only condition.

Figure 4 shows differences between groups and conditions at baseline level this is probably due to individual differences. This means that, for example, within the control group there was people reporting a higher level of engagement with the goal of purchasing environmental products than in other groups. However, these differences were not significant F (1,71) =0.008 p=0.93.

Table 4. Mean and standard deviations for behaviours of purchase single-use plastic bottles and purchase of environmental products for the different times (time 1 and time 2), and different groups (Control and Imps), and for the different conditions (Visual and text, and just Text).

Measure	*Time*	*Group*	*Condition*	*Mean*	*SD*
Purchase single-use plastic bottles	Time 1	Control	Text	3.68	1.89
			Visual + text	4.16	1.77
		Imps	Text	3.90	1.83
			Visual + text	3.68	1.45
	Time 2	Control	Text	3.14	1.86
			Visual + text	2.16	1.64
		Imps	Text	2.45	1.64
			Visual + text	2.95	1.96
Purchase of environmental products	Time 1	Control	Text	3.20	0.64
			Visual + text	3.13	0.69
		Imps	Text	3.11	0.58
			Visual + text	3.13	0.74
	Time 2	Control	Text	3.09	0.53
			Visual + text	2.67	1.01
		Imps	Text	2.63	0.91
			Visual + text	2.77	0.93

3.3.3 Behavioural spillover

For the assessment of the behavioural spillover effect, we were interested on assessing the impact of the Imps strategies on other pro-environmental behaviours that were not promoted by these behavioural strategies. An ANOVA of repeated measures was performed for the variable of spillover on environmental behaviours and the variable of spillover on non-environmental behaviours respectively, the ANOVA analysis included the within factor of time with two levels (time 1 and time 2) and two between factors: group with two levels (Control, intervention group), and condition with two levels (visual + text, text). The covariates of age and gender were considered in this analysis. Results on engagement with environmental behaviours indicated no differences in the levels of engagement between times $F(1,71) = 2.26$ $p = 0.137$; no effects of the interaction of group and condition on the reported levels of engagement with environmental behaviours across time $F(1,71) = 0.93$ $p = 0.33$. As for the engagement with non-environmental

behaviour, results showed an effect of time on the levels of engagement with non-environmental behaviours $F(1,71) = 4.23$ $p<0.05$. In other words, overall participants engaged less with non-environmental behaviours after committing to engage with the environmental behaviours assessed in this study (avoid single-use plastic bottles and purchasing environmental products). Additionally, findings indicated no effect of the interaction of group and condition on the levels of engagement with non-environmental behaviours across times $F(1,71) = 0.88$ $p=0.35$, this means that the presentation of imps, on its different forms (i.e., text, visual + text) had no impact on the engagement with non-environmental behaviours.

3.3.4 Habits and pro-environmental goals

A one-way ANOVA was performed on the habits scale for each goal respectively with the fixed factors: group with two levels (control and Imps) and the factor of condition with two levels (text and visual + text), and the covariates of age and gender. Results of the habits scale for the goal of avoiding plastic bottles indicated no effect of the presentation of Imps and the visual imagery descriptions on the perceived habit strength of the goal-directed behaviours $F(1,71) = 0.22$ $p=0.88$. Overall individuals reported the goal of avoid plastic bottles could somewhat fit into their daily life routine ($M=4.42$, $SD= 1.7$). Furthermore, the covariates of age and gender did not have an impact on the perception of the habit strength of the goal-directed behaviours for avoiding plastic bottles; age $F(1,71) = 0.57$ $p=0.45$, gender $F(1,71) = 0.39$ $p=0.53$ (Figure 5).

Figure 5

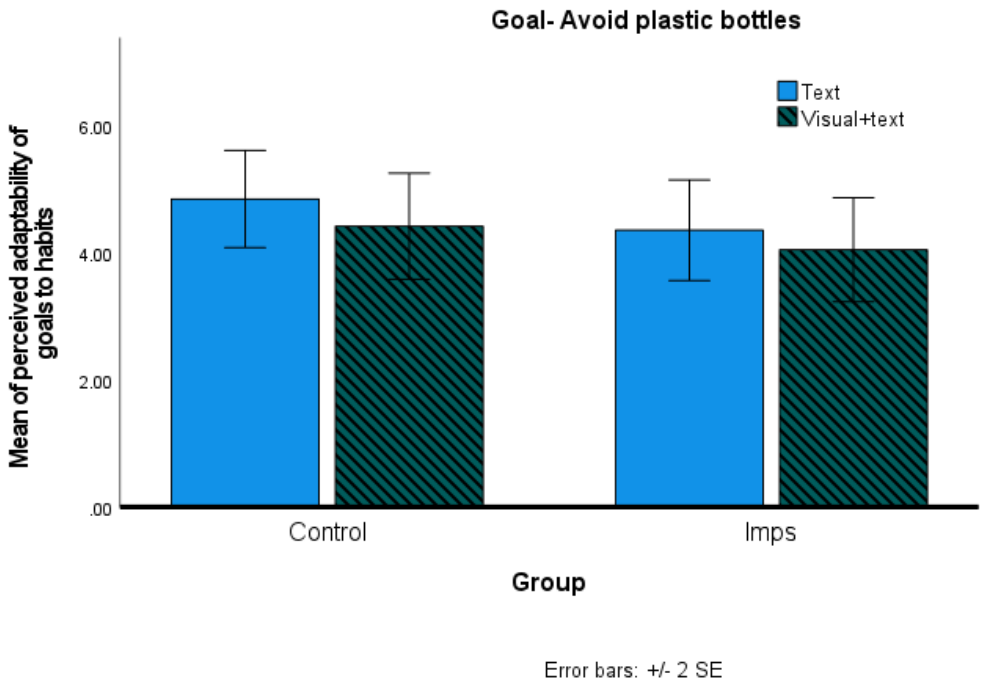

Figure 5. Mean of perceived adaptability of the goal -avoid plastic bottles- into individuals' habits. The blue-clear bars present the levels of perceived adaptability of the goal of individuals presented with text descriptions of the goal-directed behaviours for the control group, and the Imps plans for the Imps group. The green-striped bars represent the levels of perceived adaptability of goals to habits of the individuals presented with visual + text descriptions of the goal-directed behaviours for the control group, and the Imps plans for the Imps group

The analysis for the habits scale for the goal of purchasing environmental products indicated an effect of group $F(1,71) = 4.6$ $p<0.05$, in other words, participants in the Imps group reported more difficulties fitting the behaviour of purchasing environmental products to their habitual life. Results also indicated a difference on the levels of habit strength of the goal-directed behaviours for the visual + text condition in comparison with the just text condition. However, the analysis of the factor of condition (visual + text vs text only) indicated no statistical differences $F(1,71) = 1.08$ $p=0.3$. In other words, the representation of the information, either by text or text and visual imagery did not impact on individuals' perceived adaptability of the goal of purchasing environmental products to their habits. (Figure 6).

Figure 6

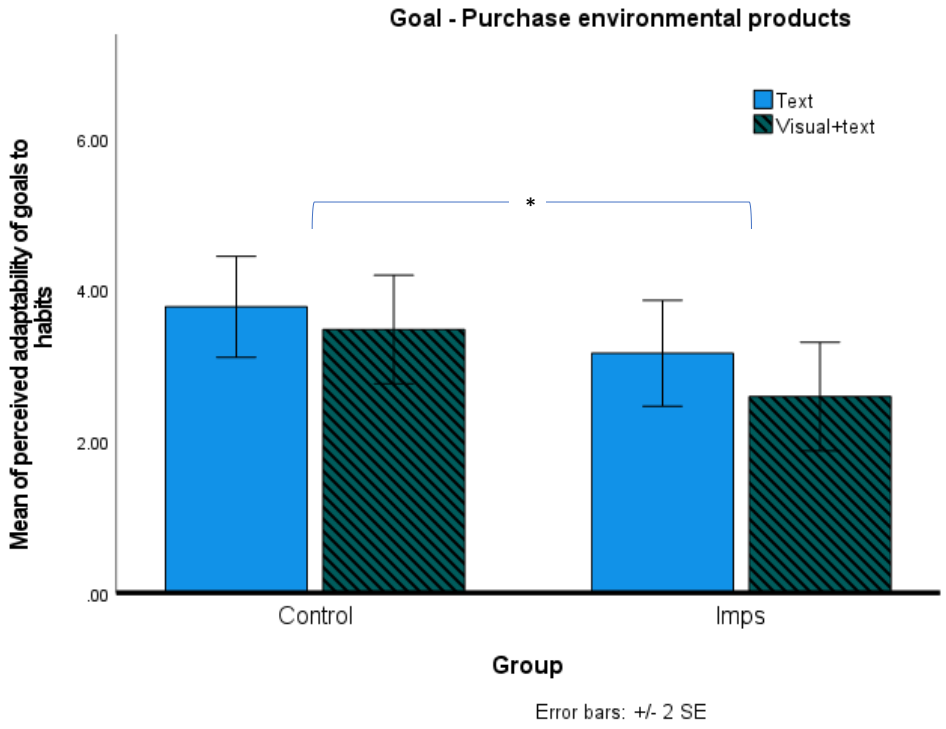

Figure 6. Mean of perceived adaptability of the goal -purchase environmental products- into individuals' habits. The blue-clear bars present the levels of perceived adaptability of the goal of individuals presented with text descriptions of the goal-directed behaviours for the control group, and the Imps plans for the Imps group. The green-striped bars represent the levels of perceived adaptability of goals to habits of the individuals presented with visual + text descriptions of the goal directed behaviours for the control group, and the Imps plans for the Imps group. The figure indicates significant differences in the perceived level of adaptability of the goal to individual's habits between the control and the Imps group.

3.4 Discussion

This study aimed to assess if Imps impact on environmental behaviours, specifically avoiding plastic bottles and purchasing environmental products; and if this impact could be enhanced by pairing Imps with visual imagery representing the cue-response links. This study hypothesised that participants who had Imps paired with visual representations of Imps would show a greater reduction in the use of plastic bottles and an increase in their purchase of environmental products. Overall, the study indicated no impact of the Imps on the engagement of the goals "to avoid single-use plastic bottles" and "purchasing environmental products". Visual imagery did not

significantly impact the levels of reported purchase of environmental products, when presented with visual images of the instructions.

This study indicates no impact of Imps on the environmental behaviours assessed here, this could be attributed to the lack of salience of the used environmental cues for the individuals' routines and behaviours. Thus, when the visual images were presented with the Imps these interfered with the salience of the image. On the other hand, the lack of impact of images on the behaviour of avoiding single-use bottles could be associated with the fact that images may have not communicated the desired message or they were not salient for the individuals. It is possible that the images used here, were not enough for individuals to visualise themselves carrying out the behaviours as part of their daily lives. This relates to research that theorizes that complex tasks that may have no clear outcomes, or outcomes that are difficult to imagine, will be difficult to promote with the use of Imps (DeWitte et al., 2003). Another explanation for the lack of impact of Imps on behaviours could be the reduced levels of rehearsal individuals had in this study, research suggests that studies with high amounts of goal rehearsals contribute to greater engagement with the behaviour change (Knäuper et al., 2011)

Even though findings here indicated no effects of Imps, this study did indicate an increase in the reported engagement with pro-environmental behaviours across all experimental groups. This could be attributed to the provision of environmental information, specifically, communicating the relevant goal-directed behaviours aimed to achieve pro-environmental goals. The implications of the results of using visual imagery in this study indicate that visual imagery strategies may not be useful to enhance the impact of Imps on behaviour change. The results indicating no effect of Imps on environmental behaviours suggest that maybe Imps are ineffective in promoting some environmental behaviours. This is consistent with the different levels of effects of Imps found in the literature (Armitage & Conner, 2001; Knäuper et al., 2011). Research suggests that Imps may not

be effective with certain behaviours, specifically when these behaviours can hinder individuals personal goals (e.g., setting goals that may interfere with habitual behaviours) (Gollwitzer & Brandstätter, 1997). Additionally, De Witte et al. (2003) suggest that complex goals that require actions that have not been fully considered and imagined by the individual may not benefit from the formation of Imps.

Although the assumption of a behavioural spillover effect when promoting environmental goals was not supported in the case of engagement with other environmental behaviours; findings did indicate engagement with non-environmental behaviours was reduced across times. The behaviours that reported a greater reduction were related to food waste and energy. This could have been attributed to the instructions on avoiding plastic bottles and purchasing environmental products, which may promote reflections on other lifestyle changes aligned to the environmentally friendly goals given to participants.

On the assessment of individuals' perception of environmental behaviours fitting into their habitual life, results indicated that people presented with the if-then plans for purchasing environmental products reported more difficulties in adding this behaviour to their daily lives. These findings suggest that Imps may promote a higher level of reflection of engagement with behaviours, requiring more cognitive effort and causing difficulties in engagement. These reported difficulties could be the cause of the lack of impact of the Imps on behaviour. The presentation of visual images seemed to have also impacted, to a lesser extent, the levels of reflection of engagement with environmental behaviour. The implications for this suggest that maybe the additional use of better and more salient images could have promoted a greater recall of the goals from the working memory, enhancing the vividness and emotional connection with the environmental goals (Holmes & Mathews, 2010; Kavanagh et al., 2005).

It is important to acknowledge the caveats of this research. Regarding of recruitment, it is important to acknowledge that the advertisement of the study in Prolific website could have affected the sample that agreed to take part in the study, resulting in a sample that may be intrinsically motivated to engage with pro-environmental behaviours. The cues used in this experiment may have not been salient or relevant enough for individuals and thus reduced the salience of the image and the effect of imps. Whilst the rehearsal exercises may be of great relevance for the effectiveness of Imps, this study may have not promoted enough the rehearsal of Imps for participants to remember them. The results of this study suggest that visual imagery can be a useful tool to convey messages. It is considered that the images in this study were not tailored enough to the situational cues faced by the individuals when engaging with pro-environmental behaviours. Another potential reason for Imps not to have an impact on outcomes examined could be that Imps were not addressing the specific barriers that prevent individuals to attain their environmental goals.

Further research should consider the relevance of understanding what barriers the public perceive when engaging with specific environmental behaviours and actions for climate change mitigation. Moreover, it is relevant to consider the formation of Imps has to include relevant situational cues for the engagement to pro-environmental behaviours; a good rehearsal strategy to remember Imps can increase the impact of the if-then plans by making them easier to recall. Additionally, future research could explore the use of tailored visual imagery to tackle the barriers to engagement with pro-environmental behaviours, contributing to goal striving. Furthermore, whilst this study may have used the visual imagery cues as process imagery tools (e.g., steps needed to reach the desired outcome), future research should consider using visual imagery to promote the processing of outcome imagery (e.g., benefits of successful completion of the goal) to help promote pro-environmental goal achievement.

In addition, this study indicates Imps may be ineffective in promoting some pro-environmental behaviours. Research on the application of Imps should assess if the effectiveness of Imps is bounded to the complexity of the behaviour, and the perception of collective and individual actions since climate change and environmental issues can be considered as collective and not an individual issue.

Chapter 4- Collective Implementation intentions and energy-saving behaviours

The following study examines how we can use implementation intentions to promote pro-environmental behaviours. In Study 3, I examine the use of collective Imps to promote energy-saving behaviours. This thesis proposed a format of collective imps different to the previous format in the literature; adding a collective section to the proposed phrasing of intentions (If we encounter X, then we'll do Y, AND we will remind others to do Y); the rationale behind this is to increase the impact of collective imps on behaviour engagement and promote collective behaviours. The findings suggest no impact of collective Imps on energy-saving behaviours. In addition, results indicated higher levels of collective spillover for individuals who were presented with collective Imps and control group, but not for those who had individual Imps. This study contributes to the findings in chapter three suggesting that Imps may not be effective for the promotion of certain behaviours. Moreover, this study implies that collective Imps also may not impact some behaviours.

4 Study 3- Collective Imps and energy-saving behaviours

4.1 Introduction

Climate change is a complex problem that requires a multi-scale response, from the individual to the collective. Climate change crises have normally been described as the result of collective behaviours, yet pro-environmental actions have usually been investigated as a personal decision-making process. There has been little research focused on collective action, cooperation,

and how social identity processes can affect pro-environmental behaviours (Dono, Webb, & Richardson, 2010; Fritsche, Barth, Jugert, Masson, & Reese, 2018).

4.1.1 Collective behaviours

Group performance has been described by the outcomes and the processes involved in groups' collective efforts to achieve a common goal (Levine & Moreland, 1990). Research indicates small groups have often seemed to outperform individuals in complex logistical tasks where all members have access to complete information about the features of the correct solution (Laughlin, Bonner, & Miner, 2002; Laughlin, Hatch, Silver, & Boh, 2006). Performance of groups is also greater than individuals in cases of recognition and adoption of correct responses and effective collective information processing (Wieber, Thürmer, & Gollwitzer, 2012). However, there are occasions when group performance is inferior to individual performance, for example, when the group does not share all available information with other members (Stasser & Titus, 2003). Another situation of group inefficiency is when the group members base their decisions on past behaviours or experiences or personal investments (e.g., time, effort, financial investment), instead of focusing on future prospects (DIETZ-UHLER, 1996). The present study examines the application of the psychology of action literature to help understand and promote group performance.

The psychology of action considers two different steps for goal attainment. The first step is to set a specific goal and commit to it, while the second step is to implement goal-directed actions and responses, also known as goal striving (Gollwitzer & Bargh, 1996; Gollwitzer & Moskowitz, 1996). The last step is where individuals fail to act in accordance with their commitments and intentions to achieve their goals. This can happen regardless of their knowledge about the relevant goal-directed actions to ensure goal attainment (Armitage & Conner, 2001; Gollwitzer & Sheeran, 2006). Researchers on group performance have implemented the use of individual goal concepts, principles of individual goal setting, and goal striving to explore how groups perform given a common goal. In

the case of goal-setting behaviour, research suggests that while the effect of individual goals may be mediated by task strategy and individual efforts, the effect of group goals can be mediated by team-related efforts only (Crown & Rosse, 1995; Locke & Latham, 2006).

4.1.2 Collective goal striving

In exploring goal striving within group performance, the research is limited (Jonas, Sassenberg, & Scheepers, 2010; Sassenberg & Woltin, 2008; Thürmer et al., 2017; Wieber et al., 2012). Sassenberg and Woltin (2008) applied self-regulation theories, self-discrepancy theory, and regulatory focus theory to understand and predict intergroup relations; for example, self-regulatory effects are more pronounced when the group members identify strongly with their group; researchers have suggested that self-regulation can be more effective for the group than for the individual.

Wieber et al. (2012) suggest the need to explore collective action control using goal intention and implementation intention (Imps) theories; the researchers indicate action control by goal intentions involves constant monitoring of the environment to detect good opportunities to act and select appropriate responses. However, even when goal striving is initiated, distractions can bring the process to a halt. The literature distinguishes between goal intentions and Imps due to the different types of processes of control actions; by using implementation intentions people can plan when, where, and how they will strive for a goal (i.e., "If I encounter a situation X, then I will perform response Y"). Imps delegate to critical situational cues the control over the initiation of goal-directed behaviours (Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2004).

