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Context matters

Three ways of how the context influences recycling behaviour

PhD thesis

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1. General introduction

In one year, humankind produces approximately 1.3 billion tonnes of waste (Hoornweg & Bhada-Tata, 2012), which can build up a mountain 3200m across and almost 2400m high (Lyons, Swann, & Levett, 2015). While the production of waste is increasing, only a small percentage of the waste produced is recycled (Hoornweg & Bhada-Tata, 2012). For instance, in the European Union, only 29% of the municipal waste was recycled and composted in 2012 (European Environment Agency, 2015). What happens to the rest of the waste? Most of the waste still goes to landfills sites or is incinerated, which both contributes to greenhouse gas emissions (Hoornweg & Bhada-Tata, 2012). Another part of the waste is disposed of improperly, resulting in littered environments and 'waste islands' swimming in the ocean.

To reduce waste problems, recycling is important. Recycling can contribute to a circular economy by increasing resource efficiency and reducing greenhouse gas emission (Corsten, Worrell, Rouw, & Van Duin, 2013; European Union, 2014), thereby combatting today's waste problems and the emerging scarcity of resources (European Environment Agency, 2015). Recycling is not only a technical issue, but also a behavioural issue. Specifically, consumers who consistently separate the waste they produced are crucial for a circular economy (Kirchherr, Reike, & Hekkert, 2017). In this dissertation, we[1] focus on the behavioural side of recycling. We define recycling as individuals' waste separation intentions and behaviour to allow materials to be re-used. The main aim of this PhD thesis is to understand what motivates individuals to engage in recycling and how recycling can be promoted.

1.1. Individual and contextual factors influencing recycling behaviour

What affects individuals' recycling behaviour? The Integrated Framework for Encouraging Pro-Environmental Behaviour (IFEP model; Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, Lindenberg, & Keizer, 2016) states that both individual and contextual factors and their interaction with each other are important to consider when aiming at better understanding pro-environmental behaviours. Following this notion, we propose that both individual and contextual factors can influence recycling behaviour. Next to these unique relationships between either individual or contextual factors and recycling behaviour, we propose that individual and contextual factors interact in influencing recycling behaviour (see Figure 1). In the following, we will elaborate on this reasoning.

Individual factors may explain why in a similar situation, one person recycles and another person does not. Many studies have examined the effect of various individual factors on recycling behaviour, and identified a wide range of individual factors that are related to recycling behaviour,

[1] I use 'we' instead of 'I' throughout this dissertation when I refer to the authors, as the research described is the product of the collaboration between me and my PhD supervisors Linda Steg, Ellen van der Werff, and Berfu Ünal.

including attitudes (e.g., Schultz, Oskamp, & Mainieri, 1995), norms (e.g., Nigbur, Lyons, & Uzzell, 2010), values (e.g., Ruepert, Steg, & Keizer, 2017) and environmental self-identity (e.g., Van der Werff, Steg, & Keizer, 2013a). In this PhD thesis, we will first examine the relative importance of these individual factors in explaining recycling behaviour. Next, we will focus on two general individual factors that are likely to affect many different types of pro-environmental actions, including recycling: biospheric values and environmental self-identity.

Values reflect general goals that serve as guiding principles in people's life (Schwartz, 1992; Feather, 1995). As desirable trans-situational goals, they reflect what individuals find important in their life, which, in turn, can affect beliefs, attitudes, norms and behaviours (Feather, 1995; Gardner & Stern, 2002). In the context of pro-environmental behaviour, *biospheric valu*es are particularly important as a consistent source of pro-environmental actions (De Groot & Steg, 2007, 2008). Biospheric values reflect how important individuals find it to benefit nature and the environment. Individuals who strongly endorse biospheric values are more likely to focus on and consider the environmental consequences of their actions, and to act pro-environmentally, such as recycling (Feather, 1995; also see Steg & De Groot, 2012 for a review). Furthermore, the stronger one's biospheric values, the more one is motivated to protect the environment, and the more willing one is to put effort into a behaviour that may benefit the environment (Steg et al., 2014; Steg, 2016).

Environmental self-identity has been shown to be another important antecedent of a wide range of pro-environmental behaviours, including recycling behaviour (Van der Werff et al., 2013a; Whitmarsh & O'Neill, 2010). Environmental self-identity reflects the extent to which one sees oneself as a type of person who acts environmentally-friendly (Van der Werff et al., 2013a). The more one sees oneself as a person who acts environmentally-friendly, the more likely one is to recycle and to also engage in other pro-environmental behaviours. The reason for this is that people are motivated to act in line with how they see themselves (Van der Werff, Steg, & Keizer, 2014a, 2014b; Kashima, Paladino, & Margetts, 2014). To sum up, we propose that biospheric values and environmental self-identity may be important individual factors that can explain recycling behaviour.

Contextual factors can be defined as characteristics of the circumstances in which recycling behaviour takes place. The context may explain why one person recycles in one situation, whereas s/he does not recycle in another situation. For example, a person may be more likely to recycle his or her paper waste when it is regularly picked up from the kerb than when s/he has to bring it to paper container that is rather far away. Although relatively few studies have investigated the effect of the context on recycling behaviour, there is some first evidence to suggest that the context in which recycling takes place may affect recycling behaviour (Oskamp, Harrington, Edwards, Sherwood, Okuda, & Swanson, 1991; Schultz et al., 1995). The context has been mostly considered as a factor that can facilitate, enable or inhibit recycling. In this respect, a relevant contextual factor may be the collection

system in place that may affect how feasible it is for people to recycle. For instance, a kerbside collection system is commonly considered as an easy collection system to use (Ando & Gosselin, 2005; Best & Kneip, 2011), which may facilitate recycling behaviour. On the other extreme, some collection systems may make it very unfeasible or even impossible for consumers to recycle certain materials. In Chapter 2, we will conduct a meta-analysis to study the relative importance of different contextual factors that may facilitate or inhibit recycling behaviour in the literature. In particular, we will examine to what extent the local circumstances (i.e., the recycling facilities in the neighbourhood, the possession of a recycling bin at home, the distance to a recycling location, and the size of the neighbourhood) and the housing situation (i.e., ownership and type of house) are related to recycling.

Importantly, extending the research on contextual factors, we will study whether the context can also affect recycling in other ways. Specifically, we test whether the context may not only facilitate or inhibit recycling behaviour but also may make people focus on the environment or strengthen the effect of individual factors on behaviour. We will explain our reasoning further below.

Additionally, we will examine the interaction between individual and contextual factors. This notion is in line with the IFEP model (Steg et al., 2014; Steg et al., 2016), stating that individual and contextual factors may interact in how they influence recycling behaviour. Interestingly, how individual and contextual factors may interact has been hardly studied, with a few exceptions (e.g., Ruepert et al., 2017). In this dissertation, we aim to address this gap in literature and aim to better understand how individual and contextual factors interact. In the following, we will elaborate on three possible ways of how contextual factors may influence recycling behaviour and how they may interact with individual factors.

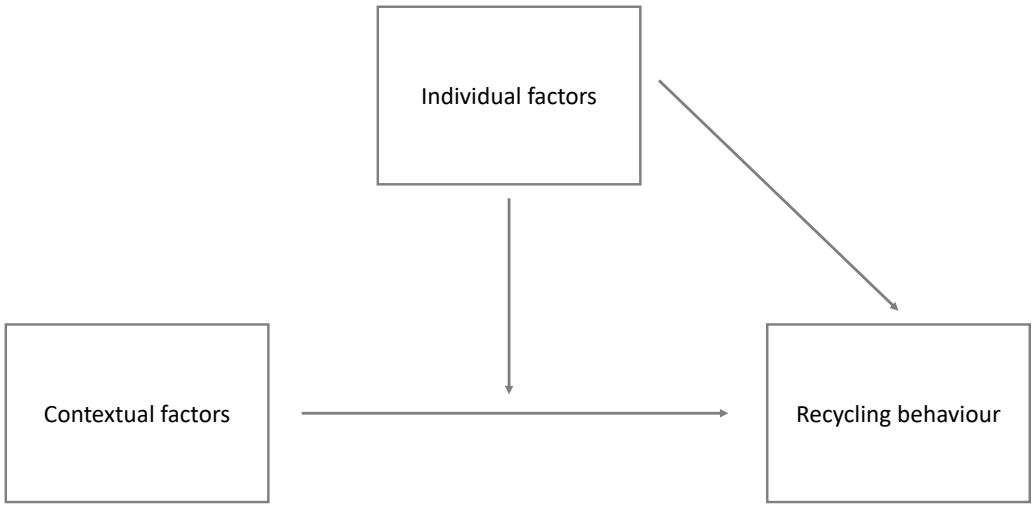

Figure 1. Conceptual model tested in this dissertation.

1.2. Perceived feasibility of recycling

The first way of how the context may influence recycling behaviour is by facilitating or

inhibiting recycling behaviour. As mentioned above, the collection system in place may be a relevant contextual factor in this respect (Derksen & Gartrell, 1993; Best & Kneip, 2011; Best & Kneip, 2019). We propose that particularly people's perceptions of the ease of using the collection system affect their recycling behaviour rather than the collection system as such (cf. Weber, 2018). Specifically, individuals may differ in how easy they believe it is to use the same collection system. The use of a collection system may be perceived as easy to use by one person, while it may be perceived as relatively difficult to use by another person. These different perceptions may result in different recycling patterns of individuals within the same collection system.

We further propose that the perceived ease to use the collection system affects recycling behaviour indirectly, via the perceived feasibility of recycling, which reflects the perceived ability to recycle (cf. IPCC, 2018) and the perceived ease of recycling (Rodgers, Conner, & Murray, 2008). Specifically, the easier one perceives the use of the collection system, the more feasible one will perceive recycling to be, which, in turn, is likely to stimulate recycling (see Figure 2). We will test this reasoning in Chapter 3, in which we will study to what extent the perceived feasibility of recycling is rooted in the perceived ease of using the collection system.

We further reason that perceived feasibility to recycle interacts with biospheric values in affecting recycling behaviour. Two theories would predict an interaction between perceived feasibility of recycling and biospheric values, but they propose different directions of such an interaction. First, the low-cost hypothesis (Diekmann & Preisendörfer, 2003) predicts a linear relationship between the effect of biospheric values and perceived feasibility of recycling. According to this theory, biospheric values are more likely to be related to recycling when recycling is perceived as rather feasible (i.e., associated with low costs), and less likely to be related to recycling when this behaviour is perceived as not very feasible (i.e., associated with high costs). Specifically, the low-cost hypothesis proposes that when recycling is not very feasible, even individuals with strong biospheric values may not engage in recycling behaviour, as in this case they may feel it is too difficult or effortful to recycle. According to the low-cost hypothesis, individuals are more likely to act in line with their biospheric values and to recycle the more feasible recycling is perceived to be.

Second, the A-B-C model (Guagnano, Stern, & Dietz, 1995; Stern, 2000) predicts a curvilinear relationship between biospheric values and recycling behaviour, contingent on the levels of perceived feasibility of recycling. Similar to the low-cost hypothesis, the A-B-C model predicts that when recycling is perceived as not very feasible, biospheric values are not likely to be strongly related to recycling behaviour. Yet, according to the A-B-C model, biospheric values are neither strongly related to recycling when recycling is perceived as very feasible, as in this case most people may engage in recycling behaviour, irrespective of the strength of their biospheric values. This implies that the relationship between biospheric values and recycling behaviour would be most pronounced when

recycling is perceived as moderately feasible (Guagnano et al., 1995; Stern, 2000; Ölander & Thøgersen, 2005). In Chapter 3, we will examine the effect of the perceived ease to use the collection system and perceived feasibility to recycle on recycling behaviour, and test whether the low-cost hypothesis or the A-B-C model is more plausible in explaining the interaction between biospheric values and perceived feasibility of recycling.

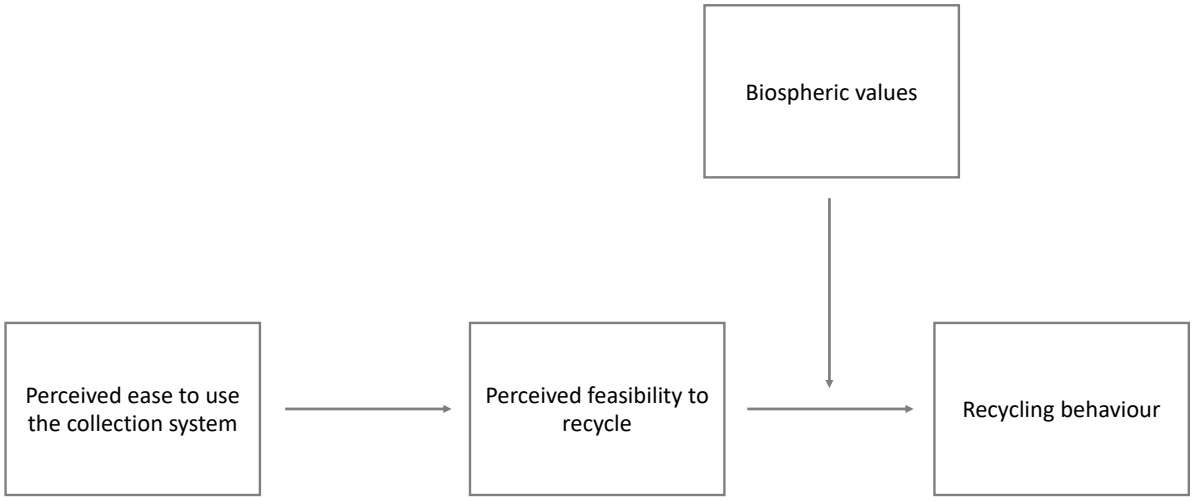

Figure 2. Conceptual model tested in Chapter 3 on how the perceived ease to use the collection system may promote recycling behaviour.

1.3. Context may make people focus on the environment

We further propose that the context can stimulate recycling behaviour by making people focus on the environment. The IFEP model (Steg et al., 2014; Steg et al., 2016) states that individuals who are focused on the environmental consequences of their behaviours and on benefitting the environment in a given situation (in the following we refer to this as 'focus on the environment'), are more likely to engage in recycling behaviour. As indicated earlier, people with stronger biospheric values are more likely to be focused on the environment, and to act pro-environmentally, such as recycling (Feather, 1995; also see Steg & De Groot, 2012 for a review). Yet, the focus on the environment may also depend on contextual factors. We propose that a relevant contextual factor that can make people focus on the environment is a packaging design. The more a packaging design makes one focus on the environment, the more likely one should be to recycle that package. There is some evidence to suggest that design can encourage pro-environmental actions (Niedderer et al., 2014; Tromp, Hekkert, & Verbeek, 2011). Yet, not much is known about how, why and under which conditions a packaging design can stimulate pro-environmental actions, amongst this recycling behaviour. We will address this research gap in this dissertation.

Importantly, we propose that packaging design and biospheric values interact – the effect of packaging design on recycling may depend on the strength of one's biospheric values (see Figure 3). In

particular, we propose that the effect of packaging design will be more pronounced among individuals with moderately strong biospheric values, as individuals with strong biospheric values may recycle anyway, whereas individuals with weak biospheric values may generally not recycle. For individuals with moderately strong biospheric values, a packaging design may provide an additional push to engage in recycling. This implies that we expect a curvilinear relationship between packaging design and biospheric values (Ruepert et al., 2017; cf. Guagnano et al., 1995). We will test our reasoning in Chapter 4, in which we collaborate with designers who designed packages that aim to focus people on the environment. To our knowledge, we are the first ones who investigate the influence of a packaging design on recycling behaviour. Such insights are important to understand the potential and to increase the impact of design in stimulating recycling behaviour.

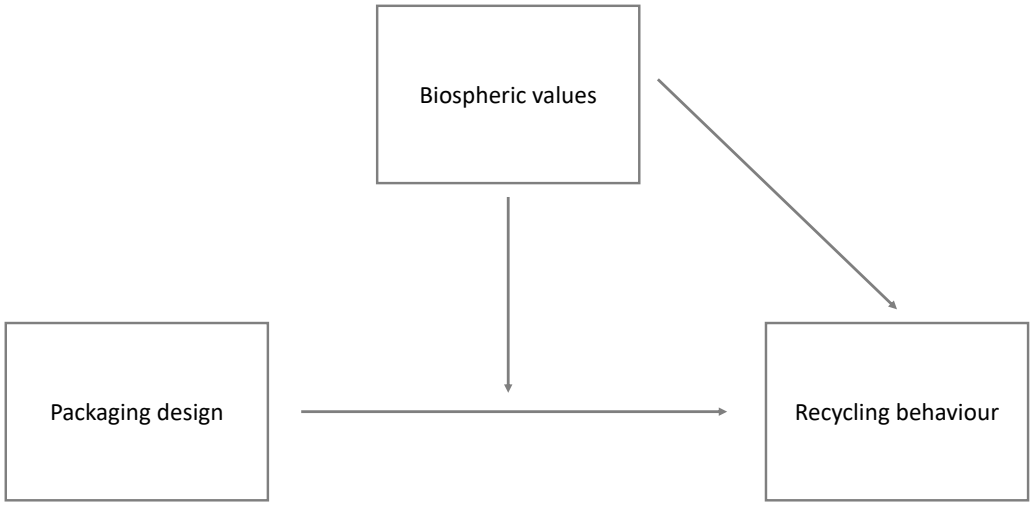

Figure 3. Conceptual model tested in Chapter 4 on how a packaging design may promote recycling behaviour.

1.4. Context may strengthen individual factors

A third way of how the context may affect recycling behaviour is by strengthening individual factors. As a case of point, we examine the effect of experiencing an art installation on recycling behaviour. We propose that art can be a powerful tool to stimulate pro-environmental actions, including recycling behaviour. A recent example of an art installation in the public space that tackles the topic of climate change is 'For Forest' by Klaus Littmann in the football stadium in Klagenfurt, Austria, that is based on a drawing by Max Peinter that shows a stadium full of visitors observing a forest inside the stadium. For this, the artist planted a mixed forest of 300 different trees at the pitch of the stadium. With this art installation, the artist aims to confront observers with the widespread attitude and assumption that nature is taking for granted. He aims to make observers aware of that nature may soon be something from the past that can only be viewed in specially designated spaces (https://forforest.net/). Yet, most art installations tackling the broad topic of climate change are built on assumptions of artists on factors that may drive behavioural change (Hekkert & Van Dijk, 2014;

Niedderer, 2007), which are typically not tested (Niedderer et al., 2014; Aryana & Boks, 2012). In Chapter 5, we will test whether an art installation that integrates scientific theory in the design of the art installation is effective in promoting pro-environmental behaviour. In particular, we propose that an art installation that is designed to strengthen environmental self-identity will lead to more recycling behaviour among people who experienced the art installation (see Figure 5). As discussed above, environmental self-identity is an important antecedent of consistent and long-lasting pro-environmental behaviours, including recycling (Van der Werff et al., 2013a, b; 2014a, b). Amongst others, environmental self-identity depends on past behaviour (Van der Werff et al., 2013a; 2014a). When people realize that they have engaged in pro-environmental behaviours in the past, they are more likely to see themselves as a pro-environmental person and are consequently more likely to act pro-environmentally in the future. We propose that experiencing an art installation in which people are, among others, being reminded of one's past pro-environmental behaviours, will strengthen one's environmental self-identity. This, in turn, should lead to more recycling behaviour.

Figure 4. Conceptual model tested in Chapter 5 on how art may promote recycling behaviour.

In doing so, we follow a novel interdisciplinary approach, integrating insights from art and environmental psychology. Specifically, psychologists will explicate theories on factors driving pro-environmental behaviour to the artist, the artist will embed one of these theories in the design of the art installation. Next, the psychologists will systematically evaluate the effect of the art installation on behaviour. Thereby, we aim to contribute to a better understanding of the extent to which, how and why art can promote pro-environmental actions. As far as we know, we initiated one of the first collaborations between designers, artists and psychologists.

1.5. Current PhD Thesis

The current PhD thesis aims at better understanding how individual and contextual factors influence recycling, with a particular focus on the role of contextual factors. The reason for this is that a systematic examination of whether, how, and under which conditions contextual factors affect recycling behaviour is understudied in the current literature on recycling behaviour. To address this gap, we will specifically address the underlying process of how contextual factors influence recycling behaviour and how contextual factors interact with individual factors, particularly with biospheric values, using different methods and different indicators of recycling.

This dissertation consists of four papers; each paper addresses a different way of how the context may affect recycling behaviour. We first conduct a meta-analysis to find key individual and contextual factors associated with recycling behaviour (Chapter 2). We expect that there has been little literature on the influence of contextual factors on recycling behaviour, and that most studies have been focused on one way in which the context may affect recycling, namely whether the context facilitates or inhibits recycling behaviour.

Chapter 3 builds on the results of the meta-analysis and investigates how the context – the collection system in place – can facilitate or inhibit recycling behaviour. We argue that individuals' perception of the ease of the collection system are crucial for individuals' perception of the feasibility of recycling, which, in turn, should affect recycling. Furthermore, we expect that the effects of perceived feasibility of recycling on recycling will depend on the extent to which individuals endorse biospheric values.

Chapter 4 addresses a second way of how the context may influence recycling. In particular, we examine whether a packaging design that makes people focus on the environment can lead to more recycling behaviour. We propose that the effect of a packaging design on recycling is more pronounced among participants with moderately strong biospheric values.

Chapter 5 addresses whether art may promote recycling behaviour by strengthening individual factors, in this case environmental self-identity. In all chapters, we not only examine the effect of the context on intended and self-reported recycling behaviour but also on actual recycling behaviour. We thereby aim to examine whether results are consistent across different indicators of recycling behaviour. We end this dissertation with a discussion of the main findings and the theoretical and practical implications of our findings (Chapter 6).

2. A Meta-Analysis of Factors Related to Recycling[2]

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2.1. Abstract

The current meta-analysis aimed to identify the most important factors related to recycling across studies. A random-effects meta-analysis of studies on individual and household recycling (*n* = 91) revealed that both individual and contextual factors are related to recycling. Among individual factors, behaviour-specific factors (i.e., recycling self-identity, personal norms towards recycling, past recycling, and perceived behavioural control over recycling) were better predictors of recycling than general factors (i.e., general knowledge, general attitudes, general personal norm). Among contextual factors, the possession of a bin at home and house ownership were particularly predictive of recycling. Moreover, individual and contextual factors better predicted intention to recycle than self-reported recycling behaviour, and particularly than observed recycling behaviour. We discuss the theoretical and practical implications of our findings. We indicate that future studies could more systematically examine the effects of contextual factors on recycling, as well as the interplay of individual and contextual factors.

Keywords: Recycling, meta-analysis, individual factors, contextual factors, self-identity, attitudes

2.2. Introduction

Across the globe, we produce approximately 1.3 billion tonnes of waste per year, and the production of waste is increasing (Hoornweg & Bhada-Tata, 2012). Most of this waste still goes to landfills or dumping sites (Hoornweg & Bhada-Tata, 2012), while only a small percentage is recycled. In 2012, for example, only 29% of the municipal waste was recycled and composted in the European Union (European Environment Agency, 2015). As recycling enables the retrieval of secondary raw materials and thereby reduces greenhouse gas emissions (Corsten, Worrell, Rouw, & Van Duin, 2013; European Union, 2014), encouraging recycling is critical to address today's waste problems. Important players, such as the European Union and the Worldbank, have put the goal to increase recycling rates on their agendas for the near future. To design effective strategies to promote recycling, it is critical to understand which factors determine individual and household recycling.

We define recycling as individuals' waste collection intentions and behaviour to allow materials to be re-used. Various studies have examined the effects of different strategies to promote recycling. A recent meta-analysis systematically synthesized this literature and found social modelling and environmental alterations to be the most effective interventions (Varotto & Spagnolli, 2017). Their meta-analysis assessed interventions to promote recycling. Yet, a synthesis of the literature on individual and contextual factors influencing recycling is lacking, despite a growing number of studies that have examined factors influencing recycling over the last two decades. The growing number of studies highlights the great interest in understanding which factors influence recycling. Whereas these studies have provided important insights in which factors are related to recycling in a particular context, little is known about robust predictors of recycling across studies and contexts. Notably, studies on recycling have focused on a variety of predictors, relying on different methodologies to explain recycling. This large and diverse literature on factors predicting recycling implies a challenge to integrate scattered findings on important factors influencing recycling. In response to this, we aim to conduct a meta-analysis to classify the most robust and important predictors of recycling across studies. A meta-analysis allows researchers to systematically review and synthesize the literature on recycling, thereby assessing the magnitude of the association between different predictors and recycling.

2.2.1 Predictors of recycling

This meta-analysis considers a wide range of factors that have been included in studies aimed to understand recycling. Specifically, the factors included can be classified into two main categories: individual factors and contextual factors. Individual factors include, amongst others, attitudes, social norms (i.e., descriptive and injunctive norms), perceived behavioural control, personal norms, values, and anticipated affect. Most of these individual factors have been included in prominent theories to

explain environmental behaviour, such as the Theory of Planned Behaviour (Ajzen, 1991), the Norm-Activation-Model (Schwartz & Howard, 1981), and the Value-Belief-Norm theory on environmentalism (Stern, 2000), but only a few studies have tested these theories explicitly. Furthermore, the individual factors have been operationalized at different levels of specificity. More specifically, individual factors have been conceptualised either at a behaviour-specific level, focusing on recycling, or at a more general level, reflecting environmental considerations or beliefs and norms regarding environmental behaviour in general.

Contextual factors reflect the circumstances in which recycling takes place. These include local circumstances (e.g., recycling facilities in the neighbourhood, possession of a recycling bin) and the housing situation (e.g., type of house).

We aim to examine the extent to which these different individual and contextual factors predict recycling. A meta-analysis by Hornik and colleagues (1995) on recycling revealed that individual factors were somewhat more strongly related to recycling than contextual factors. We extend their study by including studies that were conducted in the more than 20 years after their meta-analysis and by considering both specific and general individual factors, as well as contextual factors, and to identify the most robust and important predictors of recycling.

In the following, we will introduce the different individual factors that have been examined to understand recycling. Some of these individual factors have been conceptualised at a specific level, referring to recycling directly, while others have been conceptualised at the general level, referring to the environment or environmental behaviour. Next, we introduce contextual variables that have been examined in studies that aimed to understand recycling. We discuss the individual factors and contextual factors, respectively, in alphabetical order.

Individual factors

Anticipated affect reflects the extent to which individuals anticipate recycling will elicit different feelings. Anticipated affect proved to be an important predictor of various types of pro-environmental behaviour, next to the cognitive factors we discuss below (Gatersleben & Steg, 2013). The more people anticipate positive feelings about engaging in certain behaviour, the more likely they are to engage in this behaviour (Taufik, Bolderdijk, & Steg, 2016), while anticipated negative feelings may inhibit the relevant behaviour (Carrus, Passafaro, & Bonnes, 2008). Therefore, we expect that people are more willing to recycle when they anticipate that recycling will elicit positive feelings (rather than negative feelings).

Attitudes towards recycling reflect the extent to which people evaluate recycling favourably (cf. Ajzen, 1991), which depends on expected costs and benefits of recycling (Ajzen, 1996), including environmental costs and benefits of recycling (which is sometimes referred to as awareness of the environmental consequences of recycling). Overall, the more positive one's attitudes towards a

behaviour such as recycling, the more one is likely to engage in this behaviour. *Environmental attitudes or beliefs* reflect the extent to which an individual is concerned about the environment in general (Steg, de Groot, Dreijerink, Abrahamse, & Siero, 2011). Environmental attitudes have often been conceptualised as the New Environmental Paradigm (NEP; Dunlap, Van Liere, Mertig, & Jones, 2000), reflecting people's general beliefs on the relationship between humans and nature and the environment. Next, environmental attitudes have been conceptualized as awareness of the environmental consequences of behaviours. Environmental attitudes appeared to be positively related to a variety of pro-environmental behaviours (Steg et al., 2011). Therefore, we expect that the stronger one's environmental attitudes, the more likely people are to engage in recycling.

A descriptive norm to engage in recycling reflects the extent to which people think that other people recycle their waste, while a *descriptive norm to engage in pro-environmental behaviour* reflects the extent to which people believe that other people engage in pro-environmental behaviour in general. People are motivated to act in line with descriptive norms, thus to act in line with behaviour that is common, as descriptive norms reflect what is the most adaptive or correct behaviour in a given situation (Keizer & Schultz, 2012). Based on this, we expect that individuals are more likely to recycle their waste when they believe that many other people do recycle, or engage in pro-environmental behaviour in general.

Injunctive norms are conceptualized as individuals' perceptions of the extent to which others would approve or disapprove certain behaviours (cf. Cialdini & Trost, 1998), such as recycling, or pro-environmental behaviour in general. Complying with an injunctive norm is expected to yield social approval and rewards, while not following injunctive norms is likely to lead to social disapproval and punishments. Consequently, we expect that the more one experiences a favourable *injunctive norm towards recycling* or a favourable *injunctive norm towards pro-environmental behaviour* in general, the more likely one is to recycle.

Knowledge about recycling reflects the extent to which people know how to recycle their waste. *Knowledge about environmental problems* reflects the extent to which people know about the causes and consequences of environmental problems, or know which behaviours cause such problems (cf. Schultz, 2002). Overall, higher knowledge, both at the specific and at the general level, is likely to lead to more recycling. In particular, we expect people to be more likely to recycle their waste when they know how to do so (Schultz et al., 1995; Schahn, 1993). Furthermore, a person with more knowledge about environmental problems will be more likely to recycle than a person who has little knowledge about environmental problems (cf. Kaiser & Fuhrer, 2003).

Past recycling has been included as a predictor of recycling in various studies. Past behaviour has been only operationalized at the specific level, referring to past recycling. Past recycling may lead to a habit to recycle (cf. Verplanken & Aarts, 1999). If people have a recycling habit, they may engage

in recycling automatically, without making a conscious decision about it anymore. The more individuals recycled in the past, the more likely it is they have developed a recycling habit, the more likely they are to recycle in the future as well.

Perceived behavioural control is defined as the degree to which an individual perceives him or herself as being able to engage in a certain behaviour. Perceived behaviour control can be conceptualised with regard to recycling behaviour specifically, as well as to pro-environmental behaviour in general (cf. Ajzen, 1991). Perceived behavioural control has also been conceptualised as self-efficacy (Tabernero, Hernandez, Cuadrado, Luque, & Pereira, 2015), which reflects the extent to which individuals believe they are able to recycle or engage in pro-environmental behaviour. The higher one's perceived behaviour control to recycle and to engage in pro-environmental behaviour, and the higher their perceived self-efficacy to do so, the more likely people would be to engage in recycling.

Personal norms towards a particular behaviour reflect feelings of moral obligation to engage in this behaviour, and serve as internalized moral rules or standards for one´s own behaviour (cf. Kallgren, Reno, & Cialdini, 2000). People are motivated to act in line with their personal norms to be able to feel good about themselves, and to prevent feelings of guilt. Personal norms have been conceptualised at the specific level, reflecting personal norms to recycle, as well as at the more general level, that is, personal norms to engage in pro-environmental behaviours. We expect that stronger personal norms towards recycling as well as to engage in pro-environmental behaviour are related to more recycling.

Self-identity reflects the way individuals describe themselves (Cook, Keer, & Moore, 2002). A *recycling self-identity* reflects the degree to which a person sees him or herself as a person who recycles his or her waste (Nigbur, Lyons, & Uzzell, 2010), whereas *environmental self-identity* describes the extent to which people see themselves as an environmentally friendly person in general (Van der Werff, Steg, Keizer, 2013a, Van der Werff, Steg, Keizer, 2013b). The stronger one's environmental self-identity, the more likely it is that people engage in pro-environmental behaviour, as well as in specific pro-environmental behaviours such as recycling (Van der Werff et al., 2013a, Van der Werff et al., 2013b). Individuals are motivated to act upon how they see themselves as they aim to be or to appear consistent (Kashima, Paladino, & Margetts, 2014). Thus, we expect a person with a stronger recycling or environmental self-identity to recycle more than a person with a weaker self-identity.

Values are desirable trans-situational goals that reflect what people find important in life in general (Feather, 1995; Schwartz, 1992). Values are relatively stable and general guiding principles for individuals that may affect a wide range of pro-environmental behaviours, including recycling (e.g., Dietz, Fitzgerald, & Shwom, 2005). Particularly biospheric values, reflecting that people aim to benefit nature and the environment, appeared to be predictive of pro-environmental actions (De Groot &

Thogersen, 2012). Hence, we expect that individuals with stronger biospheric values are more likely to recycle than individuals with weaker biospheric values, as they are more likely to base their choices on the consequences of their behaviour for the environment (De Groot & Steg, 2007, 2008).

Contextual factors

Besides individual factors, contextual factors can affect recycling by facilitating or inhibiting recycling (Varotto & Spagnolli, 2017). In the following, we will introduce two types of contextual factors that can influence recycling.

Housing situation is conceptualised as the house type in which a person lives. Here, we explore two indicators of one's housing situation: ownership (own or rental house), and type of house (single-family house, apartment or detached houses). Research suggests that house-owners as well as individuals living in a single-family house recycled more than individuals living in a rented apartment (Oskamp et al., 1991). Similarly, higher recycling rates of metal were found among individuals living in single-family house than among individuals living in apartments (e.g., Hage, Söderholm, & Berglund, 2009). Ownership and type of house may affect the feasibility and practicality of recycling, which may affect the likelihood of recycling. We will explore whether the housing situation, in particular ownership and type of house, is related to recycling.

Local circumstances reflect the characterisation of the context in which recycling takes place. In this meta-analysis, we will explore four factors that may be relevant in this respect: the recycling facilities in the neighbourhood, the possession of a recycling bin at home, the distance to a recycling location, and the size of the neighbourhood. Studies have found that the possession of a recycling bin at home (e.g., Robertson & Walkington, 2009) as well as the availability of recycling facilities in the area positively influence recycling (e.g., D'Amato, Mancinelli, Zoli, 2016, Pearson, Dawson, & Breitkopf, 2012). Next, it was found that short distances to recycling facilities stimulated recycling (e.g., Hage, Söderholm & Berglund, 2009, Schultz, Oskamp, & Mainieri, 1995). Further, the size of the neighbourhood seems to affect recycling. Specifically, inhabitants of smaller neighbourhoods seemed to recycle more than inhabitants of bigger neighbourhoods (Derksen & Gartrell, 1993). Such local circumstances may influence the extent to which recycling is feasible and practical, thereby affecting recycling levels. We expect individuals to be more likely to recycle when the local circumstances facilitate recycling, that is, when individuals possess a recycling bin, when recycling facilities are in place in the neighbourhood, and when the distance to recycling facilities is short and the neighbourhood small.

2.2.2. Moderators

Extending previous research, we further aim to examine which variables moderate the relationships between different predictors and recycling, as to identify the conditions under which

different individual and contextual factors are stronger or weaker predictors of recycling. First, we will examine whether the predictive power of individual and contextual factors depends on the operationalization of recycling. Recycling has been conceptualised as intended, self-reported, or observed recycling. We expect that the predictors are more strongly related to intention to recycle than to self-reported and observed recycling behaviour, as literature has typically shown an intention-behaviour gap, suggesting that motivation may not always translate into actual behaviour (Kollmus & Agyeman, 2002). Second, we will examine whether the predictive power of factors explaining recycling differs across target groups, in particular students, households and employees in organisations. A common concern about using a student sample is the lack of representativeness and generalizability to the general population (Burkley & Blanton, 2017). In this meta-analysis, we aim to address this issue in the field of recycling by examining whether the magnitude of the association between different predictors and recycling differs across target groups.

In sum, we conducted a meta-analysis to identify individual and contextual factors that are related to recycling intentions, self-reported and observed behaviour across studies, and to examine the magnitude and consistency of these relationships. In doing so, and by considering a variety of predictors of recycling, this meta-analysis can have important implications for theory building as well as for practice; we elaborate on this in the discussion section.

2.3. Method

Literature search

We selected papers to be included in the meta-analysis via searches on the databases PSYCHInfo, Google Scholar, SCOPUS and Web of Science, and websites of journals that were most likely to publish studies on recycling (e.g., Journal for Environmental Psychology, Environment and Behavior, Journal of Applied Social Psychology, Journal of Resources, Conservation and Recycling); closing date was November 2016. Keywords were recycling (behaviour), (waste) sorting behaviour, collection behaviour, waste behaviour, and the combination of these. For an overview of the steps in the literature search process, please see Figure 1. We then checked the reference lists of articles included in this meta-analysis for additional relevant papers. To get access to unpublished studies, we personally contacted four researchers whom we knew had conducted research on recycling. As a result, we received two additional studies that were included in this meta-analysis. Moreover, we sent a request for sending us unpublished studies via relevant mailing lists (notably the Environmental Psychology list, and the Virtual Community on Sustainability and Consumption list). On the basis of the latter, we received 13 additional studies, of which 6 were included in the meta-analysis. The other 7 studies that we received were not included, as they did not meet our inclusion criteria which we discuss below.

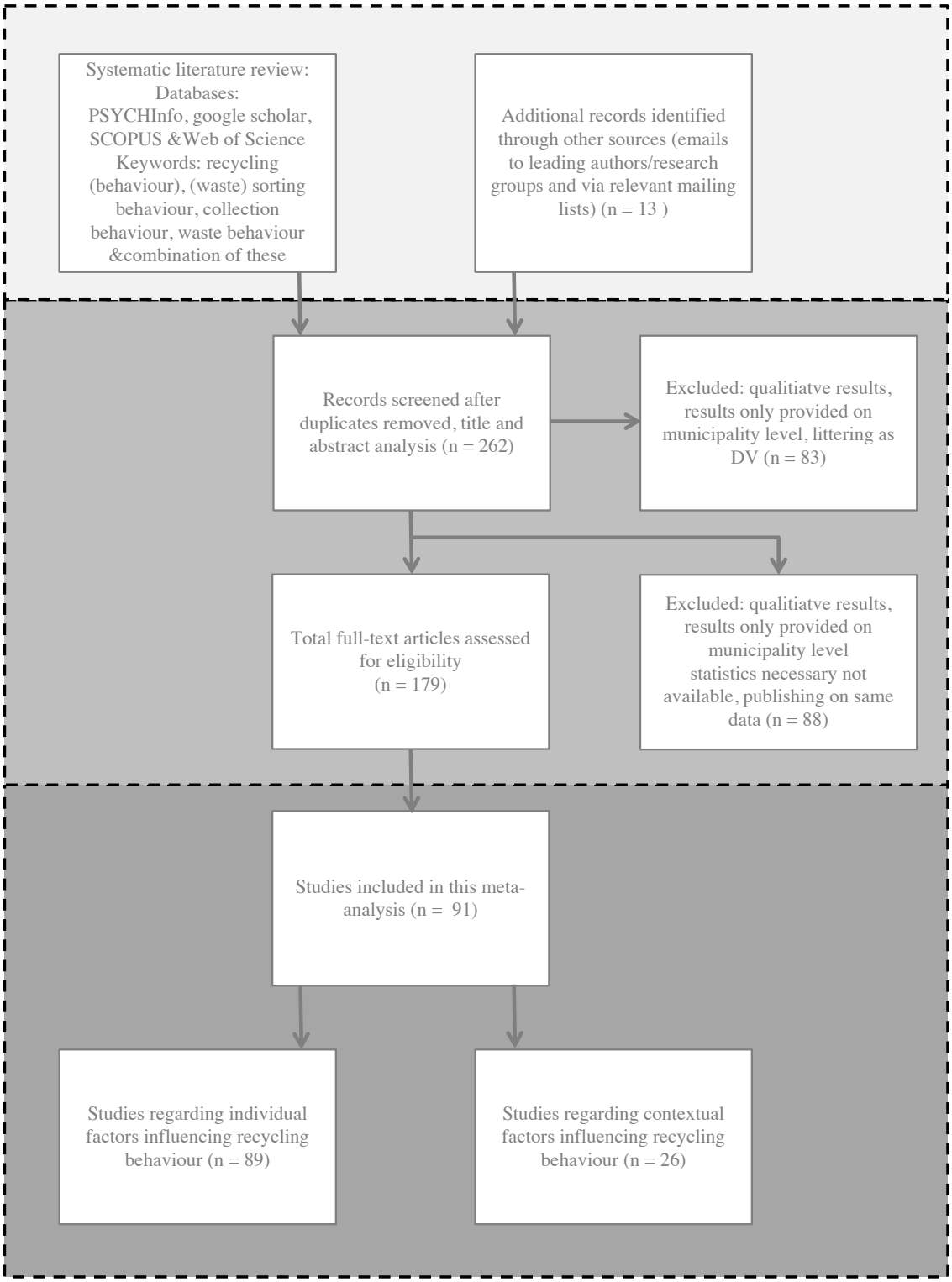

Figure 1. Steps in the current meta-analysis' literature search process (following Moher, Liberati, Tetzlaff, & Altmann, 2009). *Note.* Of the 91 studies (86 papers) included, 24 studies included individual and contextual factors, 65 studies out of the 89 studies regarding individual factors only studied individual factors and 2 studies out of the 26 studies regarding contextual factors only studied contextual factors.