Goal intention concepts ("I want to attain X") have been used to assess group intentions ("We want to attain X") in prior research where groups were asked to perform tasks and set collective goals in order to try and reduce discrepancies between actual and desired states (Weldon & Weingart, 1993). However, in some cases, the formation of collective goal intentions might not always be

enough to guarantee goal achievement, even when each group member knows the actions required for goal attainment. Similar to individuals, groups can perform poorly despite having strong goal intentions and sufficient knowledge to attain the goal. This is described as the intention-behaviour gap in the individual level of goal attainment, and can also be transferred to the collective level as the collective intention-behaviour gap (Wieber et al., 2012). By applying the intention-behaviour gap concept to group behaviour, we can assess how groups should plan, given specific conditions, in order to overcome group-specific problems, and how we can take advantage of group formation and social identity to promote individual behaviours that tend to be unattainable when performed individually. Therefore, it is highly recommended that research on collective action control should address the factors that hinder performance found when assessing individual self-regulation problems and factors that may relate to group-specific dynamics.

4.1.3 Collective Imps and pro-environmental behaviours

Imps can be used as a potential escalator of commitment from individuals to promote collective goal-striving (Thürmer et al., 2017). In the case of Imps within groups, research indicates the initiation of an action is expected to be automatic. In other words, the group members do not need to notice the occurrence of the critical cue and initiate the goal-directed actions. However, the situation's presence should be enough to trigger the goal-directed actions (Wieber et al., 2012). Similar to research on goal intentions adapted to the group level, collective action planning has adapted the structure of Imps (i.e., If I see X, then I will do Y) to a group level by adjusting individual pronouns to collective pronouns (i.e., If we see X, then we will do Y); and similar to Imps, collective Imps bring to mind a desired outcome or behaviour for the group (Wieber et al., 2012). However, in this thesis, it is considered that individuals could easily miss this subtle change of pronouns, especially when dealing with complex behaviours.

Imps, also known as if-then plans, have been used to help groups attain their goal of making informed decisions in hidden profile situations and help overcome the group's inability to incorporate individual knowledge in group decisions (Thürmer et al., 2015). Thürmer et al. (2017) explored the application of Imps to help support and regulate goal striving for collective and individual goals. By using a physical persistence task, individuals were asked to form a goal of holding a ball as long as possible. This was followed by an if-then plan, "If our muscles hurt, then we will ignore the pain and tell ourselves: we can do this!" for the collective Imps. Meanwhile, it was phrased in an individual form for the individual Imps. The researchers found that collective Imps helped improve group performance in the persistence task via cooperative verbal communication (Thürmer et al., 2017).

Furthermore, Thürmer et al. (2017) manipulated the level of communication within the group and found that group performance was affected when communication within the group was hindered. This is consistent with the literature on group performance that indicates that the levels of task-related communications can impact groups' productivity (Tschan, 1995). Whilst a few studies are starting to assess the effectiveness of collective Imps, to the author's knowledge, environmental behaviours, specifically energy-saving behaviours, have not been promoted with collective Imps before. Research has assessed the impact of Imps on pro-environmental behaviours before (Bamberg, 2000, 2002, 2013; Holland et al., 2006); however, none of these had assessed the use of collective Imps to promote pro-environmental behaviours. Moreover, the studies of Imps and pro-environmental behaviours have not explored yet the promotion of energy-saving behaviours with the use of Imps.

Energy consumption has always been considered one of the most relevant responses to climate change mitigation and fossil-fuel depletion (Cotton, Miller, Winter, Bailey, & Sterling, 2016; Systems, 2018). More importantly, research indicates that household energy consumption could be reduced by almost 30 percent without making great economic or "lifestyle" sacrifices (Gardner & Stern, 2008). Unpublished research suggests that collaborative pro-environmental behaviours, such

as energy-saving behaviours, can be associated with a variety of benefits, including a bigger impact on the environment compared to individual behaviours (collective efficacy)(Spence et al., 2019[manuscript in progress]). Moreover, the promotion of energy-saving behaviours in the household has made use of group interaction, with the use of gamification, successfully using games that appeal to individuals' social identity, and competition games to help reduce energy consumption in their household (De Luca & Castri, 2014; Wemyss et al., 2016). Another suggested approach is motivating individuals to save energy at the individual level while appealing to their social identity by completing cooperative community pro-environmental goals (De Luca & Castri, 2014).

Additionally, findings on pro-environmental behaviour indicate that when individuals engage with a particular environmental behaviour, this may impact the performance or change of other behaviours (e.g., adopting other pro-environmental behaviour). This is known in the literature as behavioural spillover (Thøgersen & Crompton, 2009). The behavioural spillover effect has been defined as the observable and causal effect that changes in one behaviour have on different and subsequent behaviours (Galizzi & Whitmarsh, 2019). There is growing literature on the study of behavioural spillover within pro-environmental behaviours (S Capstick, Whitmarsh, & Nash, 2019; Dolan & Galizzi, 2015; Nash et al., 2017; Thøgersen, 1999; Thøgersen & Crompton, 2009; L. E. Whitmarsh, Haggar, & Thomas, 2018). To the authors' knowledge, there is little research evaluating the impact of Imps on behavioural spillover effects (Shreedhar & Galizzi, 2021). However, exploration of potential collective behaviour spillover has not been assessed before as the result of Imps' presentation. Hence, this study considers relevant the assessment of whether Imps promoting energy-saving behaviours can indirectly affect other behaviours, and if the collective Imps can have a behavioural spillover on collective behaviours.

4.1.4 Current study

The present study has aimed to assess the impact of both individual and collective Imps on energy-saving behaviours. This study has also proposed a format of collective imps different to the previous format in the literature, adding a collective section to the proposed phrasing of intentions (e.g., If we encounter X, then we'll do Y, AND we will remind others to do Y). This is different to the form of individual Imps commonly used in the literature (e.g., If I encounter X, then I will do Y) The rationale behind this is to increase the impact of collective imps on behaviour engagement and also specifically to promote communication with others. This study is relevant within the Imps literature since there is no evidence of assessing the impact of neither individual nor collective Imps on energy-saving behaviours.

I hypothesise that collective Imps should have a greater effect on energy-saving behaviours than individual Imps, by enhancing communication with others about the goal. In addition, this study considered the effect of Imps would create a behavioural spillover effect on other pro-environmental behaviours, the reason for this is that, since Imps are considered to automate behaviour, it is possible that other not-targeted behaviours are impacted by this process as well. Furthermore, it is considered that individual Imps should lead to greater engagement with individual environmental behaviours, and collective Imps should lead to greater engagement with collective environmental behaviours eat both an individual and collective level.

4.2 Methods

4.2.1 Participants

A total of 89 undergraduates from the School of Psychology at the University of Nottingham participated in the study in exchange for course credits. The study was advertised as a two-part study through the recruitment system of the University. Upon registration, participants were randomly

assigned to one of three experimental groups (collective Imps, individual Imps and control group). Three participants did not fill out the questionnaire at time 2, and, therefore, the final sample consisted of 86 participants' data (Collective Imps N=29, Individual Imps N=24, and control group N=36). A post-hoc power analysis was conducted using G*Power3 (Faul et al., 2007) to assess if the sample was sufficient to detect the effect of the intervention on behaviour, given a medium effect size ($\eta 2$=.041). For the achieved sample size of N=86, results indicated a power of 0.93. This indicates that the sample size was sufficient to detect an effect. Participants' mean age was 20 (SD=1.4) years old. 74% (66) of the participants were females and 26% (23) were males.

4.2.2 Materials

All participants were given a link which led them to the online survey, powered by Qualtrics (Qualtrics, 2013). The Qualtrics platform was used for both the pre and post-intervention sessions of the study (i.e., before and after participants were given the goal-directed behaviours in the different formats). The first part of the study consisted of participants filling out a questionnaire containing a section of general information (University ID, email address, gender, etc.); email addresses and University ID details were provided by the participants in order to match participants' responses at time 1 with their responses at time 2. After doing this, their contact information was deleted and not considered in the analysis.

The questionnaire consisted of items for assessing injunctive and descriptive norms adapted from previous social norms research (White, Smith, Terry, Greenslade, & McKimmie, 2009). These variables were assessed with a seven-points Likert scale of agreement *(Strongly disagree/strongly agree*). Injunctive norms asked what participants considered their significant others think they ought to do regarding energy-saving behaviours (e.g., "Most people important to me think I should make an effort to save more energy") This three-items scale indicated a reliability score of α=0.63. Whilst this is not considered as satisfactory, it is considered acceptable for exploratory research (Gliem &

Gliem, 2003). For descriptive norms, participants were asked what they think other people do energy-saving behaviours (e.g., "I often see people who are important to me making efforts to save energy"). This three items scale showed satisfactory reliability scores for both the injunctive and descriptive norms questions α=0.85 (see Appendix 8.3.1). The questionnaire also assessed energy consumption behaviours that were undertaken within the last two weeks (e.g., "Leave the lights on when leaving any room?"). This was assessed with a seven-point scale of frequency *Rarely/ Often*. The reliability analysis for this five items scale indicated a Cronbach's alpha of α= 0.53. After removing one item (i.e., *Completely switching off electronic devices (TV, computer)*), the reliability analysis indicated a Cronbach's alpha of α= 0.7. Questions assessing environmental behaviour beyond energy-saving were adapted from seven-point Likert scales (Rarely/Often) assessing pro-environmental behaviours (Alisat & Riemer, 2015) to assess behavioural spillover. These questions were separated into two scales. The first scale was a two items scale asking about recycling and use of plastic bags; this two items scale indicated a satisfactory level of reliability for this scale α=0.7 The second scale assessed behaviours of purchasing eco-friendly products. This two items scale indicated a satisfactory level of reliability α=0.79. The study also asked about the level of engagement with collective environmental behaviours to assess potential collective behaviour spillover (e.g., "Talked with others about environmental issues"). The scale was a seven-point Likert scale *(Rarely/Often)* adapted from the cooperative energy behaviour intentions scale from unpublished work (Spence, Leygue et al (unpublished)) showed to be reliable with a Cronbach alpha of α= .706 (Appendix 8.3.1).

In the second part of the study, – two weeks after participants took part in the first part- participants were asked again about their energy behaviours, social norms, and any potential barriers that could have interfered with their performance on energy-saving behaviours. This part assessed two types of barriers (goal initiation and goal shielding) with a seven-point Likert scale of agreement (Strongly disagree/Strongly agree), adapted from the conceptual framework of barriers mentioned in

chapter two (Gollwitzer & Sheeran, 2006) for energy-saving behaviours. The goal initiation barriers scale assessed potential barriers faced when starting the behaviours (e.g., I found it difficult noticing opportunities in order to save energy, I was unsure how to actively save energy), this scale had a substantial level of reliability α= 0.71. The goal shielding barriers scale assessed potential barriers that kept individuals derailed from their environmental goals (e.g., "I easily gave up on energy-saving goals", "I was willing to save energy, even if it required a change in my routine"), this sale had a substantial level of reliability α= 0.79. Goal disengagement and overextending oneself were not assessed in this study due to the nature of the behaviours.

4.2.3 Procedure

Participants were randomly allocated to three different groups, Collective Imps (N=29), Individual Imps (N=24) and the Control group (N=36). The Collective Imps group was required to work in groups. Participants allocated to this group were asked to sign up to timeslots where they were paired with 3 or 4 more participants; ongoing communication between members of the groups was encouraged through Padlet software, a real-time collaborative online platform used to organize and share content with other people. Each group was assigned a chat forum in Padlet. All groups were asked to commit to an energy-saving goal and were provided with information regarding the importance of saving energy in the household along with the presentation of goals (Appendix 8.3.2).

After the presentation of the energy-saving information, participants were presented with four goal-directed behaviours aiming to help them commit to their energy-saving goals. These were formatted differently depending on the experimental group. In the collective Imps group the behaviours were given in collective action plans form (e.g., "If we notice our laptops are fully charged, then we will unplug them, and we will remind others to do the same). The Individual Imps group was presented with the same if-then plans as the collective group with the distinction of the pronoun, and without the collective component (e.g., "If I notice my laptop is fully charged, then I

will unplug it"). The control group were presented with goal-directed behaviours only without if-then action plans (e.g., "I will remember to unplug my laptop").

Additionally, all participants were asked to complete an icebreaker. All participants responded to the puzzle except for one participant that did not complete part two, their data was not included in the analysis. The icebreaker was a puzzle on a frog escaping a 30 ft. well, sourced online from (Folj.com). To help build cohesion within the collective group participants were asked to complete this online with the members of the assigned group at the timeslot they stated. All communication between members was made through Padlet and was online instead of face-to-face.

After the presentation of Imps, a rehearsal activity was presented to the two intervention groups (collective and individual Imps groups), as a reminder of the goals. Participants engaged in a drag and drop the activity, matching the first and second part of the Imps statements together (e.g., "*If I am making hot drinks*" match with "*then will fill the kettle up to the amount I need*"). In the case of the collective Imps group, the then component was linked with the collective component and participants had to connect these two with the if-component (e.g., "*If we are making hot drinks*" match with "*we will ask others if they need the kettle too and we will only fill it up to the amount we need*"). All participants match all sentences correctly. In the second part of the study, participants were contacted via email seven days after the moment they completed the first part of the study, prompting them to complete the second part of the study.

4.3 Results

4.3.1 Energy consumption goal

Firstly, we assessed the energy consumption behaviours before and after the energy-savings goals were set. A repeated measures ANOVA was performed with the within factor of Time with 2 levels (pre and post-goal setting), and the between factor of group (collective Imps, individual Imps

and control). The results indicated significant differences in reported energy-saving behaviours between times overall F (1,86) =5.27 p<.05, indicating a lower energy consumption at time 2 in comparison with time 1. Whilst the means of energy consumption seemed to indicate differences in the consumption of control and collective Imps groups, the analysis indicated no significant differences between groups (Figure 7). In other words, no effect of the different presentation of Imps on the energy-saving behaviour across times was found F (2,86) =1.83 p=0.16 (Figure 7).

Figure 7

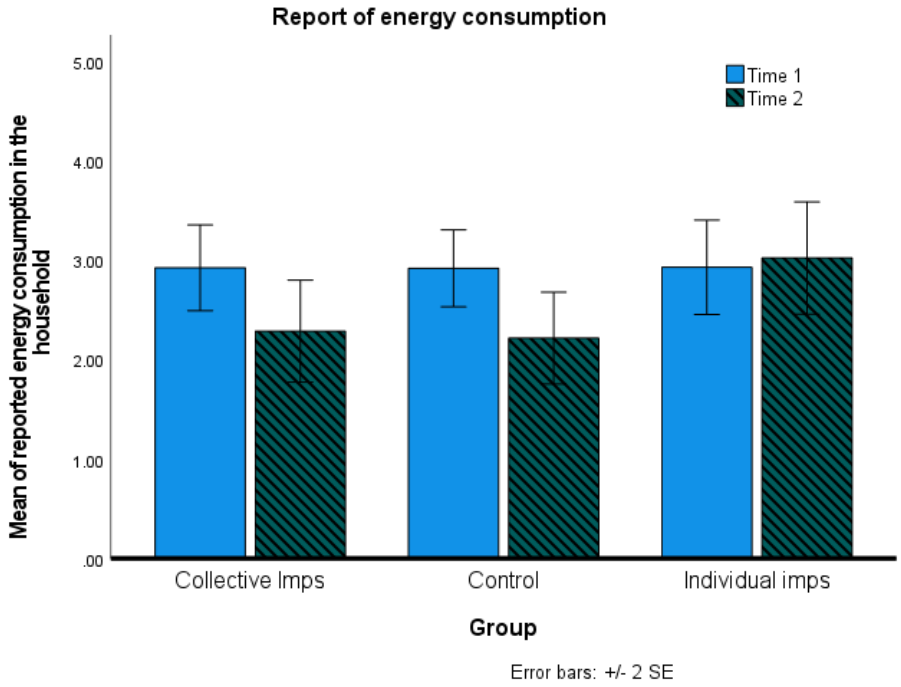

Figure 7 Mean of reported behaviour- energy consumption behaviours for the three experimental groups (Collective Imps, control, and individual Imps), the blue-cleared bars represent the energy consumption at time 1 for each group with their respective standard error (SE), and the green-striped bars represent the energy consumption at time 2 for each group, with their respective standard error (SE). The figure indicates a change in the energy consumption across time for the control and collective Imps groups, but not for the individual Imps group

4.3.2 Social norms and energy-saving behaviours

The action plans' impact on the individuals' perception of both injunctive and descriptive social norms was also assessed in this study. The rationale behind this was to explore if the collective Imps had an effect on people's perceptions of social norms around energy saving behaviours. A

repeated measures ANOVA analysis was performed first for the variable of injunctive social norms, with the within factor of time with two levels (pre and post-intervention), and the between factor of presentation of imps with three levels (collective Imps, individual Imps and control group). Results indicated no significant differences between times for the different groups F (2,86) =2.55 p=.083 (see Figure 8). Findings did indicate a marginal effect of time on the perception of the injunctive norms, F (1,86) =3.658 p=.059. After the setting of goals and commitment to undertake energy-saving behaviours, individuals reported at time 2 that they perceived others do not consider them undertaking energy-saving behaviours as that important to them, this was across all groups (Table 5).

Figure 8

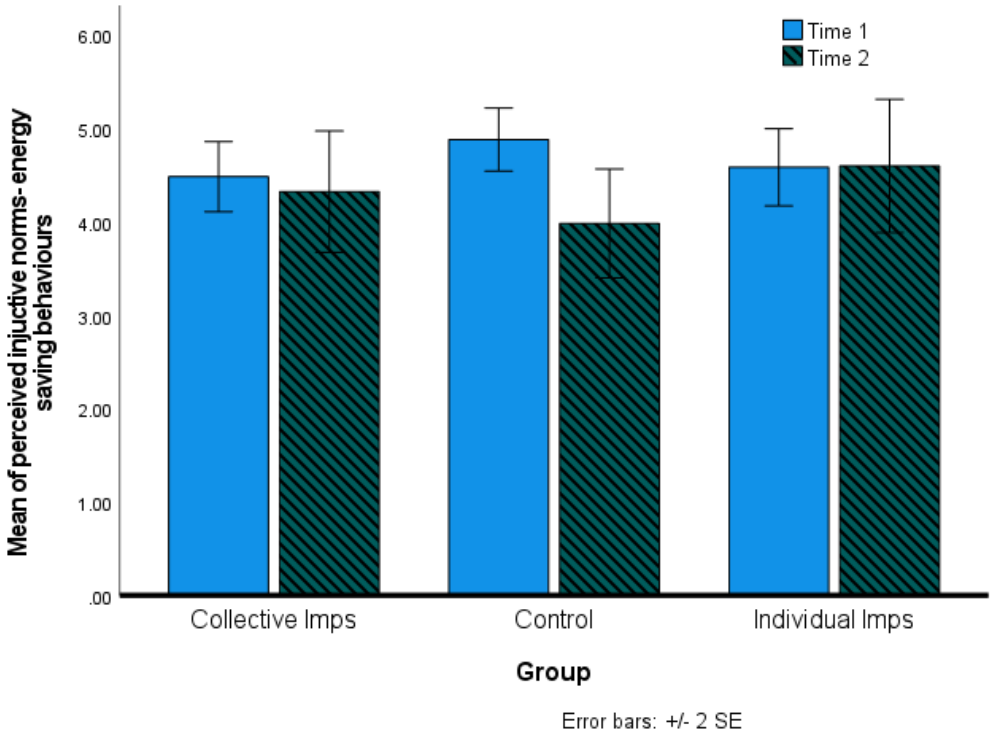

Figure 8 Mean of reported injunctive norms for all three experimental groups at the different times of assessment. The blue-clear bars represent the mean of perceived injunctive norms for energy-saving behaviours at time 1, whereas the green-striped bars represent the perceived injunctive norms for energy-saving behaviours at time 2.

I also assessed the descriptive norms for energy-saving behaviours at time 1 and at time 2. The ANOVA repeated measures analysis of this variable was performed with the within factor of time with two levels (pre and post-goal setting), and the between factor of group with three levels (Collective Imps, Individual Imps and Control group). Results indicated no significant differences

between times for the different groups F (2,86) =1.01 p=0.5 (Table 5). Also, results indicated no changes between times on the perceived descriptive norms for energy-saving behaviours F (1,86) =0.5.

4.3.3 Behavioural spillover and collective behavioural spillover

Furthermore, this study examined the behavioural spillover effect of the Imps strategies over other pro- environmental behaviours that were not promoted by the Imps. Results indicated no differences between times on the reported levels of engagement with recycling and avoiding plastic bags behaviours F (1,86) =2.23 p= 0.13; results also indicated no effect of the different presentation of Imps on the reported levels of engagement with other pro-environmental behaviours across times F (2,86) = 1.104 p=0.33 (Table 5). Additionally, the engagement with behaviours related to purchasing environmental products also indicated no significant differences between times F (1,86) =1.57 p=0.21, and no significant differences between groups across times F (2,86) = 2.23 p=0.11(Table 5). As for whether the participants engaged with collective environmental behaviours beyond energy-saving, and if the presentation of collective and individual Imps increased the levels of engagement with these practices. The results indicated no significant differences between groups and across times F (2,86) = 1.87 p=.159 (Table 5). However, when assessing the differences between the collective Imps and the individual Imps group only, this indicated a marginal effect between groups and across times F (1,51) =3.03 p=0.08, suggesting the collective Imps group reported a greater increase in collective spillover effect in comparison to the one reported by the Individual group.

Figure 9

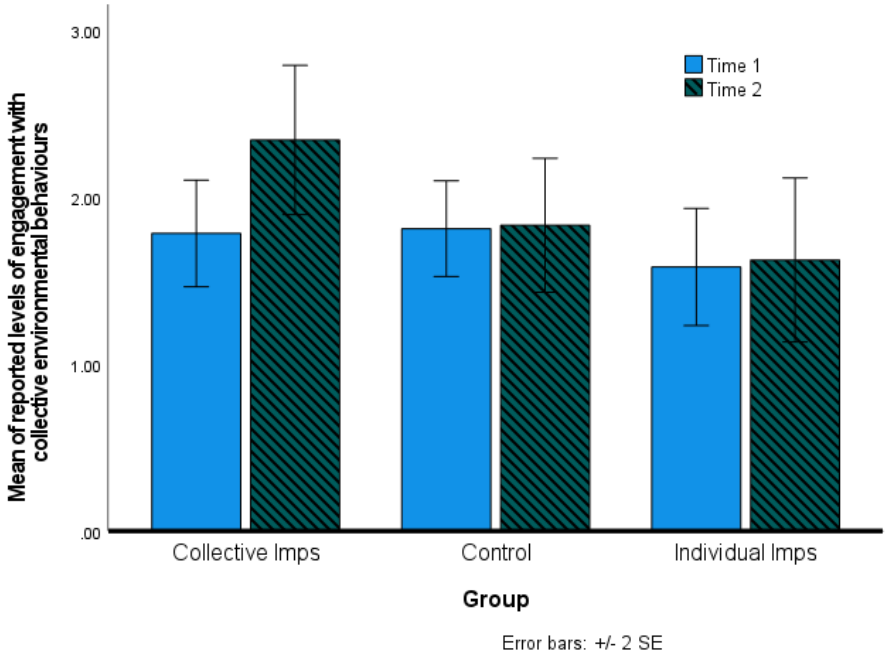

Figure 9. Means of reported levels of engagement with collective environmental behaviours for the different experimental groups. The blue-clear bars represent the mean of reported levels of engagement with collective behaviours at time 1 with its respective standard error (SE), the green-stripped bars represent the levels of engagement with collective behaviours at time 1, with its respective standard error (SE).

Table 5Mean and standard deviations for energy consumption, injunctive and descriptive norms, behavioural spillover (recycling and avoiding plastic), behavioural spillover for purchase of environmental products, and collective spillover for the different times (time 1 and time 2), and different groups (collective Imps, control, and individual Imps)

Measure	*Time*	*Group*	*Mean*	*SD*
Energy consumption	Time 1	Collective Imps	2.92	0.96
		Control	2.92	1.37
		Individual Imps	2.93	1.03
	Time 2	Collective Imps	2.28	1.32
		Control	2.22	1.45
		Individual Imps	3.02	1.35
Injunctive norms	Time 1	Collective Imps	4.48	0.99
		Control	4.88	1.12
		Individual Imps	4.58	0.84
	Time 2	Collective Imps	4.32	1.55
		Control	3.98	2.04

		Individual Imps	4.60	1.48
Descriptive norms	Time 1	Collective Imps	4.40	1.31
		Control	4.54	1.31
		Individual Imps	4.36	1.12
	Time 2	Collective Imps	4.37	1.53
		Control	4.05	2.02
		Individual Imps	4.50	1.48
Behavioural spillover - recycling, and avoiding plastic bags	Time 1	Collective Imps	5.97	0.98
		Control	5.17	1.29
		Individual Imps	5.17	1.18
	Time 2	Collective Imps	6.00	1.81
		Control	4.78	2.38
		Individual Imps	5.35	1.66
Behavioural spillover - purchasing environmental products	Time 1	Collective Imps	1.45	0.93
		Control	1.28	0.47
		Individual Imps	1.21	0.36
	Time 2	Collective Imps	2.07	1.65
		Control	1.18	1.04
		Individual Imps	1.21	0.55
Collective spillover	Time 1	Collective Imps	1.78	0.88
		Control	1.81	0.88
		Individual Imps	1.58	0.82
	Time 2	Collective Imps	2.34	1.21
		Control	1.83	1.33
		Individual Imps	1.63	0.97

4.3.4 Goal barriers to pro-environmental goals (Goal initiation and Goal Shielding)

Finally, the analyses of the reported goal barriers were performed (goal initiation and goal shielding), these barriers were only reported by the participants at time 2. A univariate ANOVA analysis was performed for assessing goal initiation barriers reported by the participants with the

factor of group with three levels (collective Imps, individual Imps and control group); results indicated no effect of the presentation of Imps on the reported barriers to the initiation of the goal-directed behaviours F (2,81) = 1.11 p= 0.33, individuals reported a similar low prevalence of goal initiation barriers across all groups (Table 6). For the goal shielding barriers, again, a univariate ANOVA analysis with the factor of group with three levels (collective Imps, individual Imps and control group) was performed to examine if different groups reported different levels of prevalence of shielding barriers preventing individuals to stick to their energy-saving behaviours. Results indicated a marginal effect of the presentation of Imps on the reported prevalence of goal shielding barriers F (2,81) =3.08 p=0.052 (Table 6). Post hoc analysis indicated collective Imps group reported significantly fewer shielding barriers than the Individual Imps, but no differences with the control group (see Figure 10).

Table 6 Mean and standard deviation for the measures of goal initiation and goal shielding barriers, for the different experimental groups (Collective Imps, Control, and Individual Imps)

Measure	*Group*	*Mean*	*SD*
Goal initiation	Collective Imps	3.06	1.09
	Control	2.76	0.90
	Individual Imps	3.14	1.05
Goal shielding	Collective Imps	3.00	0.70
	Control	3.31	0.99
	Individual Imps	3.60	0.83

Figure 10

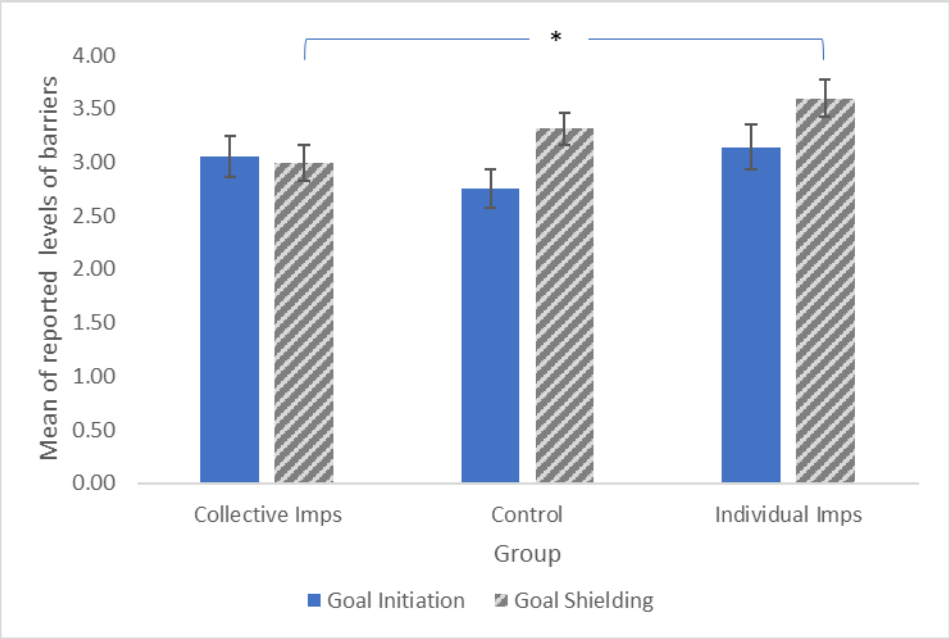

Figure 10. Reported means of goal barriers preventing energy-saving behaviour. The blue-clear bars represent the reported perceived barriers to initiating the goal (Goal Initiation); for all experimental groups along with their respective standard error (SE)., the grey-stripped bars represent the reported perceived barriers to shielding the goal (Goal Shielding) for all experimental groups along with their respective standard error (SE).

It is important to note that the collective groups did not use the space provided (Padlet) to communicate their efforts with the group. Moreover, all participants indicated they remembered the goal of saving energy and intended to save energy within the two weeks when the behaviours were assessed.

4.4 Discussion

This study aimed to examine the impact of Imps on promoting energy-saving behaviours and compared the effect of individual Imps and collective Imps on engagement with encouraged energy-saving behaviour. This study explored the gaps in the literature between collective Imps and environmental behaviours. It aimed to contribute to the existing literature on the effect of Imps on pro-environmental behaviours. Overall, the study indicated no impact of the presentation of either individual or collective forms of Imps on the levels of engagement with energy-saving behaviours. Participants reported a reduction of energy behaviours over time across conditions, possibly attributed

to the instructions given about the goal-directed behaviours. The findings suggest that the use of Imps, in both the collective and individual forms, may only sometimes show an impact on behaviour. Furthermore, these findings indicate that communication with others could contribute to the engagement of other behaviours collective behaviours, this was considered a collective behavioural spillover.

In addition, findings suggested no effect of Imps strategies on the engagement with other pro-environmental behaviour assessed here. This could be attributable to the fact that energy-saving behaviours may not be directly linked to purchasing environmental products and recycling and avoiding plastic behaviours. However, when added the control group to the analysis, this marginal effect disappeared. This could be because the control group reported similar levels of engagement with other collective behaviours reported at time 1. This is attributable to the collective Imps presentation, with the proposed section added at the end of the Imps that encouraged communication with others. The implications of these results to the literature on collective Imps involve the fact that collective Imps that promote collective environmental behaviours could also promote engagement with other collective behaviours environmental behaviours. Research on collective Imps needs to assess the impact of Imps on other pro-environmental behaviours to assess the chance of replicability within other pro-environmental behaviours (e.g., food waste, travel habits, and environmental purchases). In addition, it is considered relevant for other studies on Imps to assess whether the generic form of Imps can also promote collective spillover on other individual pro-environmental behaviours that were not assessed here (e.g., travel habits, food waste, water usage).

The cues used within the Imps groups were not sufficient or non-relevant for individuals; as a result, individuals in these groups may have not been able to seize the right opportunities to act. In the case of the control group, the directions given to the participants about the goal-directed behaviours to undertake could have helped individuals to develop their self-regulation strategies on

their own, or other strategies tailored to their lifestyle and routines which could have helped them reduce their energy consumption.

The implications of the results on the impact of Imps suggest that Imps may not affect some pro-environmental behaviours. These are controversial results to the ones found in the literature on Imps and pro-environmental behaviours (Bamberg, 2000, 2002; Holland et al., 2006). However, these findings are consistent with the research suggesting different levels of effect of Imps on different behaviours (Armitage & Conner, 2001; Gollwitzer & Brandstätter, 1997; Knäuper et al., 2011)

Another explanation for the lack of effect of Imps on behaviour could be associated with potential differences between individuals' self-report energy consumption behaviour and their actual energy consumption levels. Although studies in environmental psychology rely on self-reports (Fuj, Hennessy, & Mak, 1985; Steg & Vlek, 2009), studies have reported low correlations between self-reported and observed behaviour (Corral-Verdugo, 1997). Energy-saving behaviour could be challenging to report due to the complexity of quantifying energy consumption without observing meter readings. The short time window in which the energy-saving behaviours were assessed could have also contributed to an inaccurate self-report of energy consumption. Further research could consider using objective measures of behaviour, e.g., smart meter readings, as part of participants' reports of energy behaviours.

Findings on perceived social pressure from others to undertake energy-saving behaviours (injunctive norms) suggested a marginal effect on the reported levels of perceived injunctive norms for the collective and control groups. Individuals in these groups reported lower levels of perceived injunctive norms regarding energy-saving behaviours at time 2 compared to time 1. In other words, after attempting to act according to the set goal and intentions to save energy, individuals reported that people close to them do not consider it important for them to engage in energy-saving behaviour.

These changes may be due to individuals starting to observe energy-saving behaviour in others and communicate with others on the topic. This may suggest that people around them do not engage in energy-saving behaviours, which could have influenced participants' perceptions about the relevancy of these behaviours. Participants within the Imps group did not show this reduction in perceived injunctive norms, perhaps due to the lack of engagement with energy consumption, which resulted in not paying attention to others' behaviours.

The changes in the perception of injunctive norms could explain the low levels of engagement with the goal-directed behaviours to save energy reported at time 2. These findings imply that, since the perceived injunctive norms were not promoting the engagement with energy-saving behaviours, individuals may have decided to make less effort to commit to their saving energy goals, which would also impact the effectiveness of Imps. This is consistent with the Theory of Planned Behaviour's main assumption stating that attitudes and subjective norms are key determinants of intentions (Ajzen, 1985, 1991).

While acting as part of a group, individuals using collective Imps should be able to identify the opportunities or critical cues to act towards the collective goal and initiate the relevant actions. However, collective goal striving, in the same way as individual goal striving, can face obstacles that may interfere with the groups' goal attainment. This study examined potential barriers to initiating and shielding energy-saving goals. Findings indicated that individuals encounter similar barriers to initiating energy-saving goals throughout the period when they engage with the behaviour. However, in the case of goal-shielding barriers, collective groups indicated fewer problems shielding their goals to save energy than the group of individual Imps. This could be attributed to the lack of impact of the Imps, leaving individuals to attempt to stick to their intentions without any self-regulatory strategy.

This study presented several caveats in terms of recruitment, especially within the collective group. Students within the collective group did not use the communication tool to talk with others within their group about their efforts to save energy, the lack of cohesion of the group could have contributed to the lack of effect of collective Imps on energy-saving behaviours. Furthermore, as research has suggested that the amount of rehearsal of the Imps can have an impact on the effectiveness of Imps (Knäuper et al., 2011), the levels of rehearsal could be enhanced to ensure the impact of Imps. I consider that any further research considering collective behaviours should consider face-to-face interaction with the people within the group. Additionally, it is important to note that the collective Imps group fail on communicating across the duration of the experiment, this could have had an impact on the overall results.

For the literature on Imps, this research implies that Imps may not be effective in promoting some behaviours. For the collective Imps literature, this research implies that collective Imps may not effectively promote engagement with complex behaviours such as pro-environmental behaviours. Furthermore, this research implies the need to assess collective behavioural spillover caused by pro-environmental behaviours and indicates that strategies promoting communication with others could impact on collective spillover. In the case of policymakers, this research implies that community engagement and collective communication could be a good strategy for promoting pro-environmental behaviours within the society.

Overall, the study showed no effect of Imps on the pro-environmental behaviour assessed in this study (saving energy), the implications of this for the literature suggest that Imps may not be effective in the promotion of some pro-environmental behaviours. However, it is important to note that results obtained in this study indicated a reported reduction on the energy consumption overall, these could be attributed to the provision of information regarding the relevant goal-directed behaviours to adopt to achieve energy-saving goals. In addition, this study suggests that collective

Imps strategies may not affect pro-environmental behaviours; however, they did seem to promote communication with others. It is considered relevant to assess whether this communication could promote a behaviour change in others. Future research should consider the use of barriers assessment to tailor self-regulatory strategies to promote individual and collective behaviour. In addition, further research assessing the proposed formation of collective Imps and if different behaviours are impacted differently by Imps depending on the perceived social norms. This could contribute to the literature on group performance, addressing the collective intention-behaviour gap and help to understand whether social norms can determine group pro-environmental behaviours.

Chapter 5: Collective and Shielding Implementation Intentions

Abstract

The following study examines how we can use implementation intentions to promote pro-environmental behaviours. In Study 4, I examined the use of collective Imps to promote the reduction of food waste in the household. By using the same format of collective Imps as the one suggested in chapter four, this study explored the use of collective Imps to shield goal-directed behaviours to avoid food waste in households in the UK. The findings suggest that Imps -both individual and collective- had no effect on reducing or maintaining the behaviour of food waste. In addition, results indicated shielding goal-directed behaviours did help participants to reduce their food waste across all experimental groups. The collective imps did not affect individuals' level of communication with others about their efforts on avoiding food waste. This study contributes to the conclusions from prior chapters implying that Imps- in the individual and collective form- may not impact some behaviours.

5 Study 4- Love food, avoid waste: Implementation intentions and collective behaviours to reduce food waste in the households.

5.1 Introduction

5.1.1 Food waste

The problem of loss of food due to waste has become a global concern; approximately one-third of edible food produced for human consumption is lost or wasted each year (FAO, 2011; Gustavsson, Cederberg, Sonesson, Van Otterdijk, & Meybeck, 2011; Secondi, Principato, & Laureti, 2015). These losses may occur during different phases of the Food Supply Chain (FSC); in developing countries, food losses often occur during the early stages of the FSC (e.g., production and industrial transformation), while in developed countries losses tend to occur in the final stages of the FSC due to cultural, social or economic decisions made by the producers and final consumers.

Food waste in developing countries can be due to distribution, retail, and final consumption- the latter is one of the leading causes of most food wasted in developed countries. The European Commission had reported that the food wasted per capita by consumers in Europe and North-America is 95-115 kg/year, while in Sub-Saharan Africa and South/Southeast Asia is 6-11 kg/year (Stenmarck et al., 2016). According to the 2021 food waste report from the United Nations Environment Programme (UNEP), around 931 million tonnes of food waste were generated in 2019, of which 61% came from households, and the rest came from food service and retail (United Nations Environment Programme, 2021). The implications of food waste are large; from the

economic point of view, it has been estimated that food waste represents a cost of £420 a year for an average UK household (Segrè & Falasconi, 2011). As for the environmental implications, the British Waste and Resources Action Programme calculated the average carbon footprint of avoidable household food waste to be equal to 330 kg CO2 per person per year, which corresponds to one-third of the CO2 emissions attributed to household electricity use per person in the UK (T. Quested & Parry, 2011). Recent research on quantifying the potential for climate change mitigation of some consumption options suggests food waste reduction options could mitigate an average of 0.3 tons of CO2 equivalent per capita per year (tCO2 eq/cap), considered a substantial mitigation potential (Ivanova et al., 2020).