Inclusion criteria

The following criteria were used to select studies relevant for the current meta-analysis. First, we only included studies that examined recycling, operationalized in one of the following ways:

observed, self-reported, or intended recycling. We selected studies that focused on general recycling as well as recycling of particular materials (e.g., plastics, paper). Second, we only included studies that examined recycling on the individual or household level. Third, studies had to report the statistics necessary to calculate the effect size of the relationships between individual and contextual factors and recycling. If relevant statistics were not reported, we contacted the authors and asked for the information missing. In total 24 researchers were contacted, of which seven responded. Yet, only two of them provided the statistics necessary to include the study in the meta-analysis. The reason why the other five researchers could not provide the data requested was that the data was not accessible for them anymore (i.e., old data, researcher retired). We further had to exclude the paper by Tabernero and Hernandez (2011) which was based on the exact same datasets as one other paper that had been already included in our analyses that was reported in a paper by Tabernero, Hernandez, Cuadrado, Luque and Pereira (2015). This decision was based on the inspection of number of participants, mean age, gender distribution, country and year in which the studies were conducted. In this case, we included the study that provided most data on correlations between variables of interest in the analyses.

Data extraction and coding

Two coders were involved in the screening, selection and extraction processes. They first screened all titles and abstracts to select relevant studies. In a second step, full papers of possibly relevant studies were evaluated and a final selection was made in agreement. The two coders performed these steps independently. Inter-rater agreement was high (88.89%). Disagreements were solved through discussion. We further used a standardised coding procedure to abstract the following data from the articles into a coding table: relevant individual factors and their level of specificity (i.e., focusing on recycling in particular, or the environment in general), relevant contextual factors, the operationalization of recycling (i.e., intention, self-reported behaviour or observed behaviour), country in which the study was conducted, target group (i.e., households, students or employees), number and gender of participants, and the statistics needed to calculate the effect sizes. In total, 91 studies met all inclusion criteria and were thus considered to be relevant for this meta-analysis, of which 89 studies reported results on individual factors, while 26 studies reported results on contextual factors. Publication year ranged from 1977 to 2016. Table 5 in the Appendix displays an overview of the studies included, and reports the number of participants, country, mean age, gender distribution, predictors, operationalization of recycling, target group, and effect sizes including 95% confidence intervals for each study.

Data analyses

We ran the meta-analysis with the program Comprehensive Meta-Analysis version 3 (CMA; Borenstein, Hedges, Higgins, Rothstein, 2014). As studies were assumed to show between-study

variability and within-study variability, we chose to use random-effects models to calculate the overall effect size (Field, 2003; Lipsey & Wilson, 2001; Rosenthal, 1994), which is a more conservative test than fixed-effects models (Hunter & Schmidt, 2004).

We used the correlation coefficient *r* as an index for the effect size as most of the reported studies were correlational. When studies depicted other statistics (e.g., *t*-, *F*-, or X^2-values) we converted them into *r* using Rosenthal's (1994) formulas. For the analyses, the correlations were converted to Fisher's Z metric. For display, we transformed the effects obtained back into correlations. In research involving individual differences, effect sizes of .10 are considered to be small, effect sizes of .20 as medium, and effect sizes of .30 as large (Gignac & Szodorai, 2016). For the individual factors that were measured at the specific as well as at the general level, we report overall effect sizes and effect sizes at the two levels. To compare the effect sizes of the predictors, we calculated the 95% confidence intervals around the effect sizes and examined the extent to which they overlap. We consider effect sizes to be significantly different from each other when the 95% confidence intervals overlap less than half the distance of one side of the confidence interval (Masson & Loftus, 2003).

Some papers included multiple predictors of recycling or multiple indicators of recycling, in which case multiple effect sizes could be extracted for one sample. As these effect sizes are not independent from each other, we pooled all effect sizes from one study to yield an average r. In case multiple effect sizes could be obtained from one study for different moderator analyses, we segregated the effect sizes needed for a particular moderator analysis. This implies that the total number of effect sizes is larger than the number of studies included in this meta-analysis (cf. Van Zomeren, Postmes, & Spears, 2008).

Testing for Heterogeneity

To assess homogeneity across studies, Q and I^2 statistics were calculated for each predictor (Higgins & Green, 2011). The Q statistic is a test of homogeneity across studies. Specifically, it reveals whether effect sizes vary substantially across studies. If heterogeneity is observed across studies, this suggests that moderators may play a role, and that it is worthwhile to explore this. I^2 reveals the ratio of true heterogeneity to total variation in reported studies, and, hence, reveals the proportion of systematic variation that can potentially be explained by moderator variables. For the moderator analysis of operationalization of recycling and target group, we collapsed the results across the specificity level of the individual factors. Hence, for the moderator analysis we did not differentiate between individual factors on a specific and general level. The reason for this was that the number of studies would have been too small for the moderator analyses at each level separately.

Correction for attenuation

The I^2 -statistic may not only reflect pure between-study variations that can be accounted for by moderators, but may also be affected by artifacts, such as measurement error. If not controlling for

measurement error, the estimation of the strength of the moderators may be overestimated. Therefore, we also report correlations corrected for measurement error. For this, we extracted the reliability of measures (Cronbach's alpha) from the primary studies and corrected for measurement error following Hunter and Schmidt (1990). Yet, in our sample, we could only compute the correlation corrected for measurement error in 31% of the cases (Cohen's Alpha was between .35 and .99). The reason for this was that primary studies either used one-item scales, or did not report the reliability coefficients of the independent variable or the dependent variable. The latter was especially considerable in the case of contextual factors; only one study reported Cronbach's alpha of the measure 'recycling facilities' needed to compute the corrected correlation. For predictors, 9.9% of the missing data was due to one-item scales. For the dependent variables, the percentage of missing data due to one-item scales was higher, namely 37.64%. Consequently, the majority of the analyses including the corrected correlations was based on a limited number of studies (oftentimes less than four), in which case moderator analyses are problematic (Fu et al., 2011; see also Thompson and Higgins, 2002), indicating that results based on correlations corrected for measurement error should be interpreted with care.

Publication bias

We report three indices to test publication bias for each predictor variable, collapsing across levels of specificity as we did for the moderator analysis: funnel plot, trim and fill analysis and Rosenthal's fail-safe N. All three approaches have been criticized for different reasons (e.g., Carter, Hilgard, Schönbrodt, & Gervais, 2017; Ioannidis & Trikalinos, 2007; Terrin, Schmid, Lau, & Olkin, 2003), we therefore decided to report all three, and examine if the funnel plot, the trim and fill analysis and Rosenthal's fail-safe N converge on a conclusion. A funnel plot is a test for asymmetry (Egger, Smith, Schneider, & Minder, 1997). This analysis depicts the pattern of the effect size of each study against its standard error. If studies do not scatter systematically around the observed effect size, a publication bias is likely. In the case of publication bias, larger studies typically cluster at the top of the graph in a funnel plot, while smaller studies tend to spread out at the bottom, as smaller studies tend to show more sampling variation. Next, to investigate the adjusted effect size if more non-significant results were included in the analysis, a trim and fill analysis was conducted (Duval & Tweedie, 2000). In this iterative method, the effect sizes are re-computed until effect sizes are distributed systematically. We lastly computed Rosenthal's fail-safe N, which reports the number of studies that would need to be included to make the overall effect size insignificant (Rosenthal, 1991).

2.4. Results

Table 1 and 2 display an overview of the effect sizes of all individual and contextual factors, including the confidence interval, the Z-statistics and the significance level, the number of studies, and

participants. Figure 2 displays a graphical depiction of the uncorrected and corrected correlations. Overall, among the individual factors, particularly recycling self-identity, personal norms towards recycling, past recycling, and perceived behavioural control over recycling were strongly related to recycling. Among the contextual factors, the possession of a recycling bin and house ownership appeared to be strong predictors of recycling. Importantly, the analyses yielded that the confidence intervals around the effect sizes were small, indicating that the assessment was rather robust. Table 3 presents three results of the analyses to assess whether a publication bias is likely. In general, the results of the three indices of publication bias converged on a clear conclusion that in most of the cases publication bias was not an issue, except for some variables (i.e., attitudes, injunctive norms, anticipated affect, and to a lesser extent, recycling facilities and distance to drop off location). In the following, we will discuss the results for each predictor in more detail, again in alphabetical order.

Effect size individual factors

The results revealed that *anticipated affect* was significantly related to recycling (r = .26; *kstudies (ks)* = 8; *keffect sizes (ke)* = 15), with a medium effect size. The results of the funnel plot revealed that publication bias may have been present for anticipated affect. This was in line with the results of Rosenthal's fail-safe N that indicated that not that many studies would be needed to render the effect size of anticipated affect non-significant. The trim and fill analysis showed that 4 studies were trimmed for anticipated affect; the adjusted effect sizes would be lower. Yet, the confidence interval of the adjusted effect size substantially overlapped with the confidence interval around the obtained effect size, suggesting that we can be rather confident about the results.

Table 1. Effect Sizes of Individual Factors

	r	95% CI		*Z*	*p*	*ks*	*ke*	*N*
Anticipated affect								
Specific	.26	.14	.37	4.19	<.001	8	15	1,346
Attitudes								
Specific	.34	.29	.39	12.58	<.001	51	108	21,247
General	.19	.15	.23	8.60	<.001	32	82	19,473
Descriptive norm								
Specific	.33	.23	.42	6.18	<.001	13	31	5,997
General	.38	.20	.53	3.94	<.001	2	4	2,175
Self-identity								
Specific	.48	.34	.59	6.29	<.001	6	9	1,613
General	.30	.14	.43	3.68	<.001	5	6	3,246
Injunctive norm								
Specific	.33	.27	.38	10.29	<.001	32	67	11,360
General	.21	.13	.29	5.07	<.001	2	3	340
Knowledge								
Specific	.20	.14	.26	6.26	<.001	15	28	9,612
General	.21	.15	.29	6.03	<.001	9	20	10,149
Past recycling								
Specific	.41	.25	.54	4.84	<.001	15	24	5,497
Perceived behavioural control								
Specific	.39	.32	.44	11.16	<.001	45	80	22,060
General	.18	.10	.26	4.26	<.001	9	13	2,985
Personal norm								
Specific	.42	.35	.49	10.367	<.001	23	45	13,079
General	.14	.06	.22	3.27	<.001	3	3	1,224
Values								
General	.24	.18	.30	7.53	<.001	8	13	5,769

Note. ks = number of studies; *ke* = number of effect sizes

Table 2. Effect Sizes of Contextual Factors

	r	95% CI		*Z*	*p*	*ks*	*ke*	*N*
Contextual Factors								
Housing situation								
House type	.12	.06	.17	4.25	<.001	9	21	47,740
Ownership	.16	.01	.31	2.09	.04	3	4	43,617
Local circumstances								
Possession of bin	.24	.16	.32	5.69	<.001	5	7	4,734
Distance	-.11	-.17	-.05	-3.43	<.001	3	10	1,285
Facilities	.26	-.09	.55	1.49	.14	12	25	52,121
Size of neighbourhood	-.17	-.35	.02	-1.8	.07	3	4	47,172

Note. ks = number of studies; *ke* = number of effect sizes

A considerable number of studies examined the effect of specific and general attitudes on recycling. *Specific attitudes* were a relatively strong predictor of recycling (*r* = .34; *ks* = 51; *ke* = 108),

yielding a large effect size. With a medium effect size, *general attitudes* were significantly less strongly related to recycling (*r* = .19; *ks* = 32; *ke* = 82), as reflected in the non-overlapping confidence intervals of specific and general attitudes. The confidence intervals around the effect sizes of specific and general attitudes were small, suggesting that the results were robust. The funnel plot suggested that a publication bias may have been present for attitudes. This was in line with the results of the trim and fill analysis that showed that 23 studies were trimmed. This suggested that if more unpublished studies had been included in this meta-analysis, the effect size for attitudes would have been considerably lower. At the same time, Rosenthal's fail-safe N indicated that relatively many studies would be needed to yield a non-significant effect size.

Specific descriptive norms regarding recycling were relatively strongly related to recycling (*r* = .33; *ks* = 13; *ke* = 31), the effect size was large, and confidence interval were relatively small. *General descriptive norm regarding pro-environmental behaviour* was one of the strongest predictors at the general level (*r* = .38; *ks* = 2; *ke* = 4) with a large effect size. The confidence interval of specific descriptive norms completely overlapped with the confidence interval of general descriptive norms, suggesting that the level of specificity of descriptive norms did not play a big role. Yet, as the confidence interval of general descriptive norms was somewhat large and the number of studies examining general descriptive norms was relatively low, these results should be interpreted with caution. Findings indicated that there was no trace of publication bias.

Relatively few studies examined specific (*ks* = 6; *ke* = 9) and general self-identity (*ks* = 5; *ke* = 6). As a behaviour-specific indicator, *recycling self-identity* was the strongest predictor of recycling (*r* = .48) with a small confidence interval. Similarly, *general environmental self-identity* was relatively strongly related to recycling, with a large effect size (*r* = .30), but with a large confidence interval. The 95% confidence intervals of recycling self-identity and environmental self-identity substantially overlapped, suggesting that the level of specificity of this variable did hardly affect the strength of the effect size. As can be seen in Table 3, analyses revealed no hint of publication bias for self-identity.

The effect size of *injunctive norms regarding recycling* was strong with a relatively small confidence interval (*r* = .33; *ks* = 32; *ke* = 67). The small confidence interval suggested that this result was rather robust. *Injunctive norms towards pro-environmental behaviour* were less strongly related to recycling (*r* = .21; *ks* = 2; *ke* = 3), yielding medium effect sizes, but this result should be interpreted with care as the effect size assessment was based on two studies only. The confidence intervals of the specific and general injunctive norms overlapped less than half the distance of one side of the confidence interval, suggesting that injunctive norms regarding recycling were significantly more strongly related to recycling than injunctive norms towards pro-environmental behaviour. With respect to publication bias, results of the funnel plot revealed that publication bias may have be an issue. Similarly, the results of the trim and fill analysis showed that 15 studies were trimmed for

injunctive norms, and the adjusted effect sizes would be substantially lower. This suggested that if more unpublished studies had been included in this meta-analysis, the correlations between recycling and injunctive norms would be considerably lower. Yet, Rosenthal's fail-safe N indicated that relatively many studies would be needed to render the effect non-significant.

The results further revealed that *knowledge about recycling* (r = .20; ks = 15; ke = 28) and *general knowledge* (r = .21; ks = 9; ke = 20) were related to recycling, yielding medium effect sizes. The analysis was based on a considerable number of studies and the confidence intervals of both variables were relatively small, indicating that the assessment was robust. Interestingly, the confidence intervals almost entirely overlapped. This suggested that the level of specificity of knowledge was hardly related to the strength of the effect size. The analysis further revealed that publication bias was unlikely for knowledge.

Past recycling appeared to be one of the predictors that was most strongly related to recycling, with a large effect size (r = .41; ks = 15; ke = 24). Past recycling was investigated relatively often and the confidence interval of this variable was relatively small, suggesting that the results were robust. Analysis revealed no hint of publication bias for past behaviour.

Specific perceived behavioural control appeared to be strongly related to recycling (r = .39; ks = 45; ke = 80). This result was based on a considerable number of studies. *Perceived behavioural control to engage in pro-environmental behaviour in general* was less strongly related to recycling (r = .18; ks = 9; ke = 13), with a small to medium effect size. The confidence intervals of both variables were relatively small and did not overlap, suggesting that the results were robust, and that specific perceived behavioural control was a better predictor of recycling than general perceived behavioural control. In the case of perceived behavioural control, publication bias was unlikely.

Among the behaviour-specific individual factors, *personal norms regarding recycling* appeared to be one of the strongest predictors of recycling (r = .42; ks = 23; ke = 45). A considerable number of studies investigated the relationship between specific personal norms and recycling and the confidence interval was small, indicating that the assessment was robust. *Personal norms to engage in pro-environmental behaviour in general* was relatively weakly related to recycling (r = .14; ks = 3; ke = 3), with small to medium effect sizes, but this result should be interpreted with care as this effects size assessment was only based on three studies. Personal norms towards recycling were more strongly related to recycling than general personal norms, as reflected in the non-overlapping 95% confidence intervals. Findings indicated that there was no trace of publication bias for personal norms to engage in pro-environmental behaviour in general.

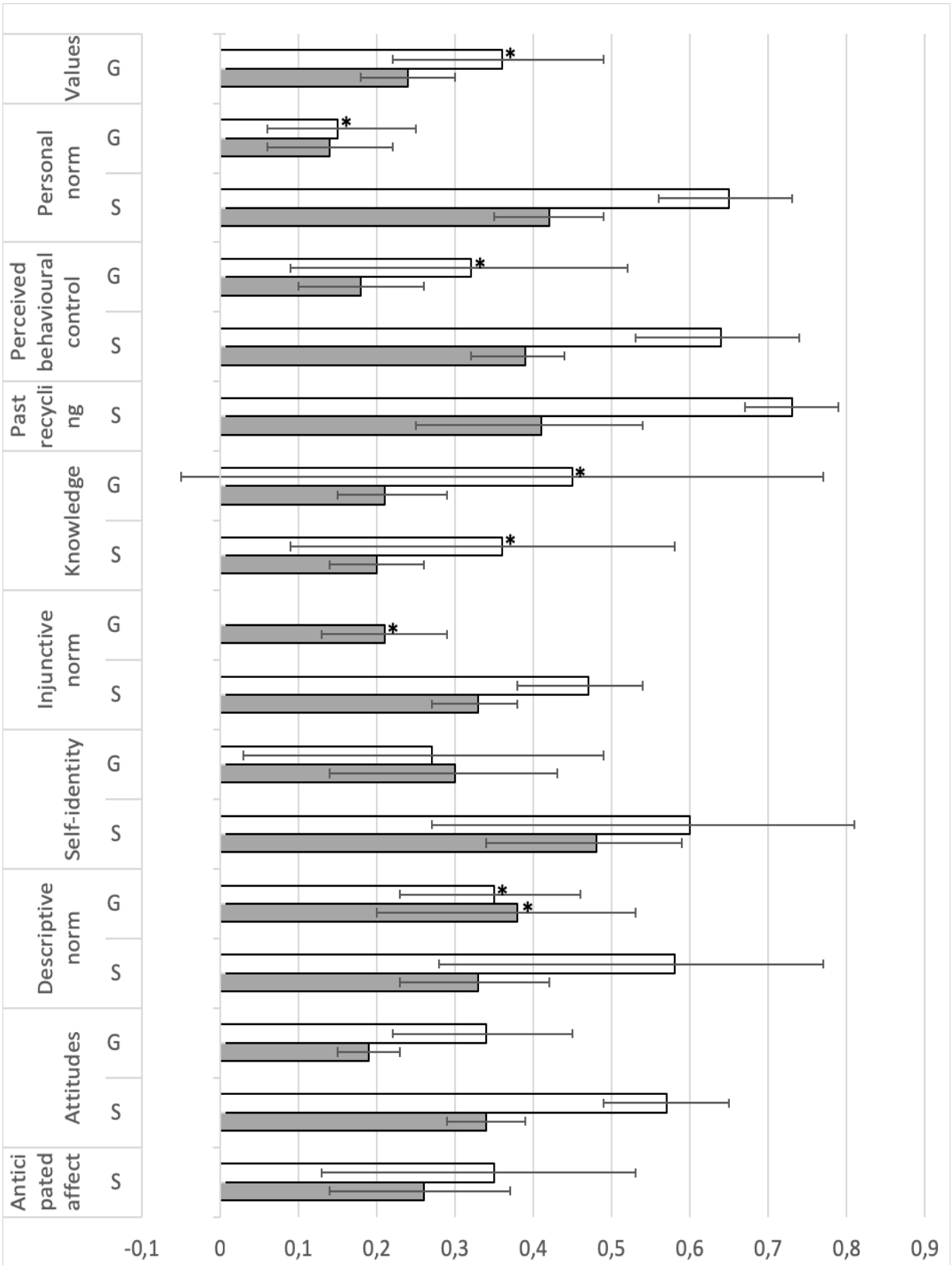

Figure 2. Uncorrected correlations (grey) and correlations corrected for measurement error (white). *Note.* Error bars represent 95% confidence interval. S = specific, focusing on recycling; G = general. * Correlations are based on less than 4 studies and should be interpreted with caution. Corrected correlations were not computed for general injunctive norms nor for any of the contextual factors the paper did not report the data to assess the corrected correlations (only one study on recycling facilities reported Cronbach's alpha to calculate the corrected correlations).

Biospheric values and recycling were relatively strongly related (*r* = .24; *ks* = 8; *ke* = 13), yielding a medium effect size. The results of the funnel plot, trim and fill analysis and Rosenthal's fail-safe N did not point to a publication bias for values.

Effect size contextual factors

Regarding the housing situation, the *type of house* (*r* = .12; *ks* = 9; *ke* = 21) and *house ownership* (*r* = .16; *ks* = 3; *ke* = 4) were both positively related to recycling with small to medium effect sizes. Yet, relatively few studies included these variables, and the confidence intervals around the effect size of both variables were relatively large, suggesting that the assessment of these variables was not very robust. The results of the funnel plot, trim and fill analysis and Rosenthal's fail-safe N did not point to a publication bias of type of house and house ownership.

In the case of local circumstances, *possession of a bin* was relatively strongly related to recycling with a medium effect size (*r* = .24; *ks* = 5; *ke* = 7). The number of studies examining this relationship was low. Yet, the confidence interval around the effect size was relatively small, suggesting that the effect size assessment of possession of a bin was rather robust. Publication bias did not seem to be an issue here.

Distance towards a drop-off location was only weakly related to recycling (*r* = -.11; *ks* = 3; *ke* = 10) with a small confidence interval. As the number of studies examining distance to a drop-off location was low, the results should be interpreted with caution. The three indices of publication bias did not converge on a conclusion. Specifically, the results of Rosenthal's fail-safe N indicated that relatively few studies with effect sizes of zero would be needed to yield non-significant effect sizes, whereas the results of the funnel plot and the trim-and fill analyses revealed that publication bias was not an issue.

The effect size of *recycling facilities in place* was strong but not statistically significant (*r* = .26; *ks* = 12; *ke* = 25) as reflected in the confidence interval that includes zero and a nonsignificant Z-statistic. However, the number of studies examining recycling facilities in place was considerable. The results of the analyses of publication bias did not converge on a conclusion whether publication bias was an issue. Specifically, the results of the funnel plot pointed to a publication bias, whereas the results of the trim and fill analysis and Rosenthal's fail-safe N did not do so.

The results of the relationship between *size of neighbourhood* and recycling showed a medium effect size (*r* = -.17; *ks* = 3; *ke* = 4). Yet, the result was only marginally significant, as reflected in the significance level of Z-statistics (*p* = .07) and in the confidence interval which had a higher bound of .02. The number of studies included in this analysis was low and the confidence interval relatively large. Hence, this result should be interpreted with care. Publication bias did not seem to be an issue for size of neighbourhood.

Table 3. Summary of Results to Test Publication Bias

	Funnel plot (Egger et al., 1997)	Trim and fill analysis (Duval & Tweedie, 2000)	Adjusted correlation	Fail N Rosenthal, 1991
Individual factors				
Affect	$t(6) = 2.44$*	4	.10; 95% CI [-.03, .23]; Q = 213.49	310
Attitudes	$t(66) = 3.14$**	23	.18; 95% CI [.13, .23]; Q = 5395.54	1423
Descriptive norms	$t(12) = 1.33$, *ns.*	6	.20; 95% CI [.09, .30]; Q = 1286.43	4873
Injunctive norms	t(31) = 3.42**	15	.18; 95% CI [.11, .24]; Q = 1793.87	4965
Knowledge	$t(21) = .91$, *ns.*	5	.16; 95% CI [.11, .21]; Q = 680.99	6129
Past recycling	$t(13) = .26$, *ns.*	1	.37; 95% CI [.21, .51]; Q = 1217.16	5296
Perceived behavioural control	$t(50) = .99$, *ns.*	8	.28; 95% CI [.21, .35]; Q = 4415.87	8167
Personal norms	$t(23) = 1.2$, *ns.*	4	.33; 95% CI [.25, .40]; Q = 1622.4	2059
Self-identity	$t(9) = .46$, *ns.*	0	-	2939
Values	$t(6) = .57$, *ns.*	2	.22; 95% CI [.19, .24]; $Q = 42.11$	556
Contextual factors				
House ownership	$t(1) = .51$, *ns.*	0	-	427
Type of house	$t(7) = 1.33$, *ns.*	0	-	972
Recycling facilities	$t(10) = 3.65$*	0	-	8991
Possession of recycling bin	$t(3) = .56$, *ns.*	0	-	377
Distance to drop-off location	$t(1) = .47$, *ns.*	0	-	32
Size of neighbourhood	$t(1) = .85$, *ns.*	0	-	1802

Note. ** $p < .001$; * $p < .05$

Table 4. Overview of Correlations and Heterogeneity Test per Predictor (specific and general combined)

	Uncorrected correlations	Q	I^2
Individual factors			
Affect	.26; 95% CI [.14, .37]	88.14**	91.87
Attitudes	.30; 95% CI [.26, .34]	2699.29**	97.52
Descriptive norms	.34; 95% CI [.24, .43]	556.77**	97.67
Injunctive norms	.32; 95% CI [.27, .38]	835.45**	96.17
Knowledge	.21; 95% CI [.17, .25]	360.79**	93.9
Past recycling	.41; 95% CI [.25, .54]	1119.52**	98.75
Perceived behavioural control	.36; 95% CI [.30, .42]	2518.15**	97.98
Personal norms	.40; 95% CI [.33, .47]	1103.72**	97.83
Self-identity	.40; 95% CI [.30, .49]	183.68**	94.56
Values	.24; 95% CI [.18, .30]		
Contextual factors			
House ownership	.12; 95% CI [.06, .17]	30.78**	93.5
Type of house	.16; 95% CI [.01, .31]	110.85**	92.78
Recycling facilities	.24; 95% CI [.16, .32]	17,438.67**	99.94
Possession of recycling bin	.1; 95% CI [.04, .15]	42.58**	90.61
Distance to drop-off location	-.11; 95% CI [-.17, -.05]	6.59*	69.64
Size of neighbourhood	-.17; 95% CI [-.35, .02]	213.57**	99.23

Note. ** $p < .0001$; * $p < .05$

Moderator analyses

As can be seen in Table 4, for all relationships, the Q statistics were significant, and the I^2 statistics suggest that the proportion of systematic variation that can potentially be explained by moderator variables was high. This indicated that moderators may have played a role, and that it was worthwhile to explore this. As indicated earlier, for the moderator analyses reported below, we did not differentiate between the specific and general conceptualisation of the predictors.

We first tested the influence of the conceptualisation of recycling as a moderator. As expected, the predictors were more strongly related to the intention to recycle (r = .41; 95% CI [.34; .48]; ks = 30; ke = 182) than to self-reported recycling behaviour (r = .28; 95% CI [.25; .30]; ks = 70; ke = 396) and particularly than to observed recycling behaviour (r = .13; 95% CI [.09; .17]; ks = 9; ke = 50; $Q(2)$ = 165.67, $p < .001$). This suggested that the individual and contextual factors better explain intention to recycle than self-reported recycling behaviour, and particularly better than observed recycling behaviour. We next compared the confidence intervals around all predictors for different conceptualisations of recycling. Figure 3 shows that the 95% confidence intervals around intention to recycle, self-reported recycling behaviour, and observed recycling behaviour did not overlap for attitudes, perceived behavioural control, and personal norms suggesting that attitudes, perceived

behavioural control and personal norms could better predict intention to recycle than self-reported recycling behaviour and particularly compared to observed recycling behaviour. In a similar vein, anticipated affect could better predict intention to recycle than self-reported behaviour, but not better than observed recycling behaviour, as reflected in the 95% confidence intervals that did not overlap. Interestingly, descriptive norms, self-identity and past behaviour did not seem to better explain intention to recycle than self-reported recycling behaviour. No studies looked at the relationship of descriptive norms nor self-identity and observed behaviour; less than four studies did this for past behaviour. The results showed that past behaviour could predict recycling intention better than observed behaviour, while the relationship between past behaviour and self-reported recycling and past behaviour and observed recycling behaviour did not seem to differ. This result was similar to the one of injunctive norms: intentions could be better explained than self-reported and observed recycling behaviour whereas the confidence intervals of self-reported and observed recycling behaviour overlapped. Furthermore, the results suggested that knowledge and values could better explain self-reported recycling behaviour than intention to recycle. This counterintuitive finding may have been due to the small number of studies that examined self-reported recycling behaviour (less than 4), hence these results should be interpreted with caution. To sum up, the majority of predictors were most strongly related to intentions, and less to self-reported and observed behaviour.

When we examined whether the obtained effect sizes for contextual factors depended on the operationalization of recycling, the results were not conclusive (see Figure 4). This is due to the limited number of studies examining the relationships between contextual factors and recycling. Notably, for none of the predictors, all three operationalizations of recycling were assessed. Furthermore, only in the cases of self-reported recycling behaviour and type of house, recycling facilities, and possession of recycling bin, the analysis was based on more than four studies. All of the 95% confidence intervals overlapped. Hence, based on the data available, no firm conclusions can be drawn on whether contextual factors better predict intentions to recycle than self-reported recycling and observed recycling behaviour.

The second moderator, namely, the target group, did not emerge as a significant moderator variable: $Q(2) = 1.40$, $p = .50$, indicating that effect sizes were similar for households, students, and employees in organisations ($r_{households} = .30$; 95% CI [.27; .33]; *ks* = 70; *ke* = 526; $r_{students} = .26$; 95% CI [.19; .33]; *ks* = 16; *ke* = 86; $r_{employees} = .27$; 95% CI [.17; .37]; *ks* = 5; *ke* = 16). This means that similar individual and contextual factors underlain the recycling of households, students and employees. As this moderator variable appeared to be non-significant at the general level, we did not run additional analysis for each predictor separately.

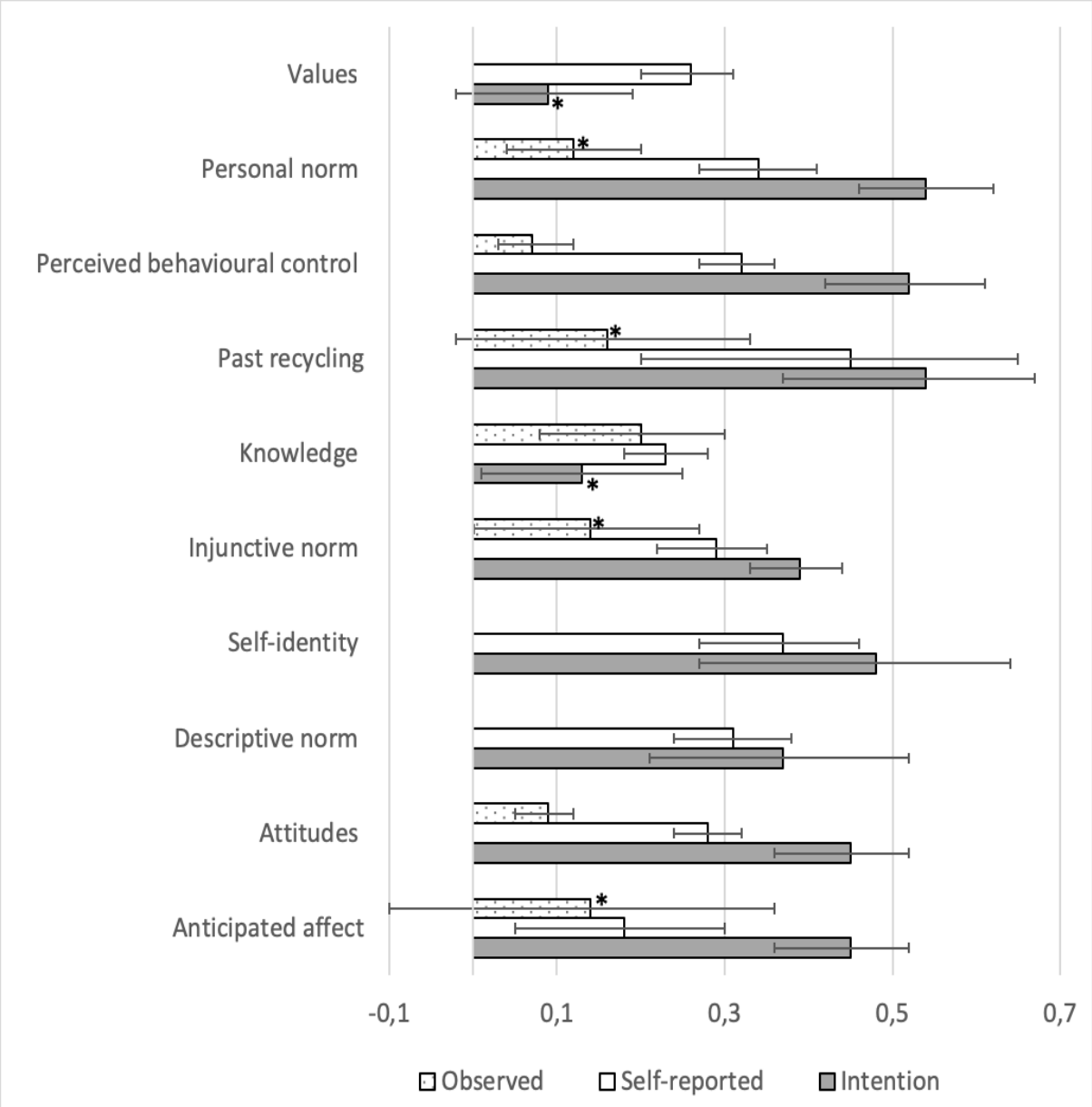

Figure 3. Uncorrected correlations of individual factors for intention to recycle (grey), self-reported (white) and observed recycling behaviour (dotted).
Note. Error bars represent 95% confidence interval. * Correlations are based on less than 4 studies and should be interpreted with caution. No studies examined correlations between observed recycling behaviour and descriptive norm, self-identity and values, respectively, so these do not appear in the Figure.

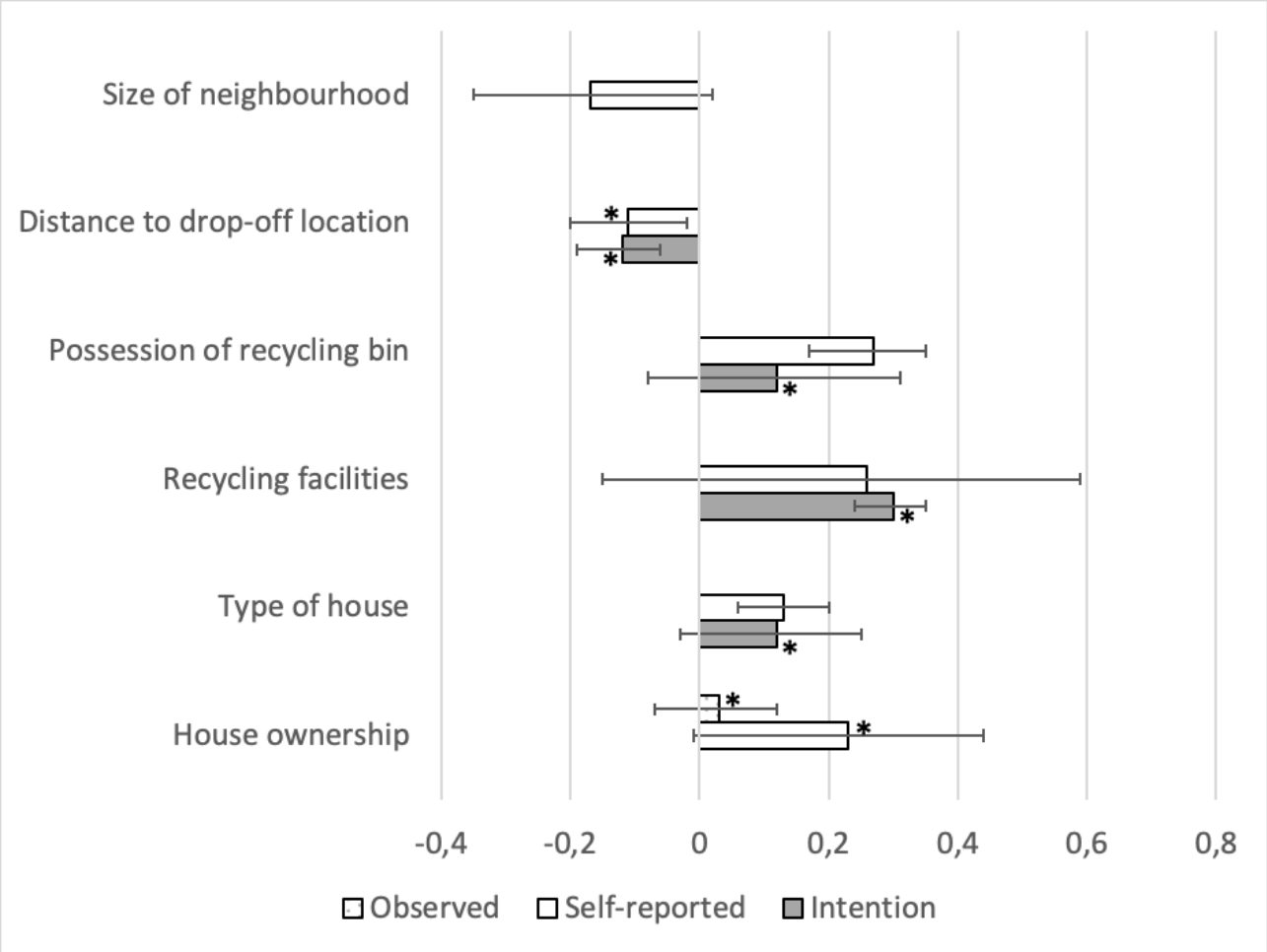

Figure 4. Uncorrected correlations of contextual factors for intention to recycle (grey), self-reported (white) and observed recycling behaviour (dotted).
Note. Error bars represent 95% confidence interval. * Correlations are based on less than 4 studies and should be interpreted with caution. No studies examined correlations between intention to recycle and house ownership and size of neighbourhood; between observed recycling and type of house, recycling facilities, possession of recycling bin, distance to drop-off location and size of neighbourhood, respectively, so these do not appear in the Figure.

Correlations corrected for measurement error

When correcting for measurement error, effect sizes were generally larger, increasing between .01 for general personal norms to .32 for past recycling behaviour (see Figure 2 for an overview of the uncorrected and corrected correlations). Yet, many corrected correlations, including the one of general self-identity, were based on a very small number of studies and should therefore be interpreted with caution. This was also reflected in the confidence intervals of the corrected correlations: they were much wider than the confidence intervals of the uncorrected correlations, indicating that we could be less confident about the effect sizes assessed. Yet, the overall pattern of the results was similar to the pattern of the results of the uncorrected correlations, again showing that recycling self-identity, past recycling behaviour and personal norms towards recycling were most strongly related to recycling, while attitudes towards the environment, personal norms towards pro-

environmental behaviour and recycling and environmental knowledge were relatively weakly related to recycling.

1.5. Discussion

The aim of the current meta-analysis was to examine the extent to which different individual and contextual factors predict recycling across studies. Furthermore, we aimed to investigate if the operationalisation of recycling and the target group studied influence the strength of these relationships. Overall, the results revealed that individual as well as contextual factors were related to recycling, with effect sizes ranging from small (e.g. for type of house) to large (e.g. for recycling self-identity and personal norms towards recycling). Furthermore, the confidence intervals around the effect sizes were small, suggesting that we can be confident about the effect sizes reported. This conclusion was further supported by the finding that except for the variables anticipated affect, attitudes and injunctive norms, no indication of publication biases was found.

Specific individual factors

Consistent with the compatibility principle (Ajzen, 1996), the results of the meta-analysis indicated that behaviour-specific individual factors, such as attitudes towards recycling, are better predictors of recycling than general predictors, such as environmental attitudes; behaviour-specific factors were also more studied than general factors. More precisely, our findings indicate that one's recycling self-identity is most strongly related to recycling: individuals seeing themselves as a person who recycles are more likely to recycle. Recycling self-identity is likely to encourage recycling, as individuals are motivated to act upon how they see themselves in order to be consistent (cf. Dietz et al., 2005). Next, our findings show that one's past recycling behaviour is strongly related to recycling. This may indicate that recycling is habitual. Yet, previous recycling may also affect recycling via a different process. Past recycling may influence how people see themselves, hence strengthening the recycling self-identity, and in turn affecting recycling. Indeed, research suggests that environmental self-identity is strengthened when people are reminded of their past pro-environmental behaviour, which in turn promotes other pro-environmental actions (Van der Werff et al., 2014). Future research is needed to explore why previous recycling affects current recycling, and particularly consider the role of habits and recycling self-identity in this process.