Since consumers in the household are one of the biggest producers of food waste, several studies have focused on investigating consumer's perceptions and behaviours related to food waste (T. E. Quested, Marsh, Stunell, & Parry, 2013; Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013; Visschers, Wickli, & Siegrist, 2016). Demographics play an interesting role in food waste at the household level: the larger the household size is, the more food is wasted (Parizeau, von Massow, & Martin, 2015; Williams, Wikström, Otterbring, Löfgren, & Gustafsson, 2012). Households with more children produce more food waste; parents report difficulties predicting their children's consumption levels. (D. Evans, 2011; Parizeau et al., 2015; Visschers et al., 2016). Specifically, having children at home resulted in more waste of particular food groups such as fruit and vegetables, meat and fish, and potatoes and rice (Visschers et al., 2016).

Age is another relevant factor to consider concerning food waste in the household, studies suggest that older participants reported lower levels of food waste (T. E. Quested et al., 2013; Visschers et al., 2016). Moreover, in terms of food management in the household, one of the recurrent issues reported in the literature refers to the incapability of buying and preparing only the

amount of food necessary for the household (D. Evans, 2012). This is more controlled by older adults compared to younger adults (Visschers et al., 2016).

5.1.2 Strategies to tackle food waste.

Consumers are often more concerned about the financial consequences of food waste than the environmental consequences. A survey on food waste indicates that the link between food waste and environmental impact is not well established in people's minds (T. E. Quested et al., 2013). However, research on interventions to reduce food waste suggests that triggering consumers by using external interventions that highlight the financial benefits as well as the environmental impacts of the behaviour resulted in no positive outcomes (Shaw, Smith, & Williams, 2018; Smith, Shaw, & Williams, 2014).

As mentioned in previous chapters, research on human behaviour has stated that individuals tend to fail to act according to their intentions, known as the intention-behaviour gap, also referred to as the value-action gap (Blake, 1999; Flynn et al., 2009; Gollwitzer & Moskowitz, 1996; Gollwitzer & Sheeran, 2006; Sheeran & Orbell, 2000) This has been reported with different behaviours and situations in environmental sector but also on health, financial, political, among others (Conner, 2018; Nickerson & Rogers, 2010; Sheeran, 2002).

Planning routines (e.g., checking supplies) contribute to the prevention of underestimating inventory and purchasing items consumers already have in their household, leading to a decrease in product spoilage (Chandon & Wansink, 2006; Stefan et al., 2013). Making shopping lists or planning meals in advance are other planning routines that can help consumers to decrease unplanned purchases and limit food waste (Bell, Corsten, & Knox, 2011). People who wasted less food were more likely to report using food management strategies (e.g., food was discarded when it

looked spoiled); shopping planning routines (e.g., making shopping lists and planning meals); and less over-purchase (D. Evans, 2011; Parizeau et al., 2015).

Stancu et al. (2016) found that planning routines made only an indirect contribution to reducing food waste, concluding that planning routines are likely to be mediated through other food-related routines (Jensen et al., 2012; Stancu et al., 2016). Chandon and Wansink (2006) findings indicated that insufficient planning may result in underestimating of stocks and lead to overbuying. Other reasons for households to waste food include food literacy, defined as the lack of knowledge regarding aspects of food management in the household (e.g., planning, buying, preparing, serving, and storing food) (Principato, Secondi, & Pratesi, 2015). Another cause of food waste can be the confusion regarding food labels stating "best before" and "use by" dates (Principato et al., 2015); poor food storage(Aschemann-Witzel, De Hooge, Amani, Bech-Larsen, & Oostindjer, 2015; van der Werf, Seabrook, & Gilliland, 2021); and lack of knowledge of what to do with leftovers (D. Evans, 2012).

Whilst there is a vast literature on behavioural strategies to promote purchasing and planning routines to avoid food waste, there needs to be more research focused on the management of food and its disposal at the household level. Aschermann-Witzel, et al. (2015) proposed three potential factors influencing consumers' concerns, perceptions and purchasing behaviours. One is the motivation to avoid food waste: while financial implications can motivate food avoidance to some extent, enacting the whole range of actions to avoid food waste is also driven by ethical and fairness reasons (e.g., in light of worldwide hunger), values or religious beliefs. Another is the management, provisioning, and handling of food, which are determined by the consumer's awareness, knowledge and capabilities (e.g., purchasing, choosing food, planning and preparing meals, and organising reuse or disposal). Finally, trade-offs between food waste and other priorities (e.g., health orientation, safety concerns) are also important. Notably, other priorities are also driven

by the individual's motivation and food management capabilities or perceived skills (Aschemann-Witzel et al., 2015). Thus, promoting motivations to reduce food waste and food managing strategies seem to be key for food waste prevention in households. (Aschemann-Witzel et al., 2015; Parry, James, & LeRoux, 2015).

5.1.3 Implementation intentions and food waste

Implementation intentions (Imps) help the realization of goal intentions by specifying when, where, and how they will perform a behaviour X if they encounter a situation Y; pre-deciding how to act in response to a specific situation and delegating the initiation of the goal-directed response to situational cues (i.e., If I get paid at the beginning of the month, I will save 10% of my money) (Achtziger et al., 2008; Gollwitzer & Sheeran, 2006; Wieber et al., 2012). The self-regulatory strategy of Imps addresses the intention-behaviour gap by creating a cue-response link between a situational cue and the desired behaviour (Ajzen, 1991; Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2004). Empirical findings indicate that the effect of Imps is contingent on the presence of strong motivations or goal intentions to perform a specific behaviour (Prestwich et al., 2015; Sheeran et al., 2005). For instance, the use of Imps has shown to have a medium-large effect when used in domains such as health (Conner, 2018; Milne et al., 2002; Orbell et al., 1997; Rise et al., 2003; Rutter, Steadman, & Quine, 2006) and voting (Nickerson & Rogers, 2010). As mentioned in previous chapters (chapters three and four), there is little research on the use Imps to promote pro-environmental behaviours (Bamberg, 2000, 2002; Holland et al., 2006). Regarding food-related behaviours, Bamberg (2002) assessed the impact of Imps on purchasing organically produced food. Bamberg (2002) found that implementation intentions instructions caused an increase in the percentage of individuals who could enact their goal intentions. Although some research proposes using Imps to tackle food waste behaviour (Geffen, Herpen, & Trijp, 2020), within the literature on

Imps and pro-environmental behaviours the impact of Imps on avoiding food waste behaviours has not been explored yet.

As discussed in chapter two, four different types of barriers or obstacles identified in the literature can hinder goal attainment: goal initiation, goal shielding, goal disengagement, and overextending oneself (Achtziger et al., 2008; Gollwitzer & Sheeran, 2006). Although research on Imps has predominantly focused on facilitating the initiation of goal-directed behaviours; researchers have shown that Imps can also help shield ongoing goal pursuits (Achtziger et al., 2008; Parks-Stamm et al., 2010). Achtzinger et al. (2008) investigated the use of implementation intentions to shield goal striving from negative inner states (i.e., craving for fast food and mood states that hamper sports performance). The researchers reported that the mere setting of goal intentions, e.g., starting a diet, or concentrating while playing a sport, did not predict goal achievement. However, when these goal intentions were furnished with Imps that shielded the goals, participants were able to deflect the detrimental effects of inner states (Achtziger et al., 2008). Shielding Imps had also been shown to be effective for shielding academic goal-striving from unwanted distractions (Parks-Stamm et al., 2010).

To the author's knowledge, in the field of food waste, there is no literature exploring the use of implementation intentions in shielding ongoing environmental goals. Furthermore, there is no evidence in the literature examining the use of Imps to promote food waste reduction at a household level. This study considers it relevant to address the problem of food waste as it is a significant contributor to UK households' carbon emissions.

5.1.4 Collective implementation intentions

Collective goals tend to highlight a positive interdependence between group members promoting cooperative verbal interaction which is not present in the case of individual goals,

meaning that setting collective goals can, in some cases, have a greater effect on goal-striving than individual goals (Thürmer et al., 2017). Thürmer et al. (2017) tested whether planning collective and individual goals with implementation intentions would have different effects on goal striving in a physical persistence task. They differentiate the individual and collective if-then action plans by changing the pronouns for individual ("If I encounter X then I will do Z") and collective goals ("If we encounter X then we will do Z"). Their findings showed that collective goals enhanced group performance by increasing cooperative interactions (Thürmer et al., 2017). To the author's knowledge, collective Imps have not been assessed within the field of pro-environmental behaviours. This study considers it relevant to explore ways to promote pro-environmental behaviours through the use of collective Imps since- as mentioned in previous chapters- collective behaviours tend to increase individuals' engagement with the goal.

5.1.5 Current study

While a vast literature focused on shopping and planning routines to reduce food waste, it is considered relevant to explore shielding strategies to reduce food waste. The study suggests that promoting behaviours that help individuals' food managing capabilities could shield their goal intentions of reducing food waste in their household and ensure that the reduction of food waste behaviour continues in the long-term. This study proposed a format of collective imps different to the previous format in the literature, adding a collective section to the proposed phrasing of intentions (e.g., If I encounter X, then I'll do Y, AND I will remind others to do Y). This is different to the form of individual Imps commonly used in the literature (e.g., If I encounter X, then I will do Y) The rationale behind this is to increase the impact of collective imps on behaviour engagement and also specifically to promote communication with others.

The present study proposes using implementation intentions as a strategy to strengthen food management capabilities to reduce food waste in the household. To date, no previous research has

used implementation intentions within the food waste literature. Furthermore, this study is the first in the literature to assess the comparison of collective and individual versions of implementations designed to shield environmental intentions.

This research aims to assess food waste behaviour in family households through a two-timepoints online study during the COVID-19 pandemic. Recent research suggests reducing food waste over the pandemic period (Rodgers et al., 2021). Although this study was conducted when most restrictions were lifted in the United Kingdom, it is possible the pandemic would still influence food waste behaviours, however, this is not the focus of the current study.

I hypothesized that by building if-then action plans, individuals will be able to shield their goal of reducing food waste in their households. Moreover, I compared the effectiveness of collective and individual Imps in reducing food waste behaviour. I hypothesized that collective Imps could promote better engagement with goal-directed behaviours than individual Imps. In addition, I examined the types of barriers (internal or external states) that prevent individuals from reducing food waste and assessed the extent to which these barriers mediate intentions and food waste behaviour.

5.2 Materials and Methods

5.2.1 Participants

A total of 270 individuals were recruited using the recruitment platform Prolific (www.prolific.co) to participate in a two-part study about food waste in households in the UK. I randomly assigned the participants to one of three different groups: individual implementation intentions, collective implementation intentions, and a control group with no implementation intentions manipulation. An a priori power analysis was conducted on the 3 (group: individual, collective implementation intentions, control group) x 2 (time: pre and post) design. Previous

studies on implementation intentions regularly consider a medium effect size, I considered a small effect size ($\eta 2=0.01$) due to the complexity of the behaviour in question. The power analysis indicated a sample of 243 participants was sufficient to achieve a power of 0.80 (Faul et al., 2007). The sample was increased by 10% due to the potential for participants drop-out (Kothe & Ling, 2019).

All groups were asked to commit to the goal of trying to avoid food waste in their household for one week. After this period, participants were asked to take part in the second part of the experiment. Six participants out of the 270 did not answer the attention question correctly in part 1 of the study; they were not asked to take part in the second part. Out of the 264 participants that were invited to participate in part two of the experiment, 250 people completed the questionnaire but only 242 answered the attention question correctly at time 2. The data analysis focused on the 242 participants who completed attention check questions at both times 1 and 2 correctly and completed questionnaires at both time points; 75 were in the collective group, 81 were in the control group, and 86 were in the individual group. Out of the total sample, 190 participants were female and 51 were male (one person preferred not to disclose their gender), the mean reported age was 42 (SD=12.06).

5.2.2 Materials

Both questionnaires were hosted on the Qualtrics online platform. The time 1 questionnaire included questions about how much food waste participants produce in their households. The food waste was assessed based on the number of leftovers wasted and the amount of food waste due to spoilage. Participants were asked to measure their food wasted in portions. Considering one potion as a handful of food, food waste was assessed with a Likert scale from *Nothing at all* to *More than three portions* (Appendix 8.3.1).

Furthermore, participants were asked about the barriers that may be in their way of reducing food waste. These were separated between barriers that are due to individual behaviours (i.e., inner barriers) and the barriers that are the result of others' behaviours or the context (i.e., outer barriers). All participants were asked about their goal intentions to reduce food waste. The list of items for each scale can be found in Appendix (8.3.1). A questionnaire at time 2 was provided two weeks after time 1. The time 2 questionnaire included the same questions as the time 1 questionnaire, and questions about the inner and outer barriers people may have faced when trying to avoid food waste. All participants were given a debrief at the end of the time 2 questionnaire informing them about the different conditions and a justification of the study.

A manipulation check variable evaluated whether people communicated their efforts to reduce food waste to others. The scale examining the construct of talking with others about food waste inside the household consisted of two items, with a reliability score of α=0.8. As for the scale assessing communication with others outside the household, it included two items with a reliability score of α=0.76 (see Appendix 8.3.1).

To examine any changes in food waste in the household, I used three scales adapted from Stefan et al. (2013). The first scale was a six items scale asking about the different types of food that were thrown away in the participant's household in the past week (e.g., fruit and vegetables, pasta, rice and corn products, meat and fish, dairy products, bread and bakery products, and fresh convenience meals). The amounts were measured in portions: one handful was one portion. The scale had five points where 1 indicated *nothing at all*, and 5 indicated *more than three portions*. One of the items was dropped from the scale in order to improve the Cronbach's alpha (α=0.68); after dropping the item (Fresh convenience meals) I obtained a reliability score of α=0.75 for this scale. This item was dropped due to the differences in the management between convenience meals and other items mentioned in this list (e.g., convenience meals are sold to be frozen, they are

purchased for specific purposes). A question assessing how much still-edible leftovers were wasted in the household within the past week, measured in portions where one portion was considered a handful. This question had a scale of from 1 to 5, where 1 indicated *nothing at all* and 5 indicated *more than three portions*. A final question about levels of food waste assessed how much food was thrown away due to spoilage. This question asked about portions of food wasted due to spoilage where 1 indicated *nothing at all* and 5 indicated *more than three portions* (see Appendix 8.3.1).

Two different scales were used for the assessment of barriers: an inner barrier scale and outer barriers scale. The inner barriers scale was a four-item scale asking about the individual's actions and mood states that prevent them from acting according to their environmental goals (e.g., I forgot about some of the food I had, and it was spoiled). The reliability score indicated an alpha of α=0.81. The outer barriers scale was a five-item scale assessing the obstacles individuals face from their context that prevent them from acting according to their environmental goals (e.g., others did not check the food and the use by date regularly). The reliability score for this scale indicated an alpha of α=0.84.

5.2.3 Procedure

I restricted participation to people who lived in England to keep a homogenous sample and to avoid different pandemic restrictions interfering with the data. Additional requirements for participants to take part were to live in a household with children and a partner/spouse; these were included due to previous literature indicating that households with children produce more food waste than other households and the consideration that it would be most useful to tackle households with larger amounts of waste. Participants completed a questionnaire at the beginning of the study, at time 1, asking about the levels of food waste in their households. The time 2 questionnaire was provided one week after the time 1 questionnaire was completed to participants who answered the attention question correctly and agreed to commit to the goal of avoiding food waste. The

questionnaire at time 2 included the same questions than the time 1 along with manipulation check questions where participants were asked if they committed to the goals set and if participants communicated with others about their efforts.

Participants were randomly allocated to one of the three different groups: individual Imps, collective Imps and a control group; and were provided with suggested behaviours to reduce food waste. The Imps group was presented with if-then action plans for supporting behaviours that reduce food waste in the household (e.g., "If I have leftovers, then I will try to eat them within the next two days"); these kept the same format that was used in the literature (Gollwitzer, 1999; Gollwitzer & Sheeran, 2009; Thürmer et al., 2017). The collective Imps version was based on the proposed version of collective Imps mentioned in chapter six. The collective Imps group was given the same if-then plans as the imps group but had an additional component, a collective cue, that asked them to discuss their behaviours with others, for example: "If I have leftovers, then I will try to eat them within the next two days and I will discuss my efforts with others". As for the control group, they were given just the behaviours, for example, "Try to eat leftovers within the next two days".

The Imps and the collective Imps groups had a rehearsal section after the presentation of imps where they were asked to reflect on the goals and imagine when and where would they perform the behaviours. This is consistent with practices in other studies where participants are asked when and how they will perform the behaviour of interest (Bamberg, 2000, 2002). The collective Imps group was additionally asked to who they would discuss their efforts to reduce food waste.

5.3 Results

5.3.1 Talk with others about food waste

To test the different hypothesis of the study, firstly I examined whether Imps have an impact on the extent to which people talked with people outside the household about reducing food waste, I used a repeated measures ANCOVA, with time as a factor with two levels (time 1 and time 2), and group as a between subjects' factor with three levels (control, Imps, and collective Imps) and covariates of gender, age, and household size. The analysis indicated no effect of the presentation of Imps on the extent to which participants talked with others about their efforts to reduce food waste $F(2,237) = 1.65$ $p>.05$ (Figure 11). Table 7 shows the means and standard deviations of to what extent people reported talking with others inside and outside of the household for each group.

The factor of communicating with others within the household was also assessed between groups (3 factors: control, imps, and collective imps) and over time (2 levels: time 1 and time 2) and with the covariates of age, gender, and household size. Results indicated no effects of the factor of group on whether people talked about their efforts reducing food waste to others within their household $F(2,237) = 1.237$ $p>.05$. In other words, Imps did not influence communication with others in the household. The covariate of age was observed to have an effect on whether people talked with others within their household about their efforts to reduce food waste; younger adults reported that they talked more with people inside the household about reducing food waste than older adults, $F(1,237) = 4.22$ $p= 0.041$. Gender and household size did not have an impact on the behaviour of talking with others.

Table 7 Means and standard deviations of the variables of communicating with others inside and outside the household about their efforts reducing food waste

Group	Mean	SD	N
Communication with Others Outside Household			
Collective Imps	3.43	1.54	73
Control	3.08	1.50	79
Individual Imps	3.10	1.59	86
Communication with Others Inside Household			
Collective Imps	3.87	1.45	73
Control	3.52	1.60	79
Individual Imps	3.69	1.47	86

Figure 11

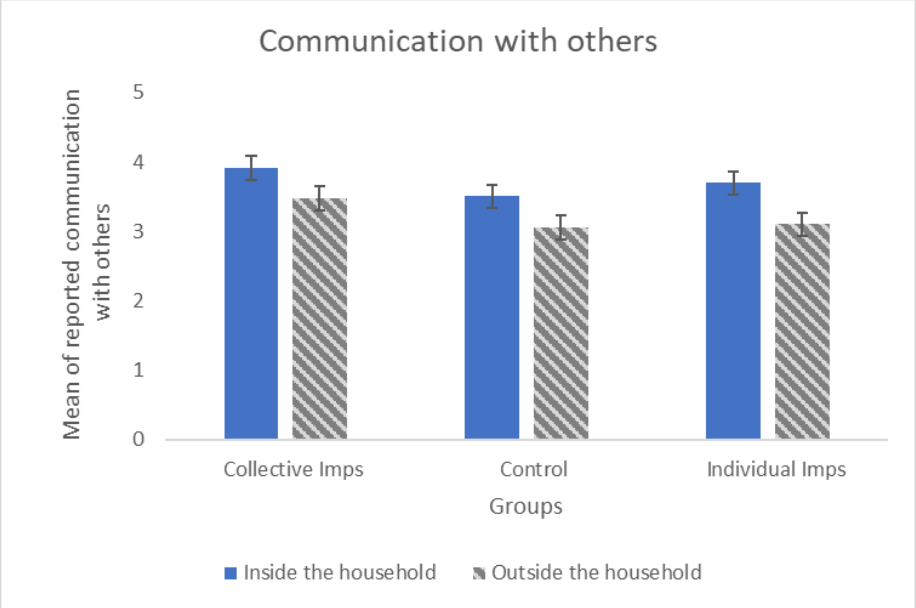

Figure 11 Means of reported levels of communication for each experimental group (collective Imps, control, and individual Imps). Representing with blue-cleared bars the communication with others within the household along with the standard error; the grey-stripped bars represent the average of communication with others outside the household along with their standard error. The graph indicates no difference in levels of communication with others – inside and outside the household- between groups.

5.3.2 Food waste of still edible leftovers

The impact of imp interventions on levels of waste of still-edible leftovers was assessed through a repeated measures ANCOVA analysis with the repeated measures factor of time (two levels: time 1 and time 2) and a between subjects' factor of group (collective Imps, individual Imps, and control groups), and covariates of age, gender and household size. Findings indicated that the reduction of wasted leftovers across time was not significantly different between groups $F(2,232) = 0.326$ $p>0.05$ (see Table 8). However, an effect of time over the waste of still-edible leftovers was found. Participants reported lower levels of still-edible leftover waste at time 2 $M= 2.42$ $SD= 1.11$ in comparison to the reported waste of still-edible leftovers at time 1 across all groups $M= 3.01$ $SD=1.22$, $F(1,232) =7.867$ $p<0.05$ (see Figure 12).

The covariate of age interacted significantly with time, younger individuals reported higher scores of still-edible leftovers wasted at time 1 in comparison to individuals at older ages (young adults $M=3.5$ $SD=1.07$, middle-aged adults $M=2.93$ $SD=1.22$, and older adults $M = 2.37$ $SD = 1.15$). The difference between the wasted leftovers at time 2 in comparison with time 1 is also greater for the younger individuals than for older individuals, $F(1,232) = 4.739$ $p < 0.05$. The covariates of gender and size of the household had no effect on behaviour change.

Figure 12

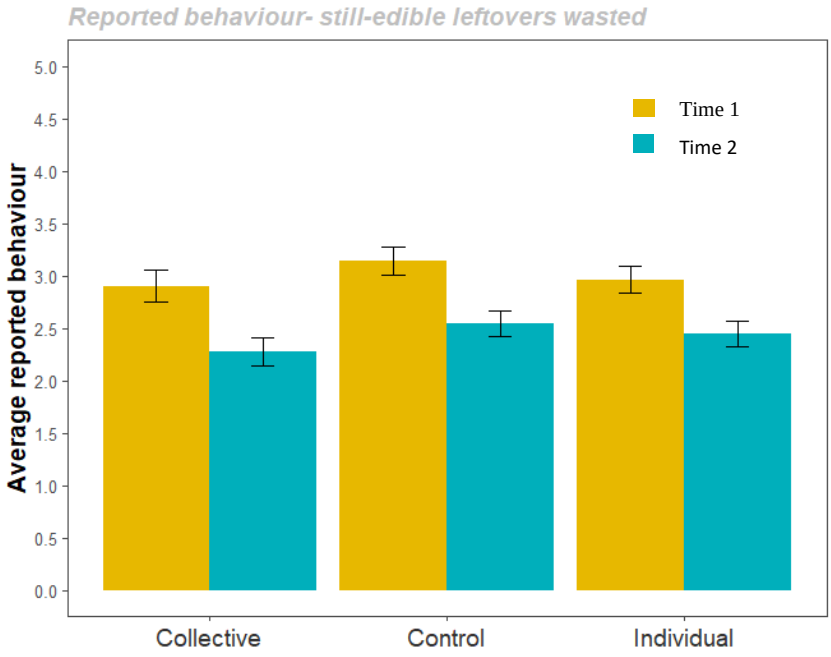

Figure 12 Means of reported waste of still-edible leftovers for the three experimental groups (collective, control, and individual). The yellow bars represent the means of the reported waste of still-edible leftovers at time 1 along with their respective standard error; the blue bars represent the means of the reported waste of still-edible leftovers at time 2 along with their respective standard error.

Table 8. Means and standard deviations (SD) of the variables of waste of still-edible leftovers for all three experimental groups.

Time	Group	Mean	SD	N
Time 1	Collective Imps	2.89	1.28	73
	Control	3.16	1.19	79
	Individual Imps	2.97	1.18	86
Time 2	Collective Imps	2.25	1.12	73
	Control	2.56	1.09	79
	Individual Imps	2.45	1.11	86

Further exploratory analysis was performed to assess the reported differences between ages and food waste due to the significant interactions found between the reported waste of still-edible leftovers and age. I was interested in whether the different presentations of Imps had an impact on

people's reported food waste depending on their ages. An ANOVA with three-way interaction analysis was performed with the amount of still edible leftovers food waste as a dependent variable; time as a within-subject factor; age groups, and presentation of imps as between subjects' factors. The findings indicated no interaction of age groups, presentation of imps, and time F (4,230) =1.46 p=0.21. When assessing the post-hoc analysis, results indicated that as age increases, the reported waste of still-edible leftovers decreases. Older adults reported less waste of still-edible leftovers than younger people, and middle-aged adults, this did not differ between groups. The reported waste of still edible leftovers did differ over time, younger people reduced their levels of waste of still edible leftovers at time 2 in comparison with time 1, this difference was statistically significant F (1,230) =35.05 p< 0.001 (Figure 13).

Figure 13

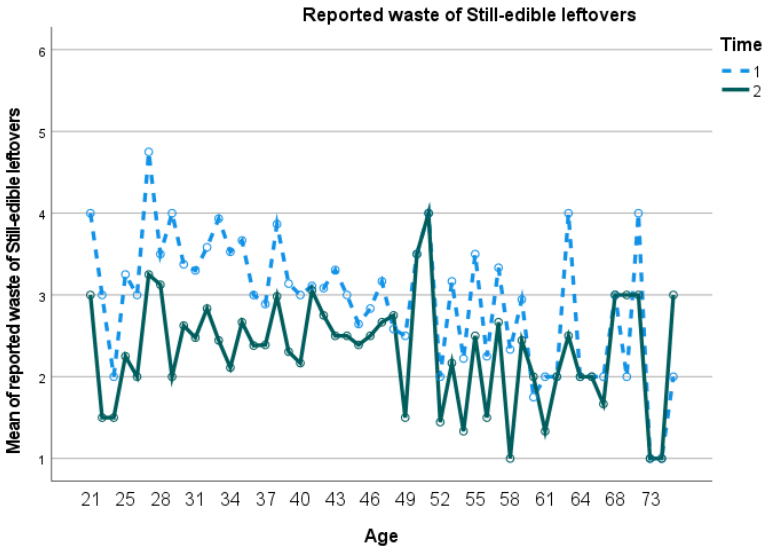

Figure 13 Mean of reported waste of still-edible leftovers for different ages at two-timepoints. The blue dotted line represents the reported waste of still-edible leftovers at time 1 for the different ages. The green solid line represents the food wasted reported at time 2 (two weeks after time 1) for the different ages.

5.3.3 Food waste due to spoilage

The impact of Imps interventions on the amount of food waste due to spoilage was assessed through a repeated measures ANCOVA analysis. The factor of time was within-subjects and had

two levels (time 1 and time 2) and the between subjects' factor of group had three levels (collective Imps, individual Imps, and control groups). Covariates of age, gender and household size were also included. The ANCOVA analysis indicated no effects of the presentation of imps on the reported waste of spoiled food at the different times $F(2,232) = 1.422$ $p = 0.24$ (see Figure 14). The means of spoiled food waste indicated a reduction of waste due to spoilage in time 2 in comparison with time 1 across all experimental groups (see Table 9), however, these differences were not significant $F(1,232) = 0.634$ $p = 0.427$. In terms of the covariates, there was no effects of age, and household size but the covariate of age did indicate different levels of food waste due to spoilage depending on age. Older adults reported lower levels of food waste due to spoilage overall in comparison with younger and middle-aged adults $F(1,232) = 7.49$ $p < 0.05$; this effect was present at time 1 but not at time 2.

Table 9. Means and standard deviations (SD) of the variables of food wasted due to spoilage for all three experimental groups.

Time	Group	Mean	SD	N
Time 1	Collective Imps	2.64	1.31	73
	Control	3.24	1.14	79
	Individual Imps	2.74	1.18	86
Time 2	Collective Imps	2.05	1.09	73
	Control	2.61	1.15	79
	Individual Imps	2.41	1.02	86

In the case of gender, there was a significant difference in the reported levels of food waste due to spoilage between times for (time 1 M= 3.04 SD ± 1.28, time 2 M = 2.25 SD±1.05) compared to females (time 1 M= 2.84 SD± 1.23, time 2 M= 2.4 SD±1.13). Males reported higher levels of food wasted at time 1, but they also reported greater reduction levels of food wasted due to spoilage in time 2 in comparison to females, this difference was found significant $F(1,232) = 2.009$ $p > 0.05$ (

Figure 15). The results of the three-way interaction analysis of time, gender, and presentation of Imps indicated no significant differences in reported levels of food waste due to spoilage for females and males with the different presentation of Imps F (2,235) =0.102 p=0.9.

Figure 14

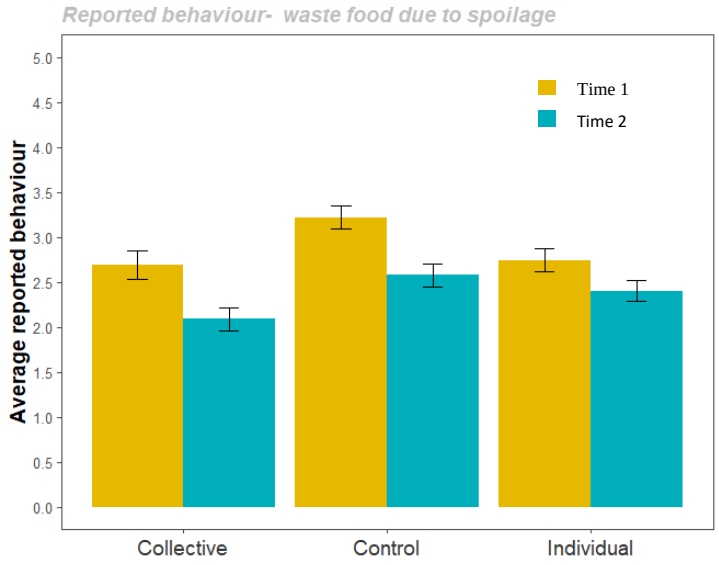

Figure 14 Means of reported waste of food due to spoilage for the three experimental groups (collective, control, and individual). The yellow bars represent the means of the reported waste of food due to spoilage at time 1 along with their respective standard error; the blue bars represent the means of the reported waste of food due to spoilage at time 2 along with their respective standard error.

Figure 15

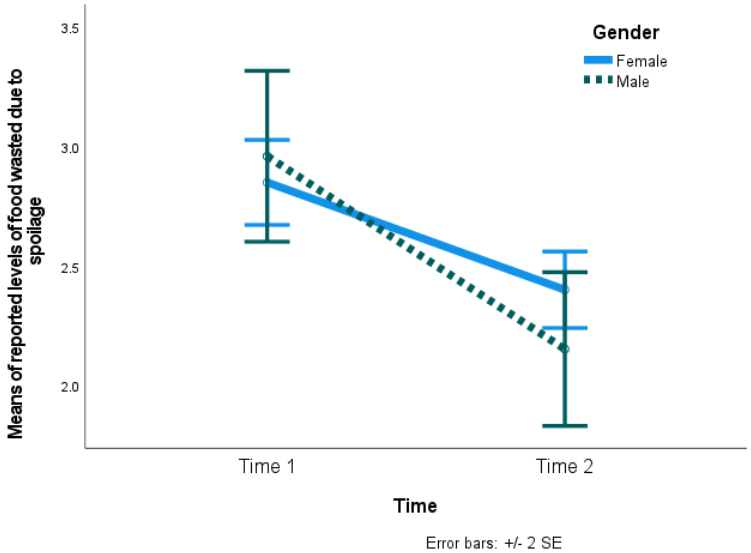

Figure 15 Mean of reported waste due to spoilage. The blue lines represent the average of waste due to spoilage reported by females in the experiment, along with their standard error. The green lines represent the average of waste due to spoilage reported by males in the experiment, along with their standard error

5.3.4 Inner barriers

I assessed barriers that prevent people from engaging to avoid food waste, specifically, the barriers that are formed by self-states or self-behaviours (e.g., forgetting, getting other behaviours in the way), considered inner barriers. Whether inner barriers experienced were different for different Imps intervention conditions was assessed through a repeated measures ANCOVA analysis. The factor of time was within-subjects with two levels (time 1 and time 2) and the between-subjects factor of group had three levels (Collective Imps, Individual Imps, and control groups); covariates of age, gender and household size were also included. Overall, participants reported fewer inner barriers at time 2 $M = 2.97$ $SD = \pm 1.32$ in comparison to time 1 $M = 3.65$ $SD = \pm 1.43$, $F(1,232) = 5.24$ $p < 0.05$. However, there was no interaction between time and group on the reported inner barriers, $F(2,232) = 2.03$ $p = 0.13$ (see Figure 16). In terms of covariates, age had an effect on reported inner barriers. Younger adults reported higher levels of inner barriers than the middle-aged, and older adults (see Table 10); $F(1,232) = 22.05$ $p < 0.05$. There was no significant interaction of age with time, $F(1,232) = 1.75$ $p > 0.05$. The covariates of gender and household size also had no effect on the reported inner barriers $F(1,232) = 2.37$ $p > 0.05$, and $F(1,232) = 0.024$ $p > 0.05$ respectively.

Figure 16

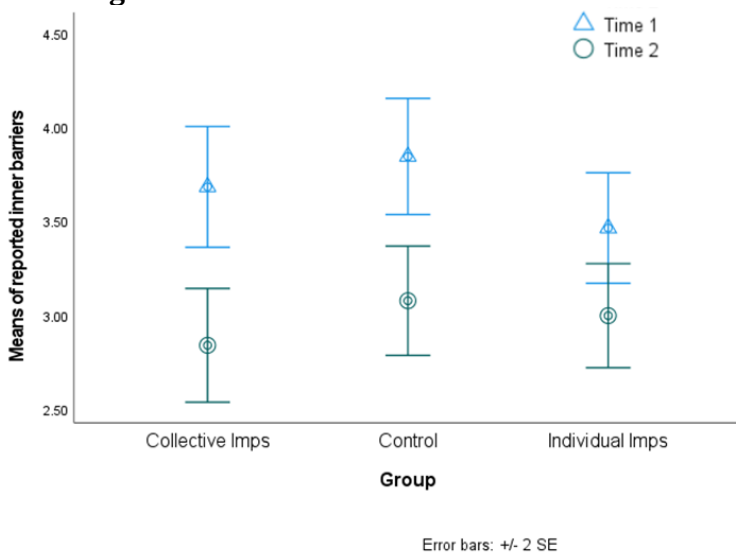

Figure 16 Mean of reported inner barriers to all experimental groups across time. The blue triangles represent the mean of reported inner barriers at time 1 for all groups with their standard error. The green triangles represent the mean of reported inner barriers at time 2 for all groups with their standard error.

5.3.5 Outer barriers

I examined whether imp interventions had an impact on perceived outer barriers to reducing food waste with an ANCOVA. The factor of time was within subjects with two levels (time 1 and time 2) and the between subjects' factor of group had three levels (Collective Imps, Individual Imps, and control groups); covariates of age, gender and household size were also included. Overall participants reported no changes in outer barriers over time $F(1, 232) = 2.73$ $p = 0.09$. There was no effect of the presentation of Imps on reported outer barriers to reducing food waste $F(2, 232) = 1.45$ $p = 0.23$ (see Figure 17). The analysis of the covariates did indicate an effect of age on the reported outer barriers: younger adults reported more outer barriers than older adults, $F(1, 232) = 12.96$ $p < 0.001$. Moreover, young adults reported that outer barriers decreased in time 2 in comparison to time 1 to a greater extent than middle-aged and older adults (see Table 10). The analysis indicated that gender also affected the reported outer barriers; males reported more outer barriers than females $F(1, 232) = 3.56$ $p < 0.05$. There was no effect of household size on the outer barriers.

Table 10 Mean and SD of reported outer barriers to different age groups at time 1 and time 2

	Inner Barriers			Outer Barriers		
Age	**Time**	**Mean**	**SD**	**Time**	**Mean**	**SD**
Young adults	1	4.13	1.34	1	4.10	1.39
	2	3.30	1.32	2	3.34	1.42
Middle-aged adults	1	3.62	1.34	1	3.45	1.39
	2	2.94	1.30	2	3.073	1.41
Older adults	1	2.92	1.53	1	2.966	1.54
	2	2.54	1.26	2	3.09	1.43

Figure 17

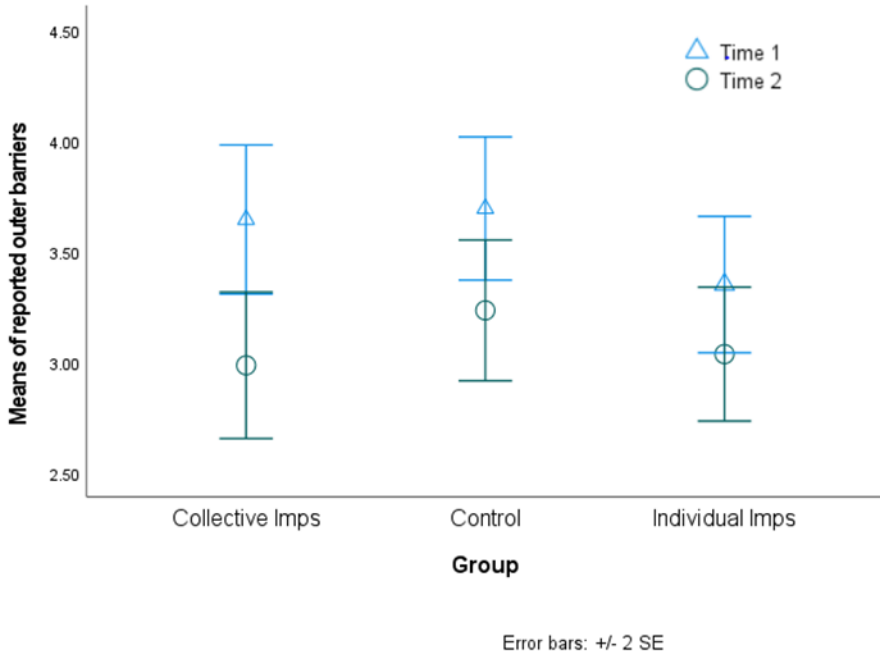

Figure 17. Mean of reported outer barriers to all experimental groups across time. The blue triangles represent the mean of reported outer barriers at time 1 for all groups with their standard error. The green triangles represent the mean of reported outer barriers at time 2 for all groups with their standard error.