Our results further suggest that both personal and social (descriptive and injunctive) norms towards recycling are positively related to recycling, all showing large effect sizes: people are more likely to recycle when they feel morally obliged to recycle, when they think others do so as well and when they believe others to approve recycling. Furthermore, a relatively strong relationship between perceived behavioural control over recycling and recycling was observed. This is in line with the results of the meta-analysis by Bamberg and Möser (2007), showing that the intention to engage in pro-environmental behaviour in general is stronger if the perceived ability to perform this behaviour is

higher. The current meta-analysis adds to these findings that perceived behavioural control is also strongly related to recycling as a specific type of pro-environmental behaviour. Attitudes towards recycling also held large effect sizes. This is consistent with literature showing that individuals who evaluate a particular behaviour more favourably are more likely to engage in this behaviour (cf. Ajzen, 1991). Based on the findings of this meta-analysis, we showed that this finding also applies to recycling: individuals evaluating recycling more favourably are more likely to recycle their waste.

Anticipated affect was related to recycling as well: people were more likely to recycle if they anticipated this would yield positive feelings, or if they anticipated that not recycling would elicit negative feelings. This finding highlights the fact that besides cognitive factors, emotional factors are also important to consider as predictors of recycling (Haidt, 2001; Zajonc, 1980). Interestingly, knowledge about how to recycle was less strongly related to recycling than motivational factors. Other studies also revealed that knowledge is less predictive of environmental behaviour than motivational factors (e.g., Hornsey, Harris, Bain, & Fielding, 2016; Schultz, 1999; Ünal, Steg, & Gorsira, 2018). Some authors have argued that knowledge may particularly affect behaviour when people are motivated to engage in the behaviour in the first place, suggesting an interaction effect between knowledge and motivational factors (Bolderdijk, Gorsira, Keizer, & Steg, 2013). Future studies are needed to examine whether knowledge particularly affects recycling among those who are strongly motivated to recycle.

General individual factors

Our results further suggest that all general individual factors were related to recycling. Interestingly, the overall pattern of these results was comparable to those of individual factors that were assessed at the specific level. Yet, the relationships were generally weaker. A stronger environmental self-identity appeared to be related to more recycling. This finding is in line with previous research revealing that environmental self-identity is an important predictor of a wide range of pro-environmental behaviours (Whitmarsh & O'Neill, 2010; Van der Werff et al., 2013a; Van der Werff et al., 2013b), among which recycling (e.g., Gatersleben, Murtagh, & Abrahamse, 2014; Nigbur et al., 2010; Peters, Van der Werff, & Steg, 2018). Biospheric values were also positively related to recycling behaviour. This finding is in line with previous studies that generally showed that the more individuals endorse biospheric values, the more likely they are to engage in pro-environmental behaviour such as recycling (De Groot & Steg, 2007, 2008). In line with the results of the specific individual factors, descriptive norms as well as injunctive norms towards pro-environmental behaviours in general are related to recycling, with a medium effect size. The more people think others act pro-environmentally or others expect them to act pro-environmentally, the higher the likelihood that they recycle their waste. However, the results on the relationships between recycling and general descriptive and injunctive norms should be interpreted with care, as these results were only based on two studies each. Knowledge about environmental problems and general environmental attitudes

were also related to recycling behaviour, indicating that individuals who are knowledgeable about the causes and consequences of environmental problems and are concerned about the environment are more likely to recycle, yielding a medium effect size. Furthermore, the more individuals feel able to engage in pro-environmental behaviour in general, the more likely they are to recycle. Interestingly, personal norms to engage in pro-environmental behaviour were only weakly related to recycling. This implies that individuals who feel morally obliged to engage in pro-environmental behaviour in general are only slightly more likely to also engage in recycling. Again, these results should be interpreted with caution as only three studies investigated this relationship.

Contextual factors

Our meta-analysis further showed that contextual factors are consistently related to recycling. More precisely, this meta-analysis revealed that the possession of a recycling bin is relatively strongly related to more recycling, whereas the size of the neighbourhood and the distance to a drop-off location were less strongly related to recycling. Furthermore, the recycling facilities in place were not significantly related to recycling. House ownership and house type were relatively weakly related to recycling, with a small to medium effect size, suggesting that that these factors are less relevant for recycling. Specifically, people owning a house are somewhat more likely to recycle than those renting a house. People living in a single-family house are somewhat more likely to recycle compared to people living in an apartment. Yet, the number of studies including these contextual factors was low and the confidence interval of the effect sizes for indicators of local circumstances were relatively large, suggesting that we can be less confident about the effect sizes for contextual factors.

Moderator analysis

We found that attitudes, perceived behavioural control, personal norms and injunctive norms better predicted intention to recycle than self-reported recycling behaviour, and particularly compared to observed recycling behaviour. Furthermore, anticipated affect could better predict intentions to recycle than self-reported recycling behaviour and past behaviour was more strongly related to intentions to recycle than to observed recycling behaviour. This may point to an intention-behaviour gap suggesting that motivation is more likely to strengthen intentions than promoting actual behaviour (Kollmus & Agyeman, 2002). This suggests that future research should clearly distinguish between the different outcome variables as this may lead to different results. Moreover, it shows that it is important to not only study intentions to recycle and self-reported recycling behaviour; it seems essential to study actual behaviour as well. In line with this, future studies could examine why the individual factors better predict intentions than behaviour. Specifically, which factors deter individuals who have (strong) intentions to recycle from engaging in this behaviour? May self-reported recycling reflect recall problems that people face when filling in a questionnaire? The results of the moderator analysis of the operationalization of recycling for contextual factors was inconclusive due the limited number

of studies investigating contextual factors. Future studies should more systematically investigate the influence of contextual factors on different indicators of recycling and examine whether these can better explain intention to recycle than self-reported or observed recycling behaviour.

Interestingly, our findings suggest that the relationships between individual and contextual factors on the one hand and recycling on the other hand, did not differ across different target groups. Notably, we found that similar factors influence the recycling of households, students, and employees in organisations. This is an important finding, suggesting that similar strategies can be employed to promote recycling across different target groups; we come back to the practical implications of these findings below. Interestingly, our results differ from previous research that has suggested that different factors may play a role in explaining pro-environmental behaviour for different target groups (e.g., students versus households; Abrahamse & Steg, 2013, Lokhorst et al., 2011). These studies, however, examined different types of pro-environmental behaviours whereas we investigated recycling in particular. Future research is needed to examine under which conditions different factors underlie behaviour of different target groups, and why this may be the case.

Theoretical implications and Future Research

The current meta-analysis revealed that both individual and contextual factors are important predictors of recycling. Most of the individual factors included in this meta-analysis have been included in theories to explain environmental behaviour, such as the Theory of Planned Behaviour (Ajzen, 1991), the Norm-Activation-Model (Schwartz & Howard, 1981), or the Value-Belief-Norm theory on environmentalism (Stern, 2000), but only few studies tested these theories explicitly. In fact, some studies on recycling were based on the Theory of Planned Behaviour (Ajzen, 1991). This theory proposes that behaviour is influenced by intentions, and that intentions in turn depend on attitudes, perceived behavioural control, and subjective norms (similar to injunctive norms). Our meta-analysis shows that the variables included in the Theory of Planned Behaviour are rather strongly related to recycling. Yet, importantly, this meta-analysis suggests that recycling not only depends on individual and social costs and benefits considerations, as reflected in attitudes and social norms towards recycling and perceived behaviour control, but also on moral and environmental costs and benefits, as reflected in environmental self-identity, values and personal norms. This is in line with other research showing that pro-environmental behaviour is not primarily motived by individual costs and benefits, but that normative and environmental concerns play a key role (e.g., Whitehead & Cherry, 2007; Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, Perlaviciute, & Van der Werff, 2015). In line with this, the Norm Activation Theory (Schwartz & Howard, 1981), the Value-Belief-Norm theory of environmentalism (Stern, 2000) and the Value-Identity-Personal norm model (Ruepert et al., 2016; Van der Werff & Steg, 2016) may be relevant when explaining recycling. These theories have in common that they focus on normative or moral considerations. Specifically, all three theories propose

that personal norms influence pro-environmental behaviour, but they include different antecedents of personal norms. Importantly, the results of the current meta-analysis suggest that variables from different theoretical frameworks such as recycling self-identity (Value-Identity-Personal norm model), personal norms towards recycling (Norm Activation Theory, Value-Belief-Norm theory of environmentalism, Value-Identity-Personal norm model), and perceived behavioural control over recycling (Theory of Planned Behaviour), seem most relevant in explaining recycling. This suggests that an integrated approach involving different theoretical frameworks may be needed to better explain recycling.

To be able to test the predictive power of different theories across studies, it would be important to also examine the relationships between predictors of recycling. Yet, only a few studies included in our meta-analysis reported data on correlations between predictors. Hence, it was not possible to test casual relationships between predictors included in the current meta-analysis. Exploring relationships between predictor variables would shed some light on why some predictors were relatively weakly and others more strongly related to recycling. For instance, biospheric values were moderately strongly related to recycling. One explanation for this result may be that biospheric values, as relatively stable and general guiding principles for choices and behaviours, are likely to influence recycling indirectly via behaviour-specific factors such as personal norms (cf. Stern, 2000; Ruepert et al., 2016; Van der Werff & Steg, 2016). These findings point to several avenues for future research. Although key variables of the models discussed above have been included in studies on recycling, not all variables from relevant theories have been included in studies on recycling. For example, outcome efficacy that is a key variable in the Norm-Activation Model and Value-Belief-Norm theory has not been included in studies on recycling. Moreover, the full models have hardly been tested in one study, and as a consequence, it is not possible to test whether the theoretical models are supported. Future studies could include key variables from different theories, as to examine to what extent and under which conditions the Theory of Planned Behaviour versus theories focusing on normative considerations (Norm Activation Theory, Value-Belief-Norm theory, Value-Identity-Personal norm model) are most predictive of recycling. This may reveal under which conditions not only individual factors but also whole theories, such as these discussed above, can predict recycling.

As yet, only a few studies have investigated the influence of contextual factors on recycling. The results of this meta-analysis suggest that considering contextual factors may be crucial. Future studies are needed to examine the relationship between contextual factors and recycling more systematically to ascertain the magnitude and consistency of these relationships. Our findings on contextual factors point to several avenues for future research. First, future studies could more systematically investigate how different contextual factors affect recycling, and explore other proxies of quality of recycling facilities. A recent meta-analysis supports the notion that interventions should

consider the context in which recycling takes place as environmental alterations were among the strongest interventions to promote recycling (Varotto & Spagnolli, 2017). Second, most studies examined the relationship of individual factors and contextual factors on recycling independently. Future research could examine to what extent contextual factors are related to individual factors, and whether both interact. For example, contextual factors may affect recycling via individual factors, for instance, via perceived behavioural control and attitudes. That is, people may feel more able to recycle and have more favourable attitudes to recycle when better recycling facilities are offered. Next, future research can study the interaction between individual and contextual factors, which will reveal under which conditions individual and contextual factors affect recycling. For example, very convenient recycling facilities may particularly affect recycling among those who do not evaluate recycling very favourably. Hence, contextual factors that make recycling more convenient can particularly encourage recycling among those who hold a less favourable attitude towards recycling who would otherwise not recycle. In line with the ABC theory (Stern, 2000), when contextual factors are less likely to favour recycling, individual factors may have a stronger influence on whether one engages in recycling. Specifically, a person with a very favourable attitude towards recycling may even recycle when contextual factors are not very favourable. The interplay between individual and contextual factors has hardly been studied, with a few exceptions (Best & Kneip, 2011; Tabernero et al., 2015; Vining & Ebreo, 1992). Future studies are needed to examine the interplay between individual and contextual factors and its relationship with recycling.

Limitations

A limitation of the current meta-analysis is that the correlations corrected for measurement error were only based on a very small number of studies, as many studies did not report reliabilities. These results should therefore be interpreted with caution. Future studies on recycling should systematically report reliabilities as well as means and standard deviations of scales to ensure that future meta-analyses can better correct for artifacts. Interestingly, we noticed a trend that particularly papers published before the 2000's did not report these measures, suggesting a development towards reporting reliabilities, means and standard deviations of scales has taken place in the last 20 years.[3]

[3] There are two issues that we would like to raise concerning the interpretation and the practical implications of corrected correlations. First, when there is no or only a small effect in the population, the corrected correlations are likely to overestimate the effect size, with the overestimation becoming stronger the lower the reliability coefficient is (Hunter & Schmidt, 1990; Murphy, 2003; Zhao, 2017). In a similar vein, there is evidence to suggest that there is no difference between the uncorrected and corrected correlations comparing it to real-world data (Zhao, 2017; also see the discussion on correcting for artifacts by Murphy, 2003). Second, correcting for measurement errors assumes that concepts can be measured in a perfect way, while this is hardly ever the case in practice. In case of low alpha's, many studies are needed to assess the effect in an adequate way and confidence intervals are likely to be relatively large. This suggests that one should be careful with overestimating the value of correlations corrected for measurement error as the interpretation and the practical implications can be debated.

Practical implications

Our meta-analysis suggests that both individual and contextual factors can be targeted to promote recycling. Interventions to promote recycling will be particularly effective if they target the most predictive individual and contextual factors of recycling. This meta-analysis indicates that interventions could best target recycling- and environmental-self-identity, past recycling behaviour, attitudes towards recycling, personal norms towards recycling, perceived behavioural control over recycling, and among contextual factors, the possession of a recycling bin. Various strategies could be employed in this respect. Regarding the contextual factors, recycling facilities and collection systems could be made more convenient and more easily accessible. For example, the frequency of collection could be increased, and recycling facilities could be placed closer to one's home (e.g., kerbside collection systems, or better storage facilities in one's home). Improving recycling facilities may not only affect behaviour directly, but also indirectly by strengthening attitudes or perceived behaviour control to recycle by making recycling more feasible and attractive. In addition to the contextual factors included in this meta-analysis, other strategies could be employed such as providing incentives or rewards for recycling or fines for not disposing recyclables correctly. This may, in turn, affect attitudes in a positive way, which appeared to be a strong predictor of recycling. Financial incentives, for example, seemed to be relatively effective in stimulating recycling as long as they are in place. However, it is not clear why financial incentives may particularly work to stimulate recycling (Maki, Burns, Ha, & Rothman, 2016).

Various strategies can be employed that target the motivational factors enhancing recycling. For example, feedback can be provided on one's recycling performance, as to make people aware of their 'good' behaviour. This may strengthen their recycling self-identity, as well as their environmental self-identity in general, which in turn may encourage them to recycle more (Van der Werff et al., 2014) and to engage in other pro-environmental behaviours (Van der Werff et al., 2014).

Furthermore, social modelling can be employed: behavioural models can demonstrate the desired behaviour, in this case recycling. Such social models can strengthen descriptive norms to recycle, and enhance perceived behaviour control when people perceive concrete guidelines on how to recycle. Similarly, information can be provided on the extent to which others recycle, about one's own recycling in comparison to others, or that others expect a person to recycle, which is likely to strengthen descriptive and injunctive norms to recycle (Abrahamse & Steg, 2013). Alternatively, the negative impact of poor waste recycling can be emphasised, which is likely to increase people's awareness of the problems and affect recycling attitudes positively, and may also strengthen personal norms to recycle (Steg, Dreijerink & Abrahamse, 2005; Stern et al., 1999). Future research is needed to test whether the strategies discussed above are indeed effective in promoting recycling, and via which processes they do so, notably whether the strategies indeed target the motivational and

contextual antecedents in the way we proposed. The latter is pivotal to enhance theory and practice on ways to promote recycling.

Interestingly, the meta-analysis suggests that there is no need to tailor interventions to different targets groups, notably for households, students and employees. Similar factors seem to underlie the recycling of these groups. This implies that the behaviour-change strategies identified above can be implemented on a large scale, thereby targeting and motivating various groups in society to recycle. By identifying important and consistent individual and contextual factors related to recycling, our meta-analysis provides important guidelines of which variables could best be targeted in future research and in policies, as for example of the European Union and the Worldbank, aiming at increasing recycling rates.

Conclusion

The current meta-analysis aimed to identify the most robust and important predictors of recycling across studies. Individual as well as contextual factors appeared to be significantly related to recycling. Among these, recycling self-identity, past recycling, perceived behavioural control over recycling, personal, descriptive and injunctive norms towards recycling and the possession of a bin are most strongly related to recycling. Behaviour-specific factors are generally better predictors of recycling than general factors. Further, the operationalization of recycling is critical: individual and contextual factors can better predict intention to recycle than self-reported recycling behaviour, and particularly compared to observed recycling behaviour.

2.7. Appendix

Table 5. Overview of studies included

Author(s)	Country	Total N	Mean age	Gender – % female	Predictors	Operationalization of Recycling	Target group	Effect size& 95% CI
Aguilar-Luzón, Calvo-Salguero, & Salinas (2014)	ES	184	21.6	75	Anticipated affect, specific attitudes	I, S	ST	.18 [.04, .32]*
Aguilar-Luzon et al. (2012)	ES	120	50.6	100	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific and general personal norms, values,	I, S	H	.32 [.15, .47]**
Allen & Ferrand (1999)	US	98	NI	85	General perceived behavioural control	S	ST	.28 [.09, .45]**
Anderson & von Borgstede (2010)	SE	418	45	55.1	Specific descriptive norms specific knowledge, specific personal norms,	S	H	.31 [.22, .40]**
Arbuthnot & Lingg (1; 1975)	F	60	NI	NI	General knowledge, general perceived behavioural control	S	H	.11 [-.16, .36]
Arbuthnot & Lingg (2; 1975)	U.S.	85	NI	NI	General knowledge, general perceived behavioural control	S	H	.32 [.15, .48]**
Barr (2001)	UK	673	NI	57	Environmental attitudes, bin, house type, specific and general knowledge	I, S	H	14 [.07, .21]**
Berger (1997)	CA	43000	NI	NI	Facilities, house type, ownership, size	S	H	.30 [.29, .31]**

Bertoldo & Castro (2015)	P, BR	331	P: 22.5, BR: 23.7	P: 59.2, BR: 47.4	Specific descriptive norms, general self-identity, specific injunctive norms, specific personal norms	S	ST	.05 [-.06, .16]
Bianchi & Birtwistle (1; 2010)	UK	504	NI	100	Environmental attitudes	S	H	.26 [.18, .34]**
Bianchi & Birtwistle (2; 2010)	AU	239	NI	100	Environmental attitudes	S	H	.26 [.13, .37]**
Boldero (1995)	AU	208	35.8	64.6	Specific attitudes and environmental attitudes, bin, specific and general injunctive norms, specific perceived behavioural control, size	S	H	.18 [.05, .30]**
Botetzagias, Dima, & Malesios (2015)	GR	293	NI	59.4	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms	I	H	.42 [.32, .51]**
Bratt (1999)	N	423	NI	NI	Specific injunctive norms, specific personal norms	S	H	.20 [.10, .29]**
Burn (1991)	U.S.	211	NI	NI	Specific descriptive norms, Specific knowledge	B	H	.23 [.09, .37]**
Carrus et al. (2009)	IT	303	40.4	50.2	General descriptive norms	I	H	.45 [.36, .54]**
Carrus, Passafaro, & Bonnes (2008)	IT	154	41	46	Anticipated affect, specific attitudes, specific injunctive norms, past recycling, specific perceived behavioural control	I	H	.49 [.36, .60]**