5.4 Discussion

This study assessed whether Imps could contribute to the shielding of food waste. The use of Imps did not affect on the reported levels of food waste. However, the reported levels of food waste did reduce over our study period for all participants; these results could be attributed to instructions given to all individuals that proposed shielding behaviours to help individuals stick to their avoiding food waste goal. Participants may have formed self-regulated strategies to reduce food waste, even those in the group with no implementation intentions.

Furthermore, this study aimed to understand if the use of collective Imps affected food waste avoidance behaviours. Findings also indicated no effect of collective Imps on the levels of communication with others about their efforts to avoid food waste. Reported levels did differ depending on the age of the individuals though; older adults seemed to talk less about their efforts in reducing food waste than younger adults. This study contributes to developing of interventions promoting sustainable behaviour change by exploring the use of shielding strategies, novel to imps in environmental psychology. The lack of effect of Imps on sustainable behaviours indicates that these are not consistently effective; future research should consider what moderates the success of imps.

This study considered prior research where individuals reported their incapability of shielding environmental goals as one of the main obstacles that prevent them from undertaking environmental behaviours (chapter two). Here, participants were provided with Imps to promote behaviours that could shield the goal of avoiding food waste. Findings suggest Imps may not impact on some behaviours, in this case, avoiding food waste. However, overall food waste was reduced across groups, possibly due to the behaviours encouraged across all groups that aim to shield the goal of avoiding food waste. This is consistent with literature suggesting that increasing of

awareness of behaviours that aim to reduce food waste can help increase engagement with these behaviours (Feijoo & Moreira, 2020; Stefan et al., 2013). This research highlights the relevance of shielding behaviours aimed at avoiding food waste; these behaviours should be targeted in future communications aimed at reducing and avoiding food waste at a household level.

Findings in this study also indicated that men reported a greater reduction in their levels of food waste in comparison to women. This could be attributed to women being more likely to waste less food than men. Therefore, when given the goal-directed behaviours, men reported a greater improvement in food management than women. This is consistent with the literature on food waste that reports that women have better food management skills than men (Abdelardi, 2018; Stefan et al., 2013).

Moreover, results indicated that younger adults waste more food than older adults. This is consistent with literature reporting that older adults are better at managing food and waste less (Abdelradi, 2018). Furthermore, younger adults reported greater reduction in food waste levels over time compared to older adults. These findings suggest that behaviours to prevent food waste were particularly effective for younger adults. This is consistent with the literature on food waste and the assessment of the different levels of food waste depending on demographics (Secondi et al., 2015; van der Werf et al., 2021; Visschers et al., 2016). The food waste literature has widely explored the use of planning strategies to limit shopping and food waste (Stefan et al., 2013). However, more attention should be given to the promotion of shielding behaviours and considering the age differences when developing strategies to reduce food waste.

In terms of reported barriers, young and middle-aged people reported more inner than outer barriers getting in the way when trying to avoid food waste in the household. This is consistent with research suggesting that the main factor contributing to food waste is poor food management and

the changes in individual capabilities to manage food as individuals age (Aschemann-Witzel et al., 2015; Von Kameke & Fischer, 2018). Reported poor food management in the literature may be due to a need for more of awareness on how to deal with food and leftovers. In addition, people reported a reduction of inner barriers at time 2 compared to time 1 (across groups); this reduction could be attributed to the presentation of behaviours that shielded the avoidance of food waste in the household. As for perceived outer barriers, while younger individuals reported a high prevalence of outer barriers compared to middle-aged and older adults, younger adults reported these barriers to decrease to a greater extent in time 2 compared to the other adults. This implies that instructions about shielding behaviours may have contributed to tackling the barriers set by their behaviours or mental states (e.g., forgetting) and barriers set by others (e.g., by spreading awareness of food waste avoidance).

One caveat of this study was it took place just after most COVID-19 restrictions were lifted in the UK and food establishments could re-open. This could have had an impact on food management and levels of food wasted in the household since people were able to eat out, changing purchasing and eating habits in the household. For the recruitment purposes, I used the Prolific platform to invite individuals in a household with children and two adults to participate in the study. However, this study indicated that there might be errors in this data since our sample included different types of households with more than two adults and no children; this may have reduced the homogeneity of the sample. Another limitation of this study is that results rely on people's reported levels of food waste. I note that reported changes in food waste levels may not be accurate, and people could lie about their levels of food waste due to the nature of the behaviour and the social connotations of wasting food (e.g., environmental impact, hunger around the world).

Further research should focus not only on helping to initiate the behaviours to avoid food waste but also on promoting shielding behaviours to maintain the goal of avoidance of food waste

in the household. Moreover, these strategies should impact young adults who report facing more barriers to engaging with food waste avoidance behaviours. The use of collective Imps did not affect the behaviour of avoiding food waste. This could be attributed to the fact that Imps may not impact on certain behaviours. However, this study found that young adults do tend to communicate with others about their efforts to avoid food waste. Future research on avoiding food waste within the young adult community could promote the reduction of food waste in households by setting collective goals or through building on other aspects of communication, e.g., social norms.

Furthermore, identifying potential barriers preventing the shielding for other pro-environmental behaviour (e.g., transport, recycling, energy-saving) could be explored to help maintain sustainable behaviours in people's daily lives. This study contributes to a better understanding of the constraints people face at the different stages of engagement with sustainable behaviour. Other stages of goal engagement could also be explored, such as being unable to disengage with non-environmental behaviours, along with the possibility of tackling these with self-regulation strategies.

Chapter 6

6 General discussion

6.1 Summary

This thesis's findings contributed to the literature on barriers to pro-environmental behaviours indicating that different behaviours, individual and collective. Furthermore, this thesis also found that implementation intentions did not affect pro-environmental behaviours. In order to help develop planning tools that help individuals overcome the intention-behaviour gap, this PhD tested the application of the conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006) for the classification of barriers to engaging with pro-environmental behaviours (i.e., individual and collective levels). Findings indicated differences between the barriers perceived for individual and collective pro-environmental behaviours. According to this thesis's findings, problems remembering to engage with pro-environmental actions and difficulties changing habits were the most common barriers to engaging with individual pro-environmental behaviours. Problems with differences of opinion and transferring guilt to others were the most common barriers to engaging with collective pro-environmental behaviours. As for the conceptual framework of barriers, the predominant type of barrier to engaging with individual and collective pro-environmental behaviours was the goal initiation barrier (GI).

Furthermore, this PhD aimed to understand the impact of implementation intentions (Imps) on pro-environmental behaviours and explore different strategies that can increase the effectiveness of Imps. This PhD found no effect of Imps on the pro-environmental behaviours assessed here; and no enhancement of this impact with the strategies used here (i.e., visual imagery, shielding strategies, and collective forms on Imps). These findings contribute to the literature on Imps,

indicating that the if-then plans may not have an impact on promoting certain behaviours. This chapter covers the practical and theoretical implications of the findings, and the shortcomings of the research. Finally, the suggested directions for future research and concluding remarks can be found at the end of this chapter.

6.2 Empirical and theoretical findings

6.2.1 Public perceptions of barriers to engagement with environmental behaviours.

This PhD applied the conceptual framework of barriers proposed by Gollwitzer (2006)- barriers to initiating, shielding the goal, disengaging from unattainable goals, and having many goals simultaneously- to identify the barriers to engaging with individual and collective pro-environmental goals.

Data obtained in this thesis indicated that people face different barriers to engaging with different levels of pro-environmental goals (i.e., individual and collective). Individual pro-environmental behaviours were related to difficulties remembering goal-directed behaviours (e.g., forgetting to bring bags when going shopping) and difficulties changing habits (e.g., driving a lot when being at home). In contrast, collective pro-environmental behaviours had more barriers related to others' inability to change habits and differences of opinion (chapter two).

In terms of the application of the conceptual framework of barriers (Gollwitzer & Sheeran, 2006), the classification of barriers relating to individual pro-environmental behaviours was difficult, possibly due to only short responses provided by participants which made clear identification of the stage of engagement difficult. In contrast, barriers reported for collective pro-environmental behaviours fitted better into the conceptual framework.

The study of barriers included in this thesis highlighted themes describing the nature of barriers to pro-environmental behaviour that have not been reported before within the literature such as, problems with differences of opinion and others inability to make a change for collective behaviours; and need of reminders for individual behaviours. Additionally, this thesis provided further information about the psychological barriers related to transferring guilt to others that was previously reported in the literature (Gifford 2001; Gifford et al 2018). Specifically, this thesis suggests that this transfer of guilt related to individuals' perceptions of others' behaviours are problems changing their habits and preferring convenience.

Furthermore, the findings in this thesis regarding problems changing habits as a barrier to pro-environmental behaviours support literature that reports that habitual behaviour can influence- or get in the way- the performance of pro-environmental behaviours (Steg and Vlek 2009). The literature on pro-environmental behaviours highlights money constraints as one of the main obstacles that limits individuals' engagement with pro-environmental behaviours (Gifford, 2011; Gifford, Lacroix, & Chen, 2018; Gifford & Chen, 2017; Kollmuss & Agyeman, 2002; Lorenzoni et al., 2007). Data within this thesis did not find barriers related to money constraints as the most relevant issue that hinders engagement to pro-environmental behaviours. This thesis suggests that problems remembering to engage with goal-directed behaviours, difficulties changing habits, and convenience are the main obstacles to engagement with individual pro-environmental behaviours.

For collective pro-environmental behaviours (chapter two), findings in this thesis indicated that differences of opinion within a group and problems observed with others' behaviours (e.g., others having difficulties changing habits, other's lack of knowledge) were perceived as the main problems in engaging with collective pro-environmental behaviours (chapter two).

In terms of the implementation of conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006) seemed to more accurately classify the stages of engagement in which the perceived barriers cause the intention-behaviour gap for collective pro-environmental behaviours.

6.2.2 Implementation intentions and environmental behaviours

This PhD found no effect of Imps on promoting the pro-environmental behaviours assessed here: energy-saving, purchase of environmental products, avoidance of single-use plastic bottles, and food waste. Findings from this thesis contribute to the literature on Imps and their impact on pro-environmental behaviours. Moreover, this thesis added to the literature by testing the effect of Imps on reported behaviour and assessing the use of other strategies that had the potential to strengthen the impact of Imps on pro-environmental behaviours. This thesis indicated that Imps did not affect the pro-environmental behaviours assessed here (i.e., energy-saving, purchase of environmental products, avoidance of single-use plastic, and avoidance of food waste). Almost all environmental behaviours assessed in this PhD reported a change across time for all experimental groups. These changes in behaviour may be attributable to the instructions given to all experimental groups. At the same time, Imps groups had if-then action plans to help them achieve their goals. It is possible that the instructions indicating goal-directed behaviours, provided to all groups, could have affected the development of a behavioural strategy in all the groups including the control groups. This is consistent with the findings of Holland et al. (2006), in which the control group had a facilitator (e.g., a special bin for recycling) that may contribute to the reduction in the amount of paper disposed of in general waste bins. However, Holland et al. (2006) did report a difference in performance between the Imps group and the control with the facilitator group. In contrast, results in this thesis indicated no differences in reported behaviour between Imps groups and control groups. These findings suggest that the presentation of simple instructions alone to control groups can change behaviours.

Data collected within this thesis suggest no effects of Imps on behaviour, this is consistent with the literature reporting difficulties promoting behavioural change within actions that hindered individuals' personal goals (i.e., setting goals that interfere with other behaviours) (Gollwitzer and Brandstätter,1997). Additionally, DeWitte et al. (2003) suggest that challenging goals that require actions that have not been fully imagined by the individual yet, may not benefit from the formation of Imps. It is possible that participants had troubles to picture themselves engaging with the given goal-directed behaviours. This could be associated with problems identifying the situational cues that can help to trigger the action.

It is also possible that the effect of Imps could have been overshadowed by the impact of instructions on goal-directed behaviours given to the control groups. Knäuper et al. (2011) reported that they found only a small effect between the behaviour change of their control condition (i.e., instructed to repeat their goal intention of consuming more fruit) and that of their Imps condition (i.e., led to repeat goal intention and form three if-then plans). This is inconsistent with the vast amount of studies reporting large to medium effects within Imps intervention studies (Armitage, 2007; Gollwitzer & Sheeran, 2006; Holland et al., 2006). It is considered that the lack of effect of Imps on the environmental behaviours assessed here could be due to the complexity of the behaviours and how embedded non-environmental activities are in people's daily lives (e.g., purchase of cheaper non-environmental products, over-shopping of food resulting on lots of waste. The complexity of pro-environmental behaviours and the non-environmental habits embedded in individuals' daily lives could have also contributed to the observed ineffectiveness of Imps in this thesis.

To the author's knowledge, this is the first thesis that tests shielding Imps (i.e., action plans aimed for maintaining the goal-directed behaviours) within the environmental domain. Most research on Imps aims to promote goal initiation; a limited number of studies assess the impact of

goal-shielding Imps on behaviour (Achtziger et al., 2008; Parks-Stamm et al., 2010). Findings here suggested no impact of shielding Imps on pro-environmental behaviour (chapter five). Overall, the presentation of goal-directed behaviours aimed to shield the food waste goal I developed helped reduce the levels of food waste due to spoilage and waste of still-edible leftovers, but Imps did not reduce waste beyond our control groups observed reduction.

6.2.3 Imps and visual imagery

Imps formatted with additional visual images were not found to impact pro-environmental behaviours here (chapter three). However, the use of images did affect behaviour overall compared to the performance of those who were presented with text representations of the goal-directed behaviours. This supports literature on images suggesting that visual imagery can communicate messages quickly, enabling the conceptualisation of complex situations (Pahl et al., 2016; Sheppard, 2005).

The lack of impacts of visual images within Imps could be attributed to the use of the environmental cues within if-then plans. These may not have been relevant for all individuals, interfering with the salience of the images and the effect of Imps on behaviour change. Interestingly, the use of Imps and images affected people's reflection on whether the behaviours could fit into their habitual routines: people with visual images reported difficulties considering the pro-environmental behaviour of purchasing environmental products as being part of their daily life behaviours. These difficulties were not present within the groups presented with only text representations of the goal-directed behaviours. It is possible that the images used were not enough for individuals to visualise themselves carrying out the behaviours as part of their daily lives. This relates to research theorising that complex tasks that may have no clear outcomes, or outcomes that are difficult to imagine, will be difficult to promote with the use of Imps (DeWitte et al., 2003).

The literature on mental imagery considers two different types of imagery that can be used to help goal achievement: outcome imagery (e.g., benefits of successful completion of the goal) and process imagery (e.g., steps needed to reach the desired outcome) (Knäuper et al., 2011). When adapting this literature to visual imagery, I focused more on process imagery rather than the outcome imagery. In terms of complex tasks, such as pro-environmental behaviours, it might be more effective to promote the outcome imagery with visual imagery to help individuals recall their environmental goals and maintain motivation to engage with goal-directed environmental behaviours.

6.2.4 Collective implementation intentions

This thesis proposed a novel way to form collective Imps. This PhD suggested a collective Imps form that includes a collective component (e.g., If we encounter X, we will do Y, and we will tell others about Y) within collective Imps. Findings indicated no impact of the Imps on the promotion of pro-environmental behaviours. This suggested form of Imps differed from previous collective Imps forms explored within the literature which have kept the form of the individual Imps, by only changing the pronoun "I" to "we" (e.g., If we encounter X, we will do Y) (Thürmer et al., 2017; Wieber et al., 2012). This change was made to make more salient to the individual the collective aspects and actions involved in collective behaviours. However, studies in this thesis indicated that collective Imps did not affect pro-environmental behaviours. All study groups reported different levels of engagement with environmental behaviours between the times when the behaviour was measured, but the control groups also exhibited differences similar to the experimental groups indicating that the general instructions provided were enough to promote behaviour change.

It is possible that the findings from this thesis on collective Imps may differ from those reported in the literature due to the complexity of the actions assessed here. It may be that the

effectiveness of the Imps depends on the behaviour one attempts to impact; simple behaviour may be more easily impacted by Imps. Furthermore, the nature of the goal used in previous studies on collective Imps (e.g., persistence task) relied on the promotion of the group concepts of identifiability (e.g., group members' sense of belonging to the group) and indispensability (e.g., feeling that your group needs you) to improve group performance (Thürmer et al., 2017). It is considered that these concepts of identifiability and indispensability were not implemented in the formation of collective Imps for promoting pro-environmental behaviours.

Interestingly, whilst there was no impact of shielding Imps on food waste behaviours, findings suggested differences in the reported behaviours from different demographics. Young adults reported that they communicated more with others about their efforts to reduce food waste at home in comparison to the levels of communication with others held by older adults; this was for all experimental groups. Young adults also reported higher levels of food waste compared with older adults. This is consistent with the research on food waste (Secondi et al., 2015; Stancu et al., 2016; Visschers et al., 2016) which indicates that young adults tend to waste more than older adults. Interestingly, data in this thesis indicated young adults also seemed to report a greater reduction in food waste across time. These findings suggest that young adults may have intentions to reduce their food waste, but they have less awareness of good management practices to avoid food waste. Moreover, findings indicated older adults reported very low levels of food waste, and this did not change much over time. It is possible that Imps did not impact the behaviour of older adults due to a ceiling effect; in other words, older adults were not able to reduce the food wasted in their household much more than what they were already reporting.

6.3 Implications of findings

6.3.1 Theoretical implications

6.3.1.1 *Perceived barriers to pro-environmental behaviours*

This research has highlighted the relevance of identifying the obstacles that hinder pro-environmental goals' achievement. This thesis suggested the assessment of these obstacles with the use of a conceptual framework of barriers to classify barriers to individual and collective pro-environmental behaviours based on the stage of engagement these barriers impact on. Whilst the conceptual framework presented difficulties categorising the barriers to individual pro-environmental behaviours, this framework seemed to fit the barriers reported for collective pro-environmental behaviours. To the author's knowledge, no previous research had implemented a theoretical approach to classify barriers that impact collective pro-environmental behaviours.

Furthermore, data presented here showed the presence of different barriers when behaving collectively compared to individually. Therefore, when developing behavioural interventions to promote pro-environmental behaviours, researchers should consider tailor interventions to individual and collective pro-environmental behavioural barriers as appropriate to the contexts (chapter two). Results in this thesis suggest engagement with individual environmental behaviours is most likely to be disrupted by barriers related to the need of reminders, and problems changing habits; whereas engagement with collective behaviours is most often disrupted by problems related to the differences of opinion within the group, and problems with others' behaviours (e.g., convenience, lack of knowledge). Hence, this thesis considers that communication campaigns promoting pro-environmental inclusion as part of people's habits could make pro-environmental behaviours more memorable for the general public. In addition, perhaps promoting initiatives that encourage people to talk about pro-environmental behaviours within their community and promote

the engagement with collective behaviours. This strategy of communication could also help engagement with individual pro-environmental behaviours since the main reported barrier here was not remembering the goal-directed behaviours.

6.3.1.2 *Implementation intentions, pro-environmental behaviours*

Data obtained within this thesis indicated that Imps might not be effective in promoting environmental behaviours tested in this thesis (i.e., energy-saving, avoiding single-use bottles, purchase of environmental products, reducing food waste). Results indicated that the use of Imps did not impact behaviour by themselves and when they were paired with visual imagery strategies or framed for shielding behaviours, and collective Imps. Whilst these findings could be attributed to no impact of the different types of Imps, it is also possible that the environmental behaviours assessed here cannot be enhanced with the use of any form of Imps. Furthermore, the findings of this thesis are relevant to the literature on Imps, indicating that the types of Imps developed here were not practical for behaviour change. It also contributes to the research on how the effect of the Imps is different, in this case, not effective, for different behaviours (DeWitte et al., 2003; Gollwitzer & Brandstätter, 1997; Knäuper et al., 2011).

Moreover, data on the impact of the proposed form of collective Imps indicated no impact on environmental behaviours. These findings might be attributable to the complexity of the behaviour examined, as well as the difficulties of assessing collective behaviours (e.g., recruitment and assessment of behaviour for all members). Further to this, since findings in this thesis on public perceptions of pro-environmental behaviours and climate actions suggest that the public considers collective action as a key component in the fight to mitigate climate change, it is relevant for academics to explore ways to promote engagement with collective environmental behaviours.

Although visual imagery did not appear to make improve the effectiveness of Imps, our data indicated visual imagery representations of goal-directed behaviours may have an impact on the effectiveness of pro-environmental behavioural goals more generally. Therefore, visual imagery could be used to help recall pro-environmental behaviours that the public intends to undertake, promoting goal attainment. As for the last strategy paired with the Imps in this thesis, although the shielding Imps had no effect on behaviour, the shielding goal-directed behaviours did have an impact on reported levels of food waste. Thus, it is considered in this thesis that exploring the use of shielding strategies as a way to help individuals act according to their pro-environmental intentions could contribute to the literature on environmental habit formation.

6.3.2 Policy making implications

The findings in this thesis are relevant to policymakers since many governments have committed to tackle the current environmental issues and encourage the adoption of environmental practices within their countries. Findings in this thesis about the perceived barriers to engagement with pro-environmental behaviours could also contribute to the identification of new initiative development for managers of the private and non-governmental organisations. This is relevant since, authorities and the general public, are increasingly paying attention to the social and environmental impacts of companies (Sun & Yu, 2015). Research indicates that employees in socially responsible companies generate better operating performances (Sun & Yu, 2015). This section provides insights for policymaking and evidence relevant for the development of both internal and external initiatives within institutions.

6.3.2.1 ***Public perceptions of pro-environmental behaviours.***

Importantly, governments should recognise and address the social obstacles that hinder public's engagement with sustainable behaviours. For instance, this thesis suggests that people have

problems remembering to engage with individual pro-environmental goal-directed behaviours. Governments could promote programmes making pro-environmental behaviours more salient to the public, perhaps through notices or contextual reminders (e.g., signs/notices on streets or shops). Public perceptions regarding engagement with pro-environmental behaviours indicate difficulties when starting collective environmental actions, particularly in relation to perceived differences of opinion of others and problems with the way others behave. Governments should consider promoting the resurgence of collective actions, supporting community discussion and collaboration around sustainable action, to help increase public engagement with climate change. Barriers to individual pro-environmental behaviours included problems changing habits, and convenience. Hence it is relevant for policy-makers to consider strategies that aim to disrupt habits that may contribute to the environmental issues by making them less accessible to people (e.g., make parking spaces less available to people), and in parallel create the opportunities for people to engage with more pro-environmental behaviours (more cycling routes, and/or more accessible public transport). One other barrier reported by individuals- in a less extent- was money constraints. Costs-effectiveness is clearly an important factor to consider in the adoption of more pro-environmental behaviours. Governments could help local and sustainable shops to promote their products creating fair market competition. In addition, the introduction of incentives (e.g., tax credit) for people engaging with pro-environmental behaviours could contribute to promote the engagement with more pro-environmental behaviours. Also, making non-environmental behaviours less accessible could contribute to people's engagement with more pro-environmental behaviours.

Furthermore, this thesis highlighted how relevant people perceive collective actions and community engagement with pro-environmental goals. It is, therefore, recommended that governments consider encouraging collective actions when promoting sustainable behaviour change. Additionally, private and non-government organisations' managers could consider this to

promote engagement with pro-environmental behaviours within their company through the use of collective interactions. This could have an effect not only on the environmental impact of the organisations but also can reduce operating costs of the company (e.g., reducing energy consumption, reducing food waste in the canteen). While promoting collective interactions and community engagement may be challenging, if successful, sustainable behaviours are likely to be maintained in the long term.

6.3.2.2 *Implementation intentions, pro-environmental behaviours*

The findings of this thesis regarding strategies used to enhance Imps indicated that shielding strategies can contribute by helping the public maintain the behaviours that are not yet embedded within their habits. The implications of this for policymaking and businesses involve the need to monitor behaviours people already undertake to ensure the public does not disengage from these behaviours, especially if they are behaviours to do individually.

Data within this thesis on food waste levels in England households indicated young adults report greater levels of food waste, potentially associated with food management issues. Governments should consider directing public policies and campaign messages aimed at this demographic. By addressing food management strategies that help reduce food waste in the household- beyond shopping planning routines- governments could contribute to a reduction of the food wasted.

Moreover, data obtained in this thesis regarding collective spillover indicates that encouraging communication with others about environmental efforts could help pave the road for the introduction of other pro-environmental behaviours. This can be useful for governments and institutions as a cost-effective strategy, exploring if the promotion of one behaviour can promote

other behaviours in the same domain (i.e., environmental behaviours) or in a different domain (e.g., healthy behaviours).

6.4 Shortcomings

Given reflection on the development of the research alongside the knowledge acquired when conducting the experiments, it is considered that certain aspects of the research would be done differently if there was a chance to repeat them.

In terms of the assessment of barriers for pro-environmental behaviours, it is considered that sampling strategy and the use of more in-depth questions could have enriched the assessment of barriers to individual and collective pro-environmental behaviours. Since the research assessing barriers involved only participants of a certain age (i.e., undergraduate students) the nature of barriers reported may not reflect all the barriers that people may face when engaging with pro-environmental behaviours. If there was a chance to repeat study 2, I would have follow-up the barriers found from the secondary data with a study assessing people's perceptions of the barriers to individual and collective behaviours mentioned in study 2.

As research suggested rehearsal of Imps can increase the likelihood of their impact on behaviour (Knäuper et al., 2011), and the use of more rehearsal strategies may have enhanced the impact of Imps on behaviour. Even though individuals reported high levels of intentions to engage with pro-environmental goals set, the use of tailored Imps to the individuals' situational cues and behaviours might have enhanced stronger intentions and resulted in greater behaviour change. Further to this, for study 2, it would have been useful to narrow the participants' recruitment to UK residents; since literature suggests different countries can have different perceptions toward climate change and pro-environmental behaviours (Poortinga, Whitmarsh, Steg, Böhm, & Fisher, 2019).

The two studies on collective Imps attempted to promote collective behaviours within participants (chapters four and five). However, due to the lack of face–to–face interaction, group cohesion was not established (chapter four), and the impact on all members of the group was not achieved (chapters four and five). A face-to-face study was attempted to be conducted to assess the impact of collective Imps on environmental behaviours; however, the global pandemic caused the suspension of this study. If the use of face-to-face testing were possible, it is considered that collective Imps could have had an impact on behaviour. In the case of study 3 (chapter four), the use of a different chat platform that is used more frequently (e.g., Facebook or WhatsApp groups) and a design where members could have known each other beforehand, increasing group cohesion, could have resulted in an impact of collective Imps on environmental behaviours. Thus, further research on this topic is recommended to fully explore the impact of collective Imps on behaviour.

In terms of recruitment, a general problem for the PhD was the occurrence of the COVID-19 global pandemic, which reduced the options of recruitment and restricted studies' design to the use of online platforms only for experiments. Study 3 (chapter four) was conducted using students who participated for course credits within the university recruitment platform. Although it might be a good recruitment platform for one-time studies or the assessment of cognitive tasks, it is not considered the most useful platform for assessing two-part studies involving collective interactions. This is due to observed problems such as participants not completing the questionnaires on the group timeslots as instructed which might have interfered with group activities and cohesion. Further to this, the development of the study of the impact of Imps on food waste (chapter five) was meant to consider households in England with two adults and two children. Whilst this filter was coded on the Prolific website, it was not considered that Prolific users may not update their basic info on the website. This meant that different kinds of the household were assessed in this study, making difficult the assessment of behaviour change within a homogenous sample as intended. In

addition, the study on promoting the avoidance of food waste with Imps (chapter five) could have considered an age limit. It could have been useful to assess the impact of imps on people with higher levels of food waste, as is likely in younger and middle-aged adults since older adults are considered to have good food-management skills.

A general shortcoming of the research conducted on Imps within this thesis is that experiments assessed behaviours through self-reported behaviour for a maximum of two different timepoints for any one study; a longer period of time of study would have been preferable The reason for this was practical, relating to the complexity of observing environmental behaviour changes (e.g., meter readings), and to monetary reasons (e.g., self-report at different timepoints could involve greater inconvenience allowances). Moreover, the time window may have been too short for the study of changes of environmental behaviours to be detected. The use of observable metrics and diaries for self-reports, along with a longer time window (e.g., a monthly assessment of behaviour) could have helped to develop more conclusive results on the effects of Imps.

6.5 Future research

6.5.1 Perceived barriers to specific behaviours

It would be interesting to further explore comparisons of reported barriers to collective and individual pro-environmental behaviours and assess if there are differences between individual and collective barriers. In addition, it would be interesting to assess potential co-occurrence effects between barriers, meaning barrier A and barrier B being reported to be present together. Despite the difficulties in classifying the secondary data according to a conceptual framework in chapter two, particularly with regards to the barriers to individual pro-environmental behaviours, it is considered in this thesis that the suggested categorisation can help to identify where, within the stages of engagement, the perceived barriers may impact behaviour.

A further focus for future research could be to explore the public's perceptions of the barrier of overextending oneself when considering engagement with pro-environmental behaviours. This was not achieved in study 1 (chapter two) due to the nature of the secondary- data (open-ended question about general barriers to pro-environmental behaviours); there were very limited qualitative descriptions of barriers experienced that fitted within this conceptual category. This could help me to understand if the barrier is not present within the problems to engaging with pro-environmental behaviours or perhaps whether this is a complex barrier for individuals to reflect on and self-report. In addition, exploring the application of the conceptual framework of barriers in the identification of barriers to other types of behaviours (e.g., healthy eating, voting, and engaging with physical activity), could be interesting for the assessment of the framework of barriers as a useful tool to help address barriers to engaging with goal-directed behaviours more widely.

It could also be fruitful to assess the perceived barriers to specific pro-environmental behaviours and climate actions, particularly in those with currently low levels of engagement. Furthermore, it may be useful to make the distinction between inner states barriers (e.g., other actions and states of mind hindering pro-environmental goals' achievement) and outer states barriers (e.g., behaviours from others and context obstacles hindering the individual pro-environmental goals' achievement). Although inner and outer states are only considered in the literature for shielding barriers (Gollwitzer & Sheeran, 2006), findings in this thesis suggest that barriers classified as goal initiation and goal disengagement can have these two states present as well.

6.5.2 Implementation intentions

The study of Imps paired with visual imagery strategies indicated some reflection of the formation of environmental habits when individuals were presented with visual and text representations of Imps. Therefore, it is considered relevant to explore the use of visual imagery

strategies to help people reflect on their pro-environmental behaviours and assess how changes could fit within their existing habits, helping in the promotion of environmental behaviours. This considers the literature suggesting that behaviour change can be hindered by well-embedded habits. If participants start considering how to disrupt existing habits, this could contribute to the adoption of new sustainable habits. It would be interesting to examine the use of more tailored imagery to individuals' situational context, perhaps requesting participants to draw how, when and where they would undertake the specific behaviour. This could allow the assessment of the impact of visual imagery using a different way of rehearsing the Imps on the impact on environmental behaviours. This could improve the rehearsing of Imps and make Imps more salient for individuals. It would also be interesting to examine the impact of using outcome visual imagery (e.g., benefits of successful completion of the goal) in comparison with process visual imagery (e.g., steps to take in order to reach the desired outcome) on behaviour engagement and formation of environmental habits. Chapter two in this thesis used process visual imagery representing the Imps, however, it is possible that visual imagery focused on behaviour outcomes could be more successful.

Within the use of Imps, it could also be useful to assess the impact of collective Imps in a face-to-face experimental design, building group cohesion and ensuring that participants commit to a common environmental goal. This could help test the hypothesis that collective Imps can impact environmental behaviours as it is possible that the online groups were lacking in cohesion. In addition, for the development of collective Imps it could be useful to promote the group concepts of identifiability (e.g., group members' sense of belonging to the group) and indispensability (e.g., feeling that your group needs you) to help improve group performance. These were factors identified within previous research on collective Imps that had found an impact of Imps on behaviour (Thürmer et al., 2017).

Whilst this thesis assessed the impact of Imps aimed to tackle initiation and shielding barriers to goal achievement (chapters two, six, and seven), it could be interesting to examine the use of Imps addressing disengagement barriers to environmental behaviours. I note that disengagement barriers were frequently considered in relation to the engagement with both collective and individual environmental behaviours and targeting these directly may be effective.

6.6 Concluding remarks

This thesis has suggested that the planning strategy of Imps may not be effective to promote certain behaviours within the environmental domain. All Imps studies conducted here found a change in behaviour, but this was observed within all intervention groups including the control groups, indicating that the general use of instructions that gave goal-directed behaviours was effective in promoting pro-environmental goals.

This thesis demonstrated that individual and collective pro-environmental behaviours are subject to different barriers. People consider the main obstacles to individual pro-environmental behaviours to be problems remembering to engage with goal-directed behaviours. At the same time, people consider problems with differences of opinion and others' behaviours as the main problems in engaging with collective pro-environmental behaviours.

The application of the conceptual framework of barriers proposed by Gollwitzer and Sheeran (2006), which includes four obstacles that may prevent goal achievement- goal initiation, goal shielding, goal disengagement, and overextending oneself – was found not useful for the classification of limited data like the one in study 1. However, this conceptual framework did seem to fit reported barriers for collective pro-environmental behaviours, suggesting that goal initiation barriers are the main problem to engaging with behaviour.

The data within this thesis has demonstrated to have important implications for the literature on environmental psychology, policymakers, and organisations. This thesis highlights the relevance to explore the potential differences between individual and collective pro-environmental behaviours as well as considering the use of different strategies to promote behavioural change. In addition, this thesis considers relevant the study of public perceptions of the barriers to pro-environmental behaviours for the development of self-regulation strategies aimed to help people achieve their environmental goals and engage with more climate change mitigation activities.

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8 Appendix

8.1 Appendix chapter 2

8.1.1 Thematic analysis for perceived barriers to individual pro-environmental behaviours

Theme	*Description*	*Example*	*References*
Need of constant reminders	Problems adding the environmental practices to their daily lives, need of constant reminders	"May get distracted and forget to turn off lights and equipment"; "Being organised enough i.e. remembering to bring reusable bags and planning means (if going vegetarian)"; Forgetting to turn off lights and electrical products, Memory - forgetting to do it, Forgetfulness, Forgetting to turn off lights, Barrier to re-using bags at the supermarket is that they are so easy to forget, which means you end up having to get another plastic bag anyway, Forgetting to do it, Remembering to act in an environmentally friendly manner, such as remembering to bring shopping bags or turn off appliances, Forgetting bags, May forget bags, Forgetting to take re-usable bags to the shops, Re-using bags: forgetting, Don't always remember to take bags, No one to remind you, Forgetting to sort my rubbish out into recycling and general waste, Forgetting to bring my bags to a shop and having to buy more, Forgetting a lot, Forgetting to turn off plugs when something is not needed, Leaving on hair straighteners for longer than necessary because of forgetting to turn them off, Re-using bags at the supermarket. Remembering to always do this. Walking back home if I've forgotten the bag(s), Forgetting will be a barrier in terms of turning off lights and remembering bags, Forgetting to take bags shopping, Forgetting to turn lights off when leaving the room, Forgetting to turn off my appliances when done with them, Sometimes forget plastic shopping bags at home so need to get new ones, Forgetting to shut windows and so wasting heating when I turn it on, Forgetting to recycle plastics etc.., Forgetting to be environmentally friendly in general	**30**
Difficulties changing habits	Individuals not able to quit making non-environmental practices part of their daily lives out of convenience or habit.	"Make notes on paper therefore use a lot", "Buying new products all the time instead of re-using things as soon as they get temperamental", "Too much of our society revolves around large use of electricity (e.g. laptops, mobile phones, lectures, reading articles online, etc) difficult to reduce this", "Changing my diet to vegetarinism. Choosing to value taste/convinence over helping the environment", "When at home drive a lot therefore burn a lot of fuels", "Buying new products all the time instead of re-using things as soon as they get temperamental", Changing	**26**

		your diet is often expensive and difficult especially as a student, Not putting stuff in the recycling when it should be recycled, Throwing away food that still could be used, Adapting to change	
Convenience	Environmental actions are not the easy or the most convenient actions to undertake	Not the most convenient options, Effort, Lack of motivation, Hassle, Using owning your home it is difficult to make decisions on the house you live to help the environment (e.g. double glazing or LED bulbs, Convinence, Changing my diet to vegetarinism. Choosing to value taste/convinence over helping the environment, Convenience, When at home drive a lot therefore burn a lot of fuels, Buying new products all the time instead of re-using things as soon as they get temperamental, Getting buses and taxis rather than walking to places; no commitment to turn off lights etc…, Need to leave lights on for security, so it's hard to carry on doing it, Other things getting in the way, Effort taken to carry out, Temptation to change diet, Missing meat, ….and only concerned myself with my own problems	**19**
Money constraints	Financial situations prevent individuals to disengage from non-environmental actions	"Changing diet: expense", "Financial and time costs involved in a diet change", can sometimes be more expensive if you are boycotting companies with bad morals, etc…, Changing your diet is often expensive ,Some foods might be more expensive, Eco-friendly products are expensive, i.e. solar panels, for a student this is unrealistic, Financial costs of switching entirely to environmentally friendly products when a student, Not being able to afford eco-friendly products, May cost me more money, Meat substitutes can be more expensive, Having to buy potentially more expensive products, Cost e.g. buying more environmentally friendly food, Not being able to afford environmentally friendly foods, Not being able to afford eco-friendly packaged products., Can't afford more eco-friendly options	**15**
Blame it on the Socio economic and political context	Individuals attributing their inability to disengage from non-environmental actions to the context or their community	"Poor public transport so I have to drive", "Lots of packaging (e.g., on foods) is not recyclable", "Lack of other option",Cannot recycle food waste in Nottingham!!, Lack of real incentive for companies and business to focus on being eco-friendly, Not having good access to facilities like public transport or recycling bins, Not being able to access environmentally friendly packaged goods, Different countries have different environmental laws or cultures	**11**