Castro et al. (2009)	P	394	29.4	59.5	Specific attitudes, environmental attitudes, facilities, general self-identity	S	H	.21 [.11, .30]**
Chan & Bishop (2013)	AU	271	24	56.8	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms	I, S	ST	.42 [.31, .51]**
Chan (1998)	HK	173	NI	67.4	Specific attitudes, specific injunctive norms, specific perceived behavioural control	I, S	H	.35 [.21, .48]**
Chen & Tung (2010)	TW	541	NI	67.3	Specific and environmental attitudes, facilities, specific injunctive norms, specific perceived behavioural control, specific personal norms	I	H	.47 [.40, .53]**
Culiberg (2014)	SLO	367	NI	50.1	Specific attitudes, specific personal norms	I	H	.45[.37, .53]**
D'Amato, Mancinelli, & Zoli (2016)	UK	2009	NI	50.7	Environmental attitudes, bin, facilities, general knowledge	S	H	.16 [.12, .21]**
Daneshvary, Daneshvary, & Schwer (1998)	U.S.	817	47.9	46	Environmental attitudes, past recycling	S	H	.05 [-.02, .12]
Davies, Foxall, & Pallister (2002)	UK	317	NI	57	Anticipated affect, specific attitudes, specific injunctive norms, specific knowledge, past recycling, specific	I, B	H	.13 [.05, .21]**

					perceived behavioural control, specific personal norms			
Davis et al. (2006)	UK	72	NI	61	Specific and environmental attitudes, past recycling	I	H	.03 [-.20, 26]
De Young (1990)	U.S.	91	NI	NI	Specific attitudes, specific perceived behavioural control, size	S	H	.17 [-.03, .36]
Derksen & Gartrell (1993)	U.S.	1245	41.1	49	Environmental attitudes	S	H	.30 [.25, .35]**
Domina & Koch (2002)	U.S.	472	NI	81	Environmental attitudes, facilities, house type, specific perceived behavioural control	S	H	.21 [.12, .29]**
Ebreo & Vining (2001)	U.S.	63	46	59.4	General knowledge, values	S	H	.35 [.11, .55]**
Elgaaied (2012)	F	276	NI	59	Anticipated affect, environmental attitudes specific perceived behavioural control	I	H	.27 [.16, .38]**
Fielding et al (2016)	AU	115	NI	66	Specific attitudes, specific descriptive norms, specific perceived behavioural control	S, B	H	.23 [.05, .40]*
Fornara et al. (2011)	IT	452	41.2	50.2	Specific attitudes, specific descriptive norms, specific injunctive norms, specific perceived behavioural control	I	H	.40 [.32, .47]**

Gamba & Oskamp (1994)	U.S.	396	47	59	Specific and environmental attitudes, specific knowledge, ownership, past recycling, specific and general perceived behavioural control	B	H	.09 [-.01, .19]
Green-Demeirs, Pelletier, & Ménard (1997)	CA	444	20.9	73.9	Specific self-identity, specific personal norms	S	ST	.25 [.16, .34]**
Guagnano, & Stern (1995)	U.S.	180	42.2	NI	Specific attitudes, bin, specific perceived behavioural control	S	H	.25 [.13, .36]**
Hage, Söderholm, & Berglund (2009)	SE	827	49.6	50	Environmental attitudes, specific descriptive norms, distance, facilities, house type, specific injunctive norms, specific personal norms	S	H	.09 [.02, .16]**
Hansmann et al. (2006)	CH	623	NI	47.4	Specific and environmental attitudes, facilities, specific perceived behavioural control, specific personal norms	S	H	.08 [.00, .16]*
Huffman, Van der Werff, & Henning (2014)	U.S.	118	NI	78.7	Specific attitudes, environmental attitudes	B, S	ST	.23 [.05, .40]**

Kalinowski, Lynne, & Johnson (2006)	U.S.	660	46	50	Past recycling, specific perceived behavioural control, specific personal norms	S	H	.21 [.14, .29]**
Knussen & Yule (2008)	UK	252	36	64	Specific attitudes, environmental attitudes, facilities, specific knowledge, specific and general perceived behavioural control	I	H	.25 [.12, .36]**
Knussen et al. (2004)	UK	239	36.1	64	Specific attitudes, specific injunctive norms, past recycling, perceived behavioural control	I, S	H	.45 [.34, .55]**
Kraft et al. (2005)	CH	110	24	79.7	Specific attitudes, specific injunctive norms, specific perceived behavioural control	S	ST	.32 [.14, .48]**
Kurz, Linden, & Sheehy (2007)	UK	765	50.6	58.4	Specific attitudes, environmental attitudes	B	H	.12 [.05, .19]**
Lange et al. (2014)	DE	282	24.4	62	Distance	I, S	ST	.16 [.05, .28]**
Lee & Paik (2011)	ROK	196	NI	56.9	Specific and environmental attitudes, house type	S	H	.26 [.13, .39]**
Lindsay & Strathman (1997)	U.S.	192	47	71.9	Specific descriptive norms specific and general knowledge, specific perceived behavioural control	S	H	.27 [.13, .40]**
Lüdemann (1999)	DE	183	37.8	66.1	Past recycling, specific injunctive norms, values	S	H	.53 [.41, .63]**

Manika et al. (2013)	UK	1043	NI	NI	Specific attitudes, general descriptive norms, facilities, general perceived behavioural control	S	E	.17 [.11, .23]**
Mannemar Sønderskov (2011)	UK, USA, DK, SE	3964	45	53	Specific perceived behavioural control, size, values	S	H	.18 [.15, .21]**
Mannetti, Pierro, & Livi (2004)	IT	230	24.4	53.3	Specific attitudes, specific injunctive norms, specific perceived behavioural control	I	ST	.44 [.33, .54]**
Marans & Lee (1993)	TW	608	NI	50.2	Specific attitudes, general descriptive norms specific injunctive norms, specific personal norms, specific knowledge	S	E	.38 [.32, .45]**
McGuinness, Jones, & Cole (1977)	U.S.	132	NI	97.7	Anticipated affect, environmental attitudes, general injunctive norms, specific perceived behavioural control	B	H	.22 [.05, .38]**
Nigbur, Lyons, & Uzzell (1; 2010)	UK	527	NI	61.7	Specific attitudes, specific descriptive norms, specific self-identity, specific injunctive norms, specific perceived behavioural control, specific personal norms	I	H	.59 [.53, .64]**

Nigbur, Lyons, & Uzzell (2; 2010)	UK	264	NI	69.7	Specific attitudes, specific descriptive norms, specific self-identity, specific injunctive norms, specific perceived behavioural control, specific personal norms	I, S	H	.40[.29, .50]**
Ohtomo & Hirose (2007)	JP	206	19.3	67	Specific descriptive norms, environmental attitudes, specific injunctive norms	I, S	ST	.36 [.23, .47]**
Oskamp et al. (1991)	U.S.	221	NI	61	Specific and environmental attitudes, specific and general descriptive norms, specific and general knowledge, house type, ownership, general perceived behavioural control	S	H	.16 [.07, .25]**
Pakpour et al. (2014)	IR	1782	31.7	63	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms, general self-identity, specific knowledge, past recycling	I, S	H	.48 [.45, .52]**
Park & Ha (2014)	U.S.	421	47	51	Specific attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms	I	H	.72 [.66, .76]**
Pearson, Dawson, & Breitkopf (2012)	U.S.	1512	30.3	100	Facilities, specific knowledge, specific perceived behavioural control	S	H	.12 [.07, .17]**

Pensini & Caltabiano (2012)	AU	85	24.2	71.8	Anticipated affect, specific attitudes	S	ST	.33 [.12, .51]**
Rhodes et al. (2015)	CA	176	49.2	61.1	Specific attitudes, distance, specific injunctive norms, specific perceived behavioural control	I, S	H	.38 [.26, .49]**
Robertson & Walkington (2009)	UK	1664	NI	NI	Specific and environmental attitudes, bin, specific descriptive norms, house type, general knowledge	I	ST	.08 [.03, .13]**
Ruepert et al. (2016)	NL, ES, RO, IT	491	43.5	49	General self-identity, general personal norms, values	S	E	.18 [.10, .27]**
Ruepert, Keizer, & Steg (2017)	NL	290	48.2	45	Values	S	E	.27 [.16, .38]**
Schultz & Oskamp (1996)	U.S.	129	NI	66.7	Environmental attitudes	B, S	ST	.19 [-.02, .39]
Schwab, Harton, & Cullum (2014)	U.S.	524	19.2	90.6	Specific attitudes, specific injunctive norms	S	ST	.24 [.16, .31]**
Seacat & Northrup (1; 2010)	U.S.	204	NI	64.5	House type, specific knowledge, specific perceived behavioural control	S	H	.18 [.05, .31]*
Seacat & Northrup (2; 2010)	U.S.	483	NI	71.4	House type, specific knowledge, specific perceived behavioural control	S	H	.16 [.08, .25]**
Segev (2015)	U.S.	410	23.6	57	Environmental attitudes, general knowledge, general	S	ST	.38 [.29, .46]**

Smith, Haugtvedt, & Petty (1994)	U.S.	198	NI	NI	perceived behavioural control, general personal norms, values Anticipated affect, specific attitudes, environmental attitudes	S	ST	.25 [.11, .37]**
Sterner & Bartelings (1999)	SE	456	51.1	351	Specific attitudes, general knowledge, past recycling, specific perceived behavioural control	B	H	.14 [.05, .23]**
Swami et al. (2011)	UK	203	35.5	49.3	Environmental attitudes	S	H	.06 [-.08, .20]
Tabernero et al. (2015)	ES	1501	NI	72.1	Specific perceived behavioural control	S	H	.41 [.37, .45]**
Tang, Chen, & Luo (2011)	CN	756	NI	38	Specific attitudes, environmental attitudes, specific injunctive norms, specific perceived behavioural control, specific personal norms	S	H	.17 [.10, .24]**
Terry, Hogg, &White (1999)	AU	114	32.7	55.9	Specific attitudes, specific descriptive norms, specific self-identity, past recycling, specific perceived behavioural control	I, S	H	.50 [.37, .58]**
Thogersen (2003)	DK	1955	NI	47	Specific knowledge, specific perceived behavioural control, specific personal norms	S	H	.24 [.20, .28]**
Thogersen (2009)	DK	200	43	54	Specific injunctive norms, specific personal norms	S	H	.48 [.37, .58]**

Tilikidou & Delistavrou (2008)	GR	420	NI	NI	Specific attitudes, environmental attitudes, general perceived behavioural control	S	H	.35 [.26, .43]**
Tonglet, Phillips, & Read (2004)	UK	191	NI	65	Specific attitudes, environmental attitudes, specific injunctive norms, specific knowledge, past recycling, specific perceived behavioural control, specific personal norms	I, S	H	.27 [.13, .40]**
Unal et al. (2016)	NL	248	38.9	53.4	General self-identity, values	S	E	.37 [.26, .47]**
Van Birgelen, Semeijn, & Keicher (2009)	DE	176	NI	54.5	Specific attitudes, specific perceived behavioural control	S	H	.54 [.42, .63]**
Vining & Ebreo (1990)	U.S.	197	NI	NI	Specific knowledge, facilities	S	H	.17 [.03, .27]*
Vining & Ebreo (1992)	U.S.	203	NI	1986: 41, 1987: 67.3, 1988: 67.4	Environmental attitudes, general knowledge, specific and general personal norms	S	H	.14 [.00, .27]
Wan, Shen, &Yu (2014)	HK	198	NI	47	Specific attitudes, specific injunctive norms, specific personal norms, specific perceived behavioural control	I, S	H	.75 [.68, .80]**
Werner & Makela (1998)	U.S.	116	40.5	NI	Specific attitudes, specific descriptive norms, facilities, specific self-identity, past recycling	S	H	.24 [.02, .43]*

White & Hyde (2012)	AU	148	33.9	56.5	Specific attitudes, specific self-identity, specific injunctive norms, specific perceived behavioural control	I, S	H	.39 [.24, .52]**
White & Hyde (2013)	AU	148	36.3	56.1	Specific injunctive norms, specific perceived behavioural control	S	H	.51 [.38, .62]**
White et al. (1; 2009)	AU	164	35.4	50.6	Specific attitudes, specific descriptive norms, specific injunctive norms, specific perceived behavioural control, specific personal norms	I, S	H	.46 [.33, .58]**
White et al. (2; 2009)	AU	175	33.3	48.6	Specific attitudes, specific descriptive norms, specific injunctive norms, perceived behavioural control, specific personal norms	I	H	.50 [.38, .60]**
Yi, Hartloff, & Meyer (1999)	UK, NL, IT	4113	44.3	NI	Specific attitudes, environmental attitudes, general knowledge	S	H	.29 [.27, .32]**

Note. ** $p < .01$, * $p < .05$, Total *N:* Number of participants. Country: Au =Australia; BR = Brazil; CA = Canada; CH = Switzerland; CN = China; DE = Germany; DK = Denmark; ES = Spain; F = France; GR = Greece; HK = Hong Kong; IT = Italy; IR = Iran; JP = Japan; N = Norway; NL = the Netherlands; P = Portugal; RO = Romania; ROK = South Korea; SE = Sweden; SLO = Slovenia; TW = Taiwan; NI = no information. Operationalization of DV: B = Observed recycling behaviour; I = Intention to recycle; S= Self-reported recycling behaviour. Target group: E = Employees; H = Households; ST = Students

3. Context matters: The role of perceived ease and feasibility vis-à-vis biospheric values in recycling behaviour

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3.2. Abstract

In this paper, we studied to what extent individual factors and perceptions of the context are related to recycling. We reasoned and found that perceived ease to use a collection system affects recycling, via perceived feasibility of recycling. Moreover, we hypothesised and found that the effect of biospheric values depends on the perceived feasibility of recycling. Interestingly, biospheric values were more strongly related to recycling when recycling was perceived as not very feasible. When recycling was perceived as very feasible, individuals recycled irrespective of their biospheric value strength. These results partially support the A-B-C-model, but do not support the low-cost-hypothesis. We replicated our findings in two questionnaire studies in two regions in the Netherlands with different waste collection systems, and for recycling in general as well as for recycling of four different waste types. We could not replicate the results for actual recycling behaviour. We discuss theoretical and practical implications.

Keywords: Recycling behaviour, perceived ease to use the collection system, perceived feasibility to recycle, biospheric values

3.3. Introduction

A circular economy aims at minimizing waste and retaining resources as much as possible (Corsten, Worrell, Rouw, & Van Duin, 2013; European Union, 2014), thereby combatting waste problems and the emerging scarcity of resources (European Environment Agency, 2015). A circular economy can be achieved, amongst others, by recycling products and materials to enable the retrieval of secondary raw materials. To realize a circular economy, consumers need to consistently engage in recycling behaviour (Kirchherr, Reike, & Hekkert, 2017). Hence, it is critical to understand what encourages recycling behaviour among consumers.

Meta-analyses and literature reviews on recycling revealed that both individual and contextual factors can affect recycling behaviour (Geiger, Steg, Van der Werff, & Ünal, 2019; Schultz, Oskamp, Mainieri, 1995). Interestingly, relatively few studies have investigated the effect of contextual factors on recycling behaviour. We argue that individuals' perceptions of the context, in particular the perceived ease of using a collection system in place, affect their recycling behaviour by enhancing the perceived feasibility of recycling. Furthermore, we propose that the effects of individual factors, in particular biospheric values, on recycling depends on the perceived feasibility of recycling. Specifically, we argue that biospheric values are more strongly related to recycling when recycling is perceived to be moderately feasible, compared to when recycling is perceived to be very feasible or hardly feasible. We elaborate on our reasoning below.

3.3.1 Perceived ease of using the collection system

The context may influence pro-environmental behaviour, including recycling (Oskamp, Harrington, Edwards, Sherwood, Okuda, & Swanson, 1991; Schultz et al., 1995). In particular, the collection system in place can affect recycling behaviour (Derksen & Gartrell, 1993; Best & Kneip, 2011; Best & Kneip, 2019). For this reason, kerbside collection systems have been introduced. In kerbside collection systems, the recycled waste is picked up from people's homes instead of people having to bring their recyclables to a recycling station. Using this collection system is considered to be relatively easy, which is expected to encourage individuals to recycle more (Ando & Gosselin, 2005; Best & Kneip, 2011). Importantly, we propose that particularly people's perceptions of the ease of using the collection system affect their recycling behaviour, rather than the recycling system in place as such (cf. Weber, 2018). The use of a collection system can be perceived as easy to use by one person, while it can be perceived to be relatively difficult to use by another person. This may affect the likelihood that individuals show different recycling patterns within the same collection system. So far, studies on recycling behaviour have hardly examined people's perception of the ease of using the collection system. In the current paper, we address this gap and examine to what extent the perceived ease of using the collection system in place is related to recycling behaviour. We hypothesise that the easier one perceives the use of the collection system, the more likely one is to recycle.

We further propose that the perceived ease to use the collection system affects recycling behaviour indirectly, via the perceived feasibility of recycling. Specifically, the easier one perceives the use of the collection system, the more feasible one will perceive recycling to be, which, in turn, is likely to encourage recycling. Perceived feasibility to recycle reflects the perceived ability to recycle (cf. IPCC, 2018) and the perceived ease of recycling (Rodgers, Conner, & Murray, 2008). Many studies examined the relationship between perceived feasibility of recycling and recycling behaviour, and revealed that the more a person thinks he or she is able to recycle, the more likely that person is to actually recycle (e.g., Chen & Tung, 2010; Harland, Staats, & Wilke 2007; Knussen, Yule, MacKenzie, & Wells, 2004; Tabernero, Hernández, Cuadrado, Luque, & Pereira, 2015; Tabernero & Hernandez, 2011). We extend the literature on the role of perceived feasibility in recycling in two ways. First, we examine to what extent the perceived feasibility of recycling is rooted in the perceived ease of using the collection system. This is particularly relevant as practitioners can redesign collection systems to make the use of a collection system easier. As such, it is important to unravel how the perceived characteristics of a recycling system are related to the perceived feasibility of recycling behaviour. Second, we propose that the effect of perceived feasibility of recycling on recycling behaviour depends on individual factors, in particular biospheric values. We will elaborate on this in the next section.

3.3.2. Biospheric values, perceived feasibility to recycle and recycling behaviour

Values reflect general goals that serve as guiding principles in people's live (Schwartz, 1992; Feather, 1995). As desirable trans-situational goals, they reflect what individuals find important in their life in general, which, in turn, can affect beliefs, attitudes, norms and behaviours (Feather, 1995; Gardner & Stern, 2002; Geiger et al., 2019). In the context of pro-environmental behaviour, biospheric values are particularly important as a consistent source of pro-environmental actions (De Groot & Steg, 2007, 2008). Biospheric values reflect how important individuals find it to benefit nature and the environment. The stronger one's biospheric values, the more one is motivated to protect the environment, and the more willing one is to put effort into a behaviour that may benefit the environment (Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, 2016). Individuals with strong biospheric values are more likely to engage in a variety of pro-environmental behaviours, including recycling (Steg, 2016; Ruepert et al., 2017).

Importantly, we propose that the relationship between biospheric values and recycling may depend on the perceived feasibility of recycling. In fact, two theories predict such an interaction between perceived feasibility of recycling and biospheric values, but make different predictions of the direction of such an interaction effect. First, the low-cost hypothesis predicts a linear relationship between the effect of biospheric values and perceived feasibility of recycling (Diekmann & Preisendörfer, 2003). Specifically, the low-cost hypothesis states that the more feasible recycling is perceived to be, the more likely biospheric values are to be related to recycling. When recycling

behaviour is perceived as very feasible, or as the authors state: 'under conditions connected with low costs and little inconvenience for the individual actor' (p.443), biospheric values should be most strongly related to recycling behaviour. When recycling is perceived as rather unfeasible, even individuals with strong biospheric values may not engage in recycling behaviour, as in this case they may feel it is too difficult or effortful to recycle. In such cases, recycling would have serious negative implications for other values, such as for hedonic values that reflect a concern for convenience and pleasure, making it less likely that people act upon their biospheric values (cf. Diekmann & Preisendörfer, 2003; Lindenberg & Steg, 2007; Steg & Vlek, 2009; Steg et al., 2014). Hence, according to the low-cost hypothesis, individuals are more likely to act in line with their biospheric values and to recycle when recycling is perceived as relatively feasible.

Second, the A-B-C model predicts a slightly different interaction effect between biospheric values and perceived feasibility of recycling (Guagnano, Stern, & Dietz, 1995; Stern, 2000). Notably, the A-B-C model proposes a curvilinear relationship between biospheric values and recycling behaviour, contingent on the levels of perceived feasibility of recycling. Similar to the low-cost hypothesis, the A-B-C model predicts that when recycling is perceived as rather unfeasible, biospheric values are not likely to be strongly related to recycling behaviour. As stated before, in such cases even individuals with strong biospheric values may experience recycling as too difficult or effortful, and therefore they do not recycle. Yet, in contrast to the low-cost hypothesis, the A-B-C model predicts that biospheric values are neither strongly related to recycling when recycling is perceived as very feasible, as in this case most people may engage in recycling behaviour, irrespective of the strength of their biospheric values. This implies that biospheric values are assumed to be hardly related to recycling behaviour if recycling is perceived to be very feasible to do, and when it is perceived to be very unfeasible to do. In other words, following the A-B-C model, the relationship between biospheric values and recycling behaviour would be most pronounced when recycling is perceived to be moderately feasible (Guagnano et al., 1995; Stern, 2000; Ölander & Thøgersen, 2005). In the current article, we will test whether the low-cost hypothesis or the A-B-C model is more plausible in explaining the interaction of perceived feasibility of recycling and biospheric values.