Lack of information	No information available on how to start being environmentally friendly	Don't know how to be eco-friendly, Failure to re-affirm the importance, Knowledge, Ignorance of my actions' consequences, Not knowing how to be more environmentally friendly, Don't know how to make a change, Knowing what to do, Taking more time to learn more about how I can help the environment, Not checking whether a company I brought from is environmentally friendly and cruelty free."Time to be able to dedicate to researching a fully free of animal product diet when a student, on a budget who leads a highly active lifestyle"	**10**
Futility efforts of individual actions	Pointless if only the individual makes efforts to disengage from non-environmental and nobody else does.	"Changing my diet - the meat industry and dairy industry is still very strong and will not be eradicated even if I choose not to eat meat", The thought that one person alone can't make a real impact so there's no point in trying, Not only useful if it's only me, Overall – there is little benefit if the majority don't do it. For example, I can re-use all my bags and recycle everything I can but won't make others do it. Everyone needs to in order for us to make a real change, Small impact of one person's use, Becoming unmotivated as not feeling like you're making a difference, You can't impact you are actually making, Small impact.	**8**
Others' responsibility			**6**
Pressure from others	Individuals feeling pushed by others to stop being environmentally friendly	"Peer pressure to eat meat", "Being dissuaded by people who aren't engaged in the idea".	2
Lack of knowledge	Others' lack of understanding, about environmental practices	"Peer pressure to eat meat", "Being dissuaded by people who aren't engaged in the idea". "Getting others to understand that there are other options for nutrition other than meat",Persuading others that the scale of our global pollution is much worse than they think, Convincing others to join, Trying to get others on board when they have strong opinions	4
Time constraints	Not having the time to be environmentally friendly	"Finding the time", "Time consuming", "Too busy ".,"Time", "Finding time to tell others"	**5**

8.1.2 Thematic analysis for perceived barriers to collective pro-environmental behaviours.

THEMES	*DESCRIPTION*	*EXAMPLES*	*REFERENCES*
others' responsibility			**56**
others' unwillingness to change habits	Others in the group not cooperating and no interested to engage with pro-environmental behaviours	"The heating temperature – is on a timer but is on is on very high and that is the way they want to keep it. They feel that because we don't let the house temperature to ever drop too low that we aren't using too much energy"; "People wanting to keep the heating on all the time"; "People not agreeing with the eco-friendly decision either for example not wanting heating lower"; "Friends and family unwilling to recycle their waste"; "Which is hard to agree on when there are lots of people living together."; "People putting the recycling and waste in the wrong bins"; "With things like eating, you can't always control what everyone else wants to do especially in a shared household, as people have their own opinions"; "Friends/housemates have different priorities, would rather have the heating on, shower for longer, etc…"; "People leaving the running water and so excessively overusing it"; "Housemates buying non-eco-friendly packaged products"; "People opening windows rather than turning the heating down"; "Others may turn lights back on"; "Not eating meat (for some) can cause health issues if not done properly (if you are iron deficient for example)"; "Even if environmental changes are made, other people may not stick to these new routines, meaning they will not have a very big effect"; "Setting a heating temperature with housemates. Resistance if they value warmth over care"; "People not taking it seriously"; "People forgetting to turn lights and plugs off when they're not needed"; "Others not turning off appliances when not in use".	30
convenience	Other people do not want to disengage from non-environmental actions out of convenience.	"Others are not willing to make sacrifices"; "Housemates driving instead of walking into university"; "People being lazy, doing what's easier, or doing what they prefer"; "There may be conflicts between being environmentally-friendly and other people's priorities (such as being comfortable). For example, some people may want the heating to be kept higher for comfort"; "Others are not willing to make sacrifices"; "People may be colder with reduced use of house heating; "Extra effort taken to complete these new tasks"; "Different diet requirements and tastes mean hassle in food choices"; "People are selfish and want what's best for them in the moment i.e. to be more quickly may want to just put the heating on, instead of wearing more layers, for example"; "Politicans own agendas"; "People are not willing to reduce meat intake because they don't care about animals"; "People buying animal cruelty products"; "Others throwing all rubbish into one bin without sorting it out"; "Housemates driving instead of walking into university".	15
others' non-acceptance of responsibility	Others not accepting the responsibility and consequences of non-environmental actions	"Others are not willing to accept their impact", "Opposition from those who do not believe in environmental issues", "People might not feel it is their responsibility to be eco-friendly"	6

perceived lack of knowledge	Others lack understanding of how to be environmentally friendly prevents the group to act.	"Ignorance fuelled by spreading of misinformation in certain tabloids", "Ignorance on the other's behalf, refusal to see another point of view", "Housemates know less about how to recycle"	4
money constraints	Financial issues preventing others in the group to be environmentally friendly	"Others not being able to afford more environmentally friendly way"	1
differences of opinion.	Differences of opinion preventing groups to act in an environmentally friendly way.	"Lack of interest from my housemates", "There could be arguments over differing views and whether there is a need to make these changes", "Talking with others about environmental issues. Them feeling pressured"," Others disagreeing with my opinions about helping animals and the environment".	**36**
no interest within the group	The groups' lack of interest on being environmentally friendly	"Lack of interest or motivation", "If live with friends lots of showers therefore lots of heating to warm up water", "Close mindedness"	**9**
money constraints	Financial issues preventing the group to be environmentally friendly	"Not having the money to buy eco-friendly products", "Cost of environmentally friendly products"," Economic problems of eco-friendly alternatives being more expensive"	**7**
need of reminders to maintain actions	Need of reminders to maintain environmental behaviours in their daily routine.	"Maintaining a system (e.g., recycling) as a group - getting enough detail that everyone is doing it the same", "Having the recycling bin emptied regularly enough to put more recycling in", "Forgetting to maintain actions"	**7**
time constraints	Problems managing their time in the group to start being environmentally friendly	"Time management", "Having the time", "Other things getting in the way", "Other housemates are too busy	**7**
Blame the socio-political and economic context: context constraints	The lack of regulations and facilities for the community to be environmentally friendly	"Being unable to change things i.e., change the lights in a rented house"," we need change to come from the top (laws etc) not the bottom"	**6**

Futility efforts	The group consider it pointless if only the some make the efforts of being environmentally friendly and nobody else does.	"Recycling will only be good if everyone does it", "People think that one person can't make a difference", "Everyone needs to switch off lights in the house for it to make a difference"	**4**

8.2 Appendix chapter 3

8.2.1 Visual Imps experiment- Questionnaire

Table 11. Scales of variables with the category levels and reliability scores

Variable	Response scale	Cronbach's alpha
Buy single-use plastic bottles- Over the past two weeks, how often did you carry out the following behaviours? Bought bottled water or other drinks (juice, smoothie, soda, etc).	*7 Likert scale* Rarely/Often	-
Purchasing environmental products Over the past two weeks, how often did you carry out the following behaviours? Purchased environmental home products (detergent, cleaner, etc.) Purchased environmental toiletries products (shampoo, soap, paper, etc.)	*7 Likert scale* Rarely/Often	α=.86 ICC (1) =.78 ICC (2) =.91-
Behavioural spillover effect-Pro-environmental behaviours Over the past two weeks, how often did you carry out the following behaviours…? -Put on more layers of clothes instead of using additional heating -Bought clothes from charity shops or second-hand websites -Separated recycling from general waste -Considered energy efficiency of environmental factors when making a new purchase for the home. -Chose eating vegetarian food instead of meat. -Used public transport instead of driving. -Educated yourself about environmental issues (e.g., through media, television, internet, blogs, etc.)	*7 Likert scale* Rarely/Often	α=.52 ICC (1) =.34 ICC (2) =.66

Behavioural spillover effect, non-environmental behaviours -Ordered takeaway coffee -Wasted food (threw away expired or leftover food)? -Bought more food that what you need? -Left the light on when you were not using it? -Left your laptop plugged in after it reaching full charge? - Boiled more water than needed when using the kettle? -Used the washing machine even though it did not have a full load? - Asked for plastic bags at the supermarket	*7 Likert scale* Rarely/Often	α=.72 ICC (1) =.61 ICC (2) =.80
Attitudes: Affective The goals messages made me feel…. Hateful Love Annoyed 1 2 3 4 5 6 7 Happy Calm 1 2 3 4 5 6 7 Tense Bored 1 2 3 4 5 6 7 Excited Relaxed 1 2 3 4 5 6 7 Angry Disgusted 1 2 3 4 5 6 7 Acceptance **Attitudes: Cognitive** I feel the messages with the goals were… Useless 1 2 3 4 5 6 7 Useful Foolish 1 2 3 4 5 6 7 Wise Beneficial 1 2 3 4 5 6 7 Harmful Worthless 1 2 3 4 5 6 7 Valuable Wholesome 1 2 3 4 5 6 7 Unhealthy **Attitudes: Evaluative** Negative 1 2 3 4 5 6 7 Positive Undesirable 1 2 3 4 5 6 7 Desirable Good 1 2 3 4 5 6 7 Bad Likable 1 2 3 4 5 6 7 Dislikeable	Seven-point semantic differential scale	-
Habits scale Thinking about the goal of …	*7 Likert scale* *Strongly disagree/Strongly agree*	α=.86 ICC (1) =.80 ICC (2) =.90

-Did it fit in with your daily life routine? STRONGLY DISAGREE/STRONGLY AGREE

- Did you do it without thinking of it? STRONGLY DISAGREE/STRONGLY AGREE

- Did it make you feel weird if you didn't do it? STRONGLY DISAGREE/STRONGLY AGREE

- Did you find it hard not to do it? STRONGLY DISAGREE/STRONGLY AGREE

8.2.2 Knowledge and goals information

Climate change is described as an anthropogenic phenomenon, the outcome of billions of acts of daily consumption. Human activity is changing the earth's climate, consequently glaciers are already disappearing, sea levels are expected to rise significantly in this century, potentially flooding coastal cities and submerging islands.

Responding to climate change has been one of the most defining challenges of our times. One way to tackle climate change is in our individual actions.

(World Bank 2014, World development report 2015: mind, society and behaviour)

Through your participation in the study, we are asking you to agree to a pro-environmental goal for a period of **TWO WEEKS**.

The following are the goals we ask you to commit to over the next two weeks. In addition, we list some behaviours that will help you attain these goals. Please check the box of the goals you want to commit to.

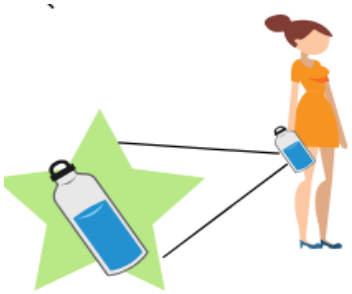
Goal 1. To avoid single-use bottles:

(CHECKBOX) I agree to commit to the goal #1 "To avoid single-use bottles".

-Control Text

Use a water bottle

-Control Visual + text

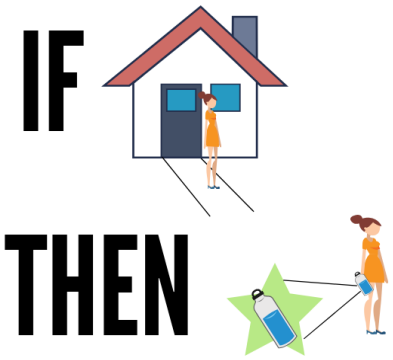


Use a water bottle

-Implementation intentions text only

If I am going out, then I will take my water bottle with me for when I'm thirsty.

-Implementation intentions text only



If I am going out, then I will take my water bottle with me for when I'm thirsty.

Goal 2. To buy environmental products:

(CHECKBOX) I agree to commit to the goal #2 "To buy environmental products".

-Control Text

Purchase the environmental version of the product you

-Control Visual+ text

Purchase the environmental version of the product you need.

-*Implementation intention Text*

If I'm going to the supermarket then I will try to purchase the environmental version of the product I need to buy.

-Implementation intention Visual +Text

If I'm going to the supermarket, then I will try to purchase the environmental version of the product I need to buy.

8.3 Appendix chapter 4

8.3.1 Questionnaire variables and reliability scores

Table 12 Scales of assessed variables with the category levels and reliability scores

Variable	Response scale	Cronbach's alpha
Injunctive norms- *adapted from Cialdini, Kallgren, & Reno, 1991* -Most people important to me think saving energy is something that we ought to do -It is expected of me that I make an effort to save energy. - Most of the people important to me think that I should save more energy	Strongly disagree/ Strongly agree	α=0.63 ICC (1) =0.47 ICC (2) =0.74
Descriptive norms *adapted from Cialdini, Kallgren, & Reno, 1991* -I often see people who are important to me making efforts to save energy. -Most people who are important to me actively try to minimise their energy consumption. -I often see my friends and family taking actions to reduce their energy use.	Strongly disagree/ Strongly agree	α=0.85 ICC (1) =0.79 ICC (2) =0.89
Energy saving behaviour (Alisat & Riemer, 2015; Blasch, Boogen, Filippini, & Kumar, 2017) Over the past two weeks, how often do you carry out the following behaviours? -Completely switching off electronic devices (TV, computer) -Leave the lights on when leaving any room? -Leave your laptop plugged in overnight? -Fill up the kettle and not using all the water? -Use natural light over artificial when being in a room	Rarely/Often	α=0.70 ICC (1) =0.56 ICC (2) =0.79
Behavioural spillover effect, adapted from Alisat & Riemer, 2015 Over the past two weeks, how frequently did you engage in the following behaviours… () -Separated recycling from general waste?	Rarely/Often	α=0.7 ICC (1) =0.52 ICC (2) =0.791

-Bought plastic bags in the supermarket?		
Behavioural spillover effect-purchasing eco-friendly products, adapted from Alisat & Riemer, 2015 Over the past two weeks, how frequently did you engage in the following behaviours… () -Purchase eco-labelled home products (detergent, cleaner, etc.)? -Purchase eco-labelled toiletries (shampoo, soap, paper, etc.)?	Rarely/Often	α=0.79 ICC (1) =0.68 ICC (2) =0.861
Collective spillover effect, adapted from Alisat & Riemer, 2015 Over the past week, how frequently did you engage in the following behaviours… (RARELY-OFTEN) - Talked with others about environmental issues -Considered energy efficiency or environmental factors when making a new purchase -Spoken to your family/housemates about energy issues -Taken part in a campaign about an energy issue. -Reminded a friend to switch something off to save energy	Rarely/Often	α=0.70 ICC (1) =0.59 ICC (2) =0.79
Goal initiation I was good at remembering to save energy. I found it difficult noticing opportunities in order to save energy. I was unsure how to actively save energy. It took me lot of time to carry out energy-saving actions in my home.	Strongly disagree/ Strongly agree	α=0.71 ICC (1) =0.59 ICC (2) =0.80
Goal Shielding I easily gave up on energy-saving goals I quickly lost interest in the energy-saving goals that were given I stayed committed to the energy-saving goals I was willing to save energy, even if it required a change in my routine. I would have easily dropped out, if energy-saving required too much effort.	Strongly disagree/ Strongly agree	α=0.79 ICC (1) =0.72 ICC (2) =0.85

I prioritised the big energy-saving goals over the small ones.	
I found it easy to justify actions that were relevant to energy-saving.	
I stuck to my energy-saving goals because I knew it led to having a reduced impact on the environment.	
I convinced myself that other smaller goals were meaningful to my main energy-saving goal	

Note: ICC= Confidence intervals, α= Cronbach's alpha.

8.3.2 Knowledge and goals information

Energy use in the UK: (BEIS, 2016)

- As an overall figure, energy consumption rose by 1.7% in 2015 compared to 2014.
- Domestic energy consumption saw a 3.6% rise in the year 2015: the biggest increase across all energy use sectors.
- The domestic sector accounted for 29% of total final energy consumption.
- Since 2002, gas and electricity prices have more than doubled.
- In March 2016, the public attitudes tracker found that 28% of households were worried or very worried about paying for their energy bills.

(Department for Business, Energy and Industrial Strategy, 2016)

The fact that so many households struggle to keep up with the demand of high energy prices highlight the importance of energy-saving. In addition, reducing the amount of energy we are using is essential for reducing carbon emission and mitigating climate change.

Through your participation in this study, we are asking you to agree to a goal of carrying out energy-saving behaviours for a period of one week, to decrease energy consumption in your household.

By clicking the button below, you are acknowledging that during the next week you are going to carry out energy-saving behaviours as much as possible. This will formally begin your participation in the experiment.

"I will try to undertake as many energy-saving behaviours as possible over the next two weeks"

[Button here]

For control group only:

To save energy…

- I will remember to unplug my laptop.
- I will only fill up the kettle to the amount I need.

- I will make sure the washing machine has a full load.
- I will remember to turn off the lights.

For individual implementation intention group only:

- If I notice our laptops are fully charged, then I will unplug it.
- If I am making hot drinks, then I will only fill the kettle up to the amount I need.
- If I am washing clothes, then I will fill the washing machine up the maximum capacity.
- When I am leaving a room, if I am not using the light, then I will turn it off.

For collective implementation intentions group only:

- If we notice our laptops are fully charged, then we will unplug them, and we will remind others to do the same.
- If we are making hot drinks, we will ask others if they need the kettle too and we will only fill it up to the amount we need.
- If we are washing clothes, then we will ask others if they want to wash their clothes too and we will fill the washing machine up to the maximum capacity.
- When we are leaving a room, if we are not using the light, then we will turn them off, and we will remind others to do the same.

8.4 Appendix chapter 5

8.4.1 Questionnaire variables and reliability scores

Table 13. Scales of variables with the category levels and reliability scores

Variable	Category	Cronbach's alpha
Food waste leftovers- How much food in leftovers would you say you throw away in a regular week? (Consider one portion as one handful of food)	*Nothing at all* *Less than half a portion* *Half a portion* *Two to three portions* *More than 3 portions*	-
Food waste due to spoilage How much food from your household would you say you throw away due to spoilage in a regular week? (Consider one portion as one handful of food)	*Nothing at all* *Less than half a portion* *Half a portion* *Two to three portions* *More than 3 portions*	-
Food waste How much of the following items would you say that you throw away, of what you buy and/or grow in a regular week? -Fruits and vegetables	*Nothing at all* *Less than half a portion* *Half a portion* *Two to three portions* *More than 3 portions*	α=0.7 ICC (1) =0.64 ICC (2) =0.75

-Pasta, rice and corn products -Meat and fish -Dairy products -Bread and bakery products	*I do not consume these products".*	
Inner Barriers - I forgot about some of the food I had and it was spoiled - I did not check the food regularly and their use by dates. - I did not stick to the meals that I had originally planned.	*Strongly disagree* *Disagree* *Somewhat disagree* *Neither agree nor disagree* *Somewhat agree* *Agree* *Strongly agree*	α=0.81 ICC (1) =0.77 ICC (2) =0.85
Outer Barriers - Other people forgot the food in the fridge and this was spoiled - Other people threw their leftovers away while they were still edible - Others did not check the food and the use by date regularly. - Others failed to stick to the meals originally planned. - Others overstocked when doing the food shopping	*Strongly disagree* *Disagree* *Somewhat disagree* *Neither agree nor disagree* *Somewhat agree* *Agree* *Strongly agree*	α=0.84 ICC (1) =0.81 ICC (2) =0.87
Manipulation check- Communication with others inside the household - Spoke to family about avoiding food waste - Discussed with others in the household that I was trying to reduce food waste	*Never* *Very rarely* *Rarely* *Sometimes* *Often* *Very Often* *Always*	α= 0.8 ICC (1) = 0.74 ICC (2) = 0.84
Manipulation check- Communication with others outside household - Encouraged others to reduce food waste in their household - Discussed food waste with others out of my household	*Never* *Very rarely* *Rarely* *Sometimes* *Often* *Very Often* *Always*	α= 0.76 ICC (1) = 0.69 ICC (2) = 0.81