3.3.3. Current research

This article has two main aims. First, we aim to test whether and how the perceived ease to use the collection system influences recycling behaviour. We expect that the perceived ease to use the collection system is indirectly related to recycling, via perceived feasibility to recycle (*Hypothesis 1;* see Figure 1).

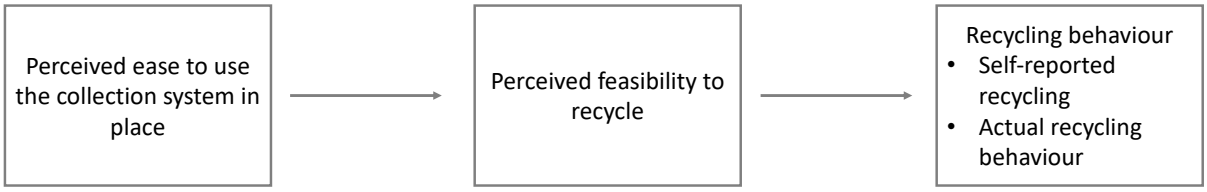

Figure 1. Conceptual model of the indirect effect of perceived ease to use the collection system on recycling behaviour.

Second, we aim to investigate whether and how the interaction between perceived feasibility to recycle and biospheric values influences recycling behaviour (see Figure 2). Following the low-cost hypothesis, one would expect a linear relationship between biospheric values and recycling behaviour, with the relationship becoming stronger with increasing perceived feasibility of recycling (*Hypothesis 2a)*. Following the A-B-C model, one would expect a curvilinear relationship between biospheric values and recycling behaviour, with the relationship being most pronounced when recycling is perceived as moderately feasible (*Hypothesis 2b)*. We will test which of these explanations is most plausible.

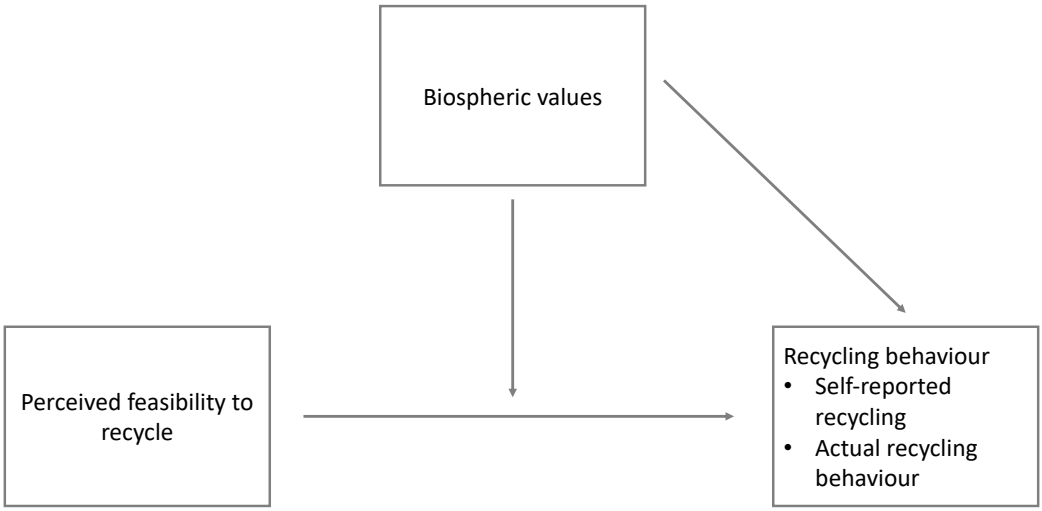

Figure 2. Conceptual model of the interaction effect of the perceived feasibility to recycle and biospheric values on recycling behaviour.

To test the robustness of our reasoning, we conducted two questionnaire studies in municipalities with different collection systems, thereby focusing on different waste streams. The first study took place in two different neighbourhoods in one municipality in the north of the Netherlands that have similar collection systems in place. The second study was conducted in two neighbouring municipalities in the south of the Netherlands in which other collection systems were in place than in Study 1, but which were similar in both municipalities. In the two studies, we will examine self-reported recycling in general as well as recycling of two specific waste streams (i.e. paper and glass in Study 1, and plastics and organic waste in Study 2). Additionally, in Study 2, we included a measure of actual recycling behaviour. A few studies have studied actual recycling behaviour, suggesting the

relationships between predictor variables and recycling is weaker for actual than for self-reported recycling behaviour (Geiger et al., 2019; Kollmuss & Agyeman, 2002). We will test whether this is the case in our study too.

3.4. Study 1

3.4.1. Method

Participants and Procedure

A questionnaire was distributed door-to-door in two neighbourhoods in a municipality in the north of the Netherlands. A drop-off collection system was in place to recycle paper and glass, which allowed participants to dispose of their paper waste and their glass bottles in close-by containers. In addition, paper waste was picked up from the kerb every two weeks. Drop-off facilities to recycle textile, batteries and electronic waste were also present. Specifically, participants could bring these waste streams to drop off locations placed in supermarkets, shops, or close-by underground containers. Moreover, a post-recycling system existed for plastics and organic waste; inhabitants thus did not need to recycle these materials at their homes. In total, 144 respondents participated in the study, of which 68 were female; 11 participants did not indicate their gender and one person indicated to not be binary. Age ranged from 18 to 86 (*M* = 43.07, *SD* = 15.71). Among all participants, 25.5% lived alone, 62.5% indicated to live with their partner and/or their children, while the remaining 12% either lived with other students or in a commune. Furthermore, 34.5% of all participants lived in an apartment, 55.3% lived in a townhouse, and 4.3% lived on a farm. Compared to the average household in this municipality, the sample was somewhat older; people living in single households were underrepresented and people living in a townhouse were overrepresented in our sample (Allecijfers 2019; Groningen Buurtmonitor, 2019).

Measures

Perceived ease to use the collection system. We measured perceived ease to use the collection system in place in one's neighbourhood in general. Participants could indicate on a 5-point Likert scale (1= completely disagree – 5= completely agree) how much they agree with the statement that 'The use of the collection system in my neighbourhood is generally easy' (M = 3.90, SD = 1.13). Additionally, we included two items addressing the perceived ease to use the collection system of paper and glass, respectively. The items were the following: 'The use of the paper collection system is easy' (*M* = 4.28, *SD*= 1.22) and 'The use of the glass collection system is easy' (*M* = 3.93, *SD*= 1.27).[4]

[4] Visual inspection of the means reveal that participants evaluated all collection systems as relatively easy to use, particularly the collection system of paper. This notion is supported by the very small percentage of participants scoring below the midpoint of the item reflecting perceived ease to use the collection system: Only 12.3% did so for the collection system in general, 12.5% for paper recycling and 15.2% for glass recycling.

Perceived ability to recycle as an indicator for perceived feasibility to recycle was assessed by asking participants to indicate how much they were able to recycle paper, glass, electronic waste, textile and batteries, respectively on a 7-point Likert scale (1 = very badly – 7 = very well). We calculated a composite score with these five items to assess the perceived ability to recycle in general. Cronbach's alpha was high (α = .83, *M* = 5.62, *SD* = 1.31). As we also aimed at testing our reasoning for paper recycling and glass recycling specifically, we used the single items referring to the perceived ability to recycle these two materials for the two separate analyses on paper and glass recycling, respectively (paper: *M* = 6.30, *SD* = 1.28; glass: *M* = 5.87, *SD* = 1.64).[56]

Biospheric values were administered by a validated value questionnaire comprising 16 items representing hedonic, egoistic, altruistic and biospheric values (Steg et al., 2014). Participants rated the importance of each value as a guiding principle in their life. Biospheric values were measured with four items: respecting the earth; unity with nature; protecting the environment; preventing pollution. Scores could vary from -1 (opposed to the principles that guide you) to 7 (extremely important). We computed the mean score on these items (*M* = 4.87, *SD* = 1.44, Cronbach's alpha α = .88).

Self-reported recycling behaviour was assessed with five items. Specifically, we asked participants to indicate to what extent they recycle the following five materials: *glass, paper, textile, batteries and electronic waste* on a 7-point Likert scale (1 = never – 7 = always). These materials matched the materials that we included to assess the perceived ability to recycle. The mean score of these items was computed reflecting self-reported recycling behaviour in general; Cronbach's alpha was high (α = .85, *M* = 5.6, *SD* = 1.54). For the analysis at the specific level of paper and glass recycling, we used the responses on the single items for paper (*M* = 6.11, *SD* = 1.62) and for glass recycling (*M* = 5.77, *SD* = 1.97), respectively.[7] The scores were relatively high, particularly for paper recycling.

3.4.3 Analyses

We conducted all analyses for recycling in general and for paper and glass separately. We first report correlations between all variables for recycling in general and for paper and glass specifically. Second, we report mediation analyses to examine whether perceived ability to recycle mediated the relationship between the perceived ease to use the collection system and recycling, again for recycling in general, and for paper and glass recycling, respectively. Specifically, we used a PROCESS macro for SPSS with a 95% bias-corrected bootstrap confidence interval with 5.000 bootstrap samples to estimate the indirect effects of the perceived ease to use the collection system on recycling behaviour

[5] For the sake of completeness, we also excluded the two specific waste streams from the general measures and ran the analyses again. The pattern of results was similar.

[6] Means were rather high and only 5.6% scored below the midpoint for perceived ability in general, 4.5% for paper recycling and 8.9% for glass recycling, indicating that participants generally seemed to feel able to recycle all waste streams, particularly paper recycling.

[7] See footnote 5.

via perceived ability of recycling (Hayes, 2013, 2016). Third, we conducted regression analyses to test the effect of perceived ability of recycling, biospheric values and their interaction on recycling in general and on paper and glass recycling. When a significant interaction effect was detected, we used the Johnson-Neyman technique in the Hayes PROCESS macro (Hayes, 2013, 2016) to identify for which levels of perceived ability of recycling biospheric values were significantly related to recycling.

3.4.4. Results

The correlation analyses revealed that the perceived ease of using the collection system in general was not significantly related to recycling in general (Table 1), whereas the perceived ease of using the paper and glass collection system were significantly and positively related to paper and glass recycling, respectively (Table 2 and 3). In other words, individuals were more likely to recycle paper and glass when they perceived the paper and glass collection systems as easy to use. The perceived ease to use the collection system in general, and perceived ease of using the paper and the glass collection systems were further positively related to the perceived ability to recycle in general and to recycle paper and glass, respectively. Table 1 shows that the higher the perceived ability to recycle in general, the more likely respondents were to recycle in general. Similarly, Tables 2 and 3 show that the higher the perceived ability to recycle paper and glass, the more likely respondents were to recycle paper and glass, respectively. The analyses further revealed that biospheric values were positively related to recycling in general and to recycling glass, while the relationship between biospheric values and paper recycling was not statistically significant. That is, the stronger one's biospheric values, the more likely one is to recycle in general and to recycle one's glass waste but not one's paper waste. Biospheric values were not significantly related to the perceived ease to use the collection system in general and of paper and glass, and the perceived ability to recycle in general and of paper and glass recycling.

Table 1. Correlations between perceived ease to use the collection system in general, perceived ability to recycle in general, biospheric values and recycling in general

	2	3	4
1. Perceived ease to use the collection system in general	.47**	.04	.11
2. Perceived ability to recycle in general		.10	.45**
3. Biospheric values			.22**
4. Recycling behaviour in general			

Note. ** p < .01; * p < .05

Table 2. Correlations between perceived ease to use the paper collection system, perceived ability to recycle paper, biospheric values and paper recycling

	2	3	4
1. Perceived ease to use the paper collection system	.60**	.13	.34**
2. Perceived ability to recycle paper		.15	.59**
3. Biospheric values			.14
4. Paper recycling behaviour			

Note. ** p < .01; * p < .05

Table 3. Correlations between perceived ease to use the glass collection system, perceived ability to recycle glass, biospheric values and glass recycling

	2	3	4
1. Perceived ease to use the glass collection system	.60**	.13	.42*
2. Perceived ability to recycle glass		.11	.54**
3. Biospheric values			.21**
4. Glass recycling behaviour			

Note. ** p < .01; * p < .05

To test Hypothesis 1 that the perceived ability of recycling mediated the relationship between the perceived ease to use the collection system and recycling behaviour, we ran mediation analyses for recycling behaviour in general and for paper and glass recycling behaviour specifically, respectively. As the relationship between the independent and the dependent variable do not need to be significant to test mediation effects (Zhao, Lynch Jr., & Chen, 2010), we also conducted mediation analysis for the perceived ease to use the collection system in general and recycling behaviour in general. In Table 4, we report the unstandardized regression coefficients of the model path estimates, and the direct, total and indirect effects. The results revealed that the mean indirect effect of the perceived ease to use the collection system on recycling in general was positive and significant, yielding an indirect-only mediation. Second, as expected, we found a positive and significant mean indirect effect of the perceived ease to use the paper collection system on paper recycling. Third, in line with our expectations, the mean indirect effect of the perceived ease to use the glass collection system on glass recycling was also positive and significant. As such, the results support Hypothesis 1 for all three indicators of recycling: the easier people think it is to use the collection system, the more feasible they perceived recycling to be, which, in turn, led to more recycling behaviour.

Table 4. Mediation analysis for recycling in general, recycling paper and recycling glass

General Model Path Estimates Study 1				
	Coefficient	SE	LL 95% CI	UL 95% CI
Ease general → Ability general	.53	.10	.33	.73
Ease paper → Ability paper	.63	.07	.48	.78
Ease glass → Ability glass	.73	.09	.55	.92

Direct effects of perceived ease to use the collection system and of perceived ability to recycle on recycling behaviour

	Coefficient	SE	LL 95% CI	UL 95% CI
Ease general → Recycling general	-.13	.12	-.38	.11
Ease paper → Recycling paper	.02	.11	-.19	.23
Ease glass → Recycling glass	.22	.13	-.04	.48
Ability general → Recycling general	.54	.11	.33	.75
Ability paper → Recycling paper	.66	.10	.46	.86
Ability glass → Recycling glass	.50	.10	.30	.70

Total effects of perceived ease to use the collection system on recycling behaviour

	Coefficient	SE	LL 95% CI	UL 95% CI
Ease general → Recycling general	.16	.12	-.09	.40
Ease paper → Recycling paper	.44	.10	.24	.63
Ease glass → Recycling glass	.59	.12	.36	.82

Indirect effects of perceived ease to use the collection system on recycling behaviour

	Coefficient	Boot SE	LL 95% CI	UL 95% CI
Ease general → Ability general → Recycling general	.29	.09	.12	.46
Ease paper → Ability paper → Recycling paper	.41	.15	.16	.74
Ease glass → Ability glass → Recycling glass	.37	.13	.15	.65

Notes. Ease general = Perceived ease to use the collection system in general; Ease paper = Perceived ease to use the paper collection system; Ease glass = Perceived ease to use the glass collection system; Ability general = Perceived ability to recycle in general; Ability paper = Perceived ability to recycle paper; Ability glass = Perceived ability to recycle glass.

To test Hypothesis 2a and 2b, we conducted regression analyses including main effects of perceived ability of recycling and biospheric values and their interaction as independent variables and self-reported recycling as the dependent variable. First, we found that respondents were more likely to engage in recycling behaviour in general when they felt more able to engage in this behaviour, and when they more strongly endorsed biospheric values, while the interaction was negative and only marginally significant (see Table 5). We used the Johnson-Neyman technique to identify for which levels of perceived ability of recycling in general biospheric values were significantly related to general recycling. Figure 3 depicts the bandwidth graph with the effect size of biospheric values on recycling behaviour in general for different levels of perceived ability to recycle in general by using the floodlight technique (Spiller, Fitzsimons, Lynch Jr, & McClelland, 2013). This technique assumes that a statistically significant relationship between biospheric values and recycling behaviour is present when the 'band' does not encompass zero. Figure 3 shows that biospheric values were positively related to recycling in general when perceived ability to recycle was lower than 5.11 (the 90th percentile), while biospheric values were not significantly related to recycling behaviour in general when perceived ability to recycle was higher than 5.11, thus when participants felt very able to recycle in general. Hence, biospheric values seemed to be significantly related to recycling behaviour in general when someone did not feel very able to recycle in general. The simple slopes (see Figure 4) revealed that when one felt relatively able to recycle (1 SD above the mean), participants generally indicated to recycle most of the times to always, irrespective of the strength of their biospheric values. Yet, stronger biospheric values were related to more recycling when participants felt somewhat less able to recycle (1 SD below the mean).

Table 5. Regression of perceived ability to recycle in general, biospheric values, and the interaction of perceived ability to recycle in general and biospheric values on recycling in general

	ß	t	p	R^2	F	df	p
				.26	11.78	3, 101	< .001
Perceived ability	.86	3.48	.001				
Biospheric values	.65	2.22	.03				
Perceived ability x biospheric values	-.69	-1.78	.08				

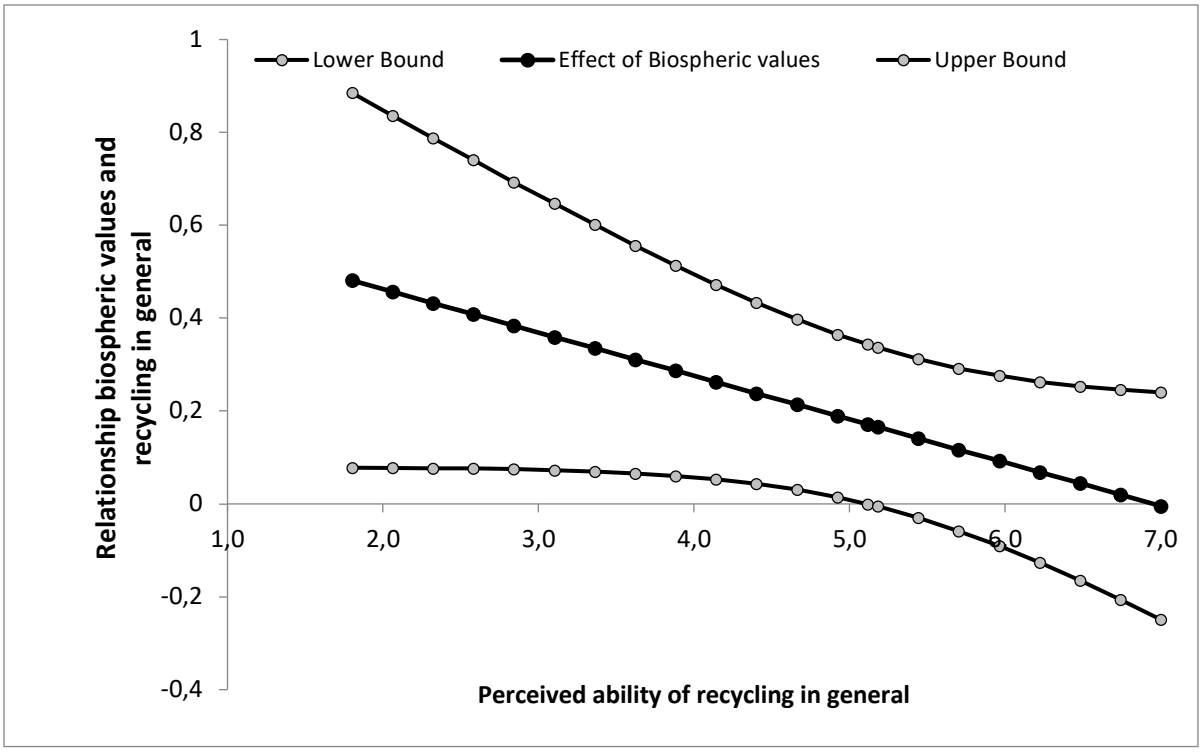

Figure 3. The relationship between biospheric values and general recycling behaviour for different levels of perceived ability of recycling in general.

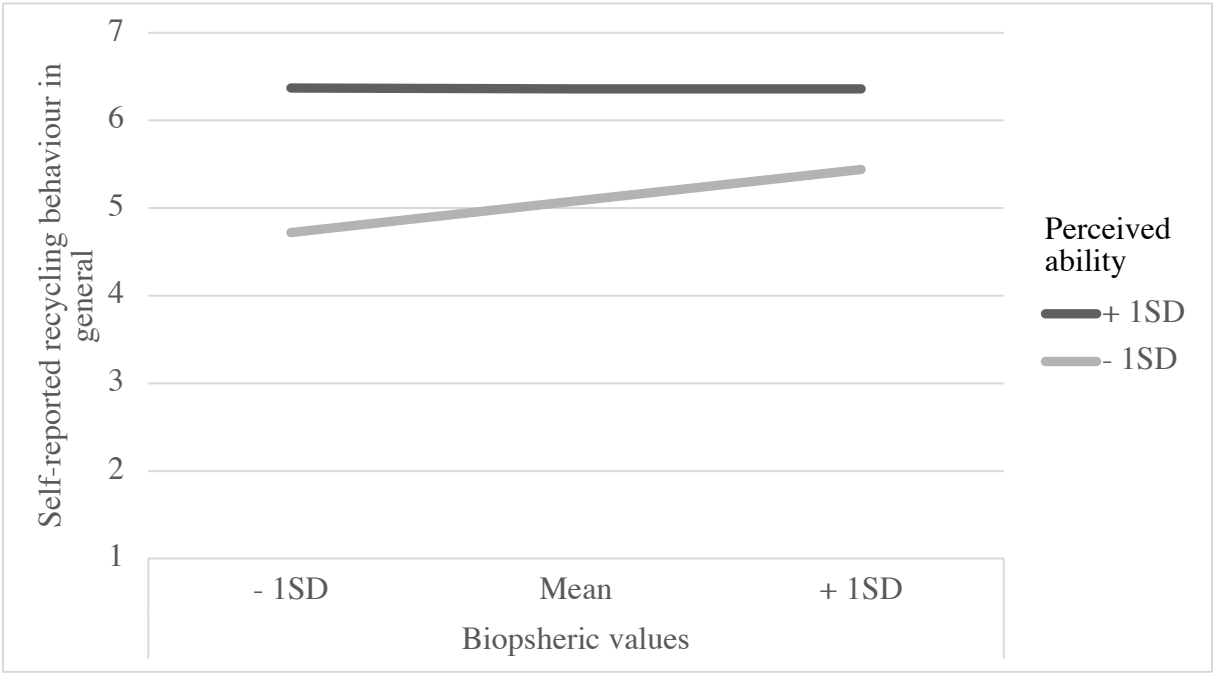

Figure 4. Plot of simple slope equation of the regression of biospheric values on self-reported recycling behaviour in general for two levels of perceived ability to recycle in general (low = 1SD below the mean; high = 1SD above the mean).

Second, Table 6 suggests that people were more likely to recycle paper when they felt more able to engage in paper recycling, while biospheric values and the interaction between biospheric

values and perceived ability of recycling paper did not significantly explain unique variance in the extent to which respondents recycled paper.

Table 6. Regression of perceived ability to recycle paper, biospheric values, and the interaction of perceived ability to recycle paper and biospheric values on paper recycling

	ß	t	p	R^2	F	df	p
				.36	22.91	3, 122	< .001
Perceived ability	.75	4.56	< .001				
Biospheric values	.30	1.35	.18				
Perceived ability x biospheric values	-.33	-1.14	.26				

Third, we found that respondents were more likely to recycle glass when they felt more able to engage in this behaviour and when they more strongly endorsed biosphere values. The interaction of the two variables was negative and significant (see Table 7). We again used the Johnson-Neyman technique to identify for which levels of perceived ability of glass recycling biospheric values were significantly related to glass recycling. The pattern of results was similar to the pattern of general recycling. Specifically, biospheric values were positively related to glass recycling behaviour when the perceived ability of glass recycling was lower than 5.65 (the 90th percentile), while biospheric values again were not significantly related to recycling behaviour when the perceived ability of recycling was higher than 5.65, thus when participants felt very able to engage in glass recycling (see Figure 5). As with general recycling, the simple slopes of glass recycling showed that when participants felt very able to recycle glass, participants generally indicated to recycle glass most of the times to always irrespective of the strength of their biospheric values (see Figure 6). However, when participants felt somewhat less able to recycle, stronger biospheric values were significantly related to more recycling of glass.

Table 7. Regression of perceived ability to recycle glass, biospheric values, and the interaction of perceived ability to recycle glass and biospheric values on glass recycling

	ß	t	p	R^2	F	df	p
				.38	24.74	3, 119	< .001
Perceived ability	1.03	5.30	< .001				
Biospheric values	.69	3.10	.002				
Perceived ability x biospheric values	-.77	-2.60	.01				

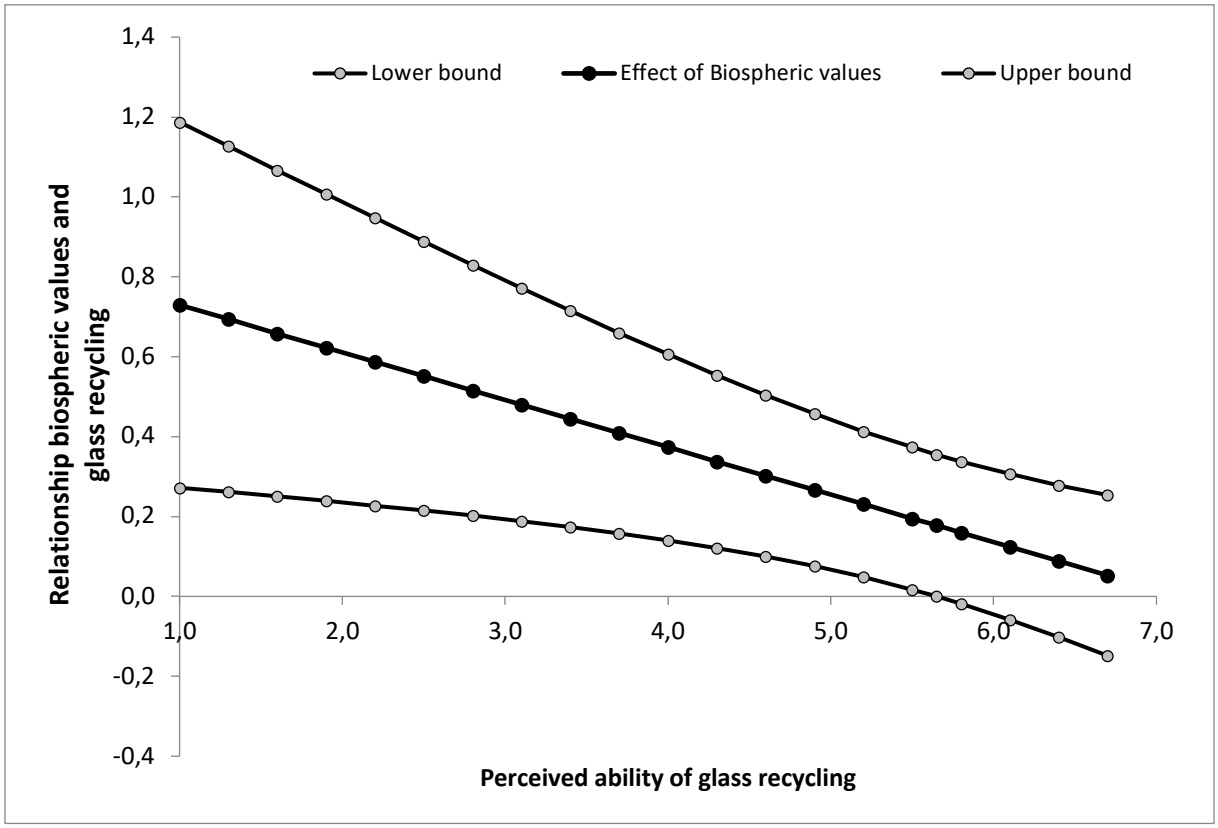

Figure 5. The relationship between biospheric values and glass recycling behaviour for different levels of perceived ability of glass recycling

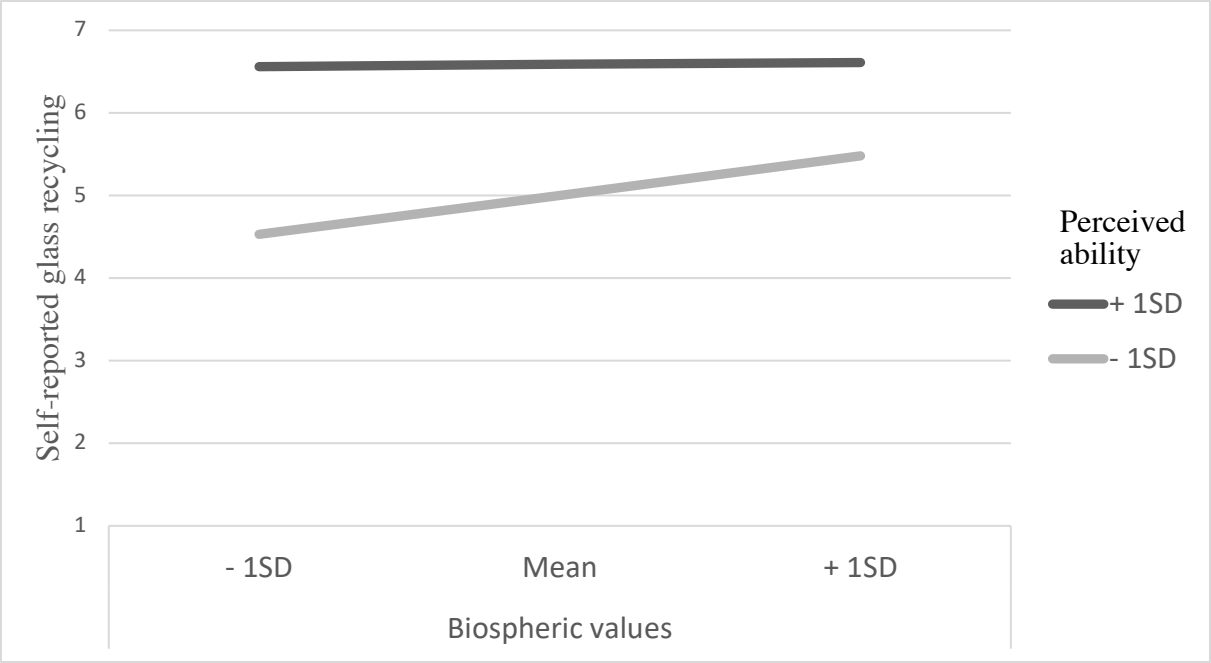

Figure 6. Plot of simple slope equation of the regression of biospheric values on self-reported glass recycling behaviour at two levels of perceived ability to recycle glass (low = 1SD below the mean; high = 1SD above the mean).

3.4.5 Discussion

The results showed that the perceived ease to use the collection system in general as well as to use the paper and glass collection systems indirectly affected recycling behaviour via perceived ability to recycle in general, and of paper and glass, respectively, providing support for Hypothesis 1. Regarding Hypothesis 2a and 2b, we found a marginally significant interaction effect of perceived ability to recycle and biospheric values on recycling in general. We found a significant interaction effect of perceived ability to recycle and biospheric values for glass recycling, while no significant interaction was found for paper recycling. Specifically, for both recycling in general and recycling of glass, biospheric values were particularly related to recycling behaviour when one did not feel very able to recycle. In contrast, when people felt very able to recycle, they recycled irrespective of their level of endorsement of biospheric values. These results do not support the low-cost hypothesis, stating that the predictive power of biospheric values will become stronger with increasing perceived ability to recycle. At a first glance, the findings seem not to support the A-B-C model, which articulates a curvilinear U-shaped relationship with biospheric values and recycling. The A-B-C model predicts that the relationship is stronger when one feels moderately able to recycle. Yet, a careful examination of the mean scores indicates that our findings may partly support the A-B-C model. Notably, the mean scores of perceived ability to recycle were rather high in our sample. Participants generally felt able to recycle all types of waste and only a few participants indicated to not feel able to recycle. One may therefore argue that the data do not allow to draw conclusions about the relationship between biospheric values and recycling behaviour when people do not feel very able to recycle. This may also

explain why we did not find a significant interaction effect of perceived ability and biospheric values on paper recycling, as participants generally felt very able to recycle paper. Given the data, we were not able to test the left part of the U-shaped function of the A-B-C model. Hence, our results seem to support the right part of the U-shaped function of the A-B-C model, suggesting that biospheric values were more strongly related to recycling when one felt moderately able rather than very able to recycle.

3.5. Study 2

Study 2 aimed to extend the results of Study 1 by employing a different sample and by focusing on a different collection system and on different waste-streams than we investigated in Study 1. Notably, this time, we approached a larger sample, and examined the recycling of plastic and organic waste. In addition, to test the robustness of our findings, Study 2 included a different indicator of perceived feasibility to recycle, namely perceived ease to recycle. Specifically, we tested whether perceived ease to recycle is rooted in the perceived ease to use the collection system and whether perceived ease to recycle interacts with biospheric values in influencing recycling. Moreover, in Study 2 we aimed to examine whether and to what extent perceived ease to use the collection system, perceived ease to recycle and biospheric values are associated with actual recycling behaviour. Specifically, we did not only include measures of self-reported recycling behaviour but also the total amount of organic waste recycled as an indicator of actual recycling behaviour.

3.5.1. Method

Participants and procedure

Participants were inhabitants of two neighbouring municipalities in the south of the Netherlands. In total, 2000 invitations to participate in this study were sent out per post. Addresses were randomly selected from a file of addresses that the municipalities provided us. For all participants, a similar kerbside collection system was in place in which plastics and organic waste was picked up from the kerb, while inhabitants had to bring their glass bottles and their paper waste to close-by containers. Drop-off facilities in supermarkets or shops, and underground containers to recycle textile, batteries and electronic waste were in place. In total, 392 respondents participated in the study (response rate of 19.6%) of which 49.9% were female. Age ranged from 20 to 88 (M = 56.97, SD = 14.54). The majority of the participants lived with their partner (55.2%) or with their partner and children (25.8%); 17.8% lived alone or with children and 1% lived with other people. Most of the participants indicated to live in a town house (31.2%), in a semi-detached house (27%), in a corner house (19.7%) or in a detached house/farm (20.8%). Compared to the average household in these municipalities, the sample was somewhat older. The percentage of people living in single households is comparable to the average in this part of the Netherlands, while people living in a townhouse were overrepresented in our sample (Allecijfers 2019; Oosterhout.nl, 2019; Oozo, 2019).

Measures

Perceived ease to use the collection system. We measured perceived ease to use the collection system in place in one's neighbourhood *in general* with the item 'How do you experience the collection system in your neighbourhood in general'. Participants could respond on a 7-point Likert scale (1 = easy – 7 = difficult). Additionally, we included two items addressing the perceived ease to use the collection system of *plastics* and *organic waste*, respectively. The items were the following: 'I experience the collection of my plastic waste as…' and 'I experience the collection of my organic waste as…'. For the ease of interpretation, we reversed the scale (1 = difficult and 7 = easy) such that higher scores reflect that it is easier to use the collection system (collection system in general: *M* = 5.56, *SD* = 1.57; collection system of plastics: *M* = 6.21, *SD* = 1.46; collection system of organic waste: *M* = 5.78, *SD* = 1.79). The means were rather high, indicating participants evaluated all collection systems as relatively easy to use, particularly the collection system of plastics.[8]

Perceived ease to recycle as an indicator for perceived feasibility to recycle was assessed by asking participants to indicate how easy they find recycling in general as well as plastics and organic waste recycling on a 7-point Likert scale (1 = very easy – 7 = very difficult). As with perceived ease to use the collection system, we reversed the scale scores (1 = very difficult and 7 = very easy) for the ease of interpretation. The mean scores of these items were relatively high (recycling in general: *M* = 5.78, *SD* = 1.64; plastics: *M* = 6.06, *SD* = 1.55; organic waste: *M* = 5.91, *SD*= 1.61), indicating that respondents evaluate recycling as relatively easy to do.[9][10]

Biospheric values were administered by the same questionnaire as in Study 1. We again computed the mean score on these items (Cronbach's alpha α = .85; *M* = 5.34, *SD* = 1.15).

Self-reported recycling behaviour was assessed with seven items. Specifically, we asked participants to indicate to what extent they recycle the following seven materials: *organic waste, plastics paper, glass, textile, batteries, and electronic waste* on a 7-point Likert scale (1 = never – 7 = always). We calculated a composite score of all of these materials reflecting recycling in general. Cronbach's alpha was good (α = .80, *M* = 6.50, *SD* = .81). For the analysis at the specific level of plastics

[8] A very small percentage of participants scoring below the midpoint of perceived ease: Only 10.9% did so for the collection system in general, 8.3% for plastics recycling and 12.6% for organic waste recycling.

[9] Only 12.1% scored below the midpoint for perceived ease in general, 9.5% for plastics recycling and 10.2% for organic waste recycling, indicating that participants seemed to perceive recycling as relatively easy, particularly plastics recycling.

[10] In Study 2, we also included perceived ability to recycle, which was the indicator of perceived feasibility used in Study 1. We found a low correlation between perceived ability to recycle and perceived ease to recycle; we therefore did not combine these two items into one scale. We found a clear ceiling effect of perceived ability to recycle, and hardly any variance in the data was explained by perceived ability to recycle. Despite this, we found support for Hypothesis 1, indicating that perceived ability of recycling different types of waste again mediated the effect of perceived ease to use the collection system and recycling in general as well as plastics and organic waste recycling. Yet, probably due to the ceiling effect and lack of variance, we only found a significant and positive interaction effect of biospheric values and perceived ability to recycle on organic waste recycling, which was in the opposite direction than expected.

and organic recycling, we only used the respective responses of plastics (*M* = 6.80, *SD* = .63) and organic recycling (*M* = 6.36, *SD* = 1.44).[11]

Actual recycling behaviour was assessed by the total weight of organic waste a household produced in the year 2017. In both municipalities, the weight of organic waste was measured every time a household disposed of this waste. We used the total weight of organic in kilogram a household produced as a measure for actual organic waste recycling behaviour. For the analyses, we controlled for the number of people living in one household, as the number of people will influence on the amount of recycled waste a household disposes of. Participants had to actively give consent at the end of the questionnaire to allow us to use their waste data. In total 276 households (70.41% of the sample) provided access to their data (*M* = 157.48, *SD* = 135.49).

3.5.3. Results

The correlation analyses revealed that the perceived ease to use the collection system in general was significantly related to recycling in general (Table 8). That is, individuals were more likely to recycle in general when they perceived the collection systems in general as easy to use. The perceived ease of using the plastics and organic waste collection system were also significantly and positively related to plastics and organic waste recycling, respectively (Table 9 and 10). The perceived ease to use the collection system in general, and to use the plastics and the organic waste collection system were further positively related to the perceived ease to recycle in general and to recycle plastics and organic waste, respectively. Table 8 shows that the easier respondents find recycling in general, the more likely they were to recycle in general. Similarly, Tables 9 and 10 show that the higher the perceived ease to recycle plastics and organic waste, the more likely respondents were to recycle plastics and organic waste, respectively. The results further show that the stronger one's biospheric values, the more likely one is to recycle in general and to recycle one's plastics and organic waste. Biospheric values were positively but weakly related to the perceived ease to use the collection system in general and of plastics and organic waste, as well as to the perceived ease to recycle in general, and to recycle plastic and organic waste. Furthermore, we found no significant correlations between the total amount of organic waste recycled and the perceived ease to use the organic waste collection system, the perceived ease to recycle organic waste, biospheric values and self-reported organic waste recycling (Table 10). We therefore did not continue with the mediation and moderation analyses on the total amount of organic waste recycled. These results suggest that we did not find support for Hypothesis 1, 2a and 2b for the total amount of organic waste recycled.

[11] See footnote 5.

Table 8. Correlations of perceived ease to use the collection system in general, perceived ease to recycle in general, biospheric values and self-reported recycling behaviour in general

	2.	3.	4.
1. Perceived ease to use the collection system in general	.48**	.20**	.20**
2. Perceived ease to recycle in general		.26**	.19**
3. Biospheric values			.25**
4. Self-reported recycling in general			

Note. ** p < .01; * p < .05.

Table 9. Correlations of perceived ease to use the plastics collection system, perceived ease to recycle plastics, biospheric values and self-reported plastics recycling behaviour

	2.	3.	4.
1. Perceived ease to use the collection system in general	.74**	.12**	.20**
2. Perceived ease to recycle in general		.16**	.33**
3. Biospheric values			.19**
4. Self-reported plastics recycling behaviour			

Note. ** p < .01; * p < .05

Table 10. Correlations of perceived ease to use the organic waste collection system, perceived ease to recycle organic waste, biospheric values and self-reported and the total amount of organic waste recycled

	2.	3.	4.	5.
1. Perceived ease to use the organic waste collection system	.64**	.20**	.37**	.01
2. Perceived ease to recycle organic waste		.26**	.34**	-.04
3. Biospheric values			.18**	.05
4. Self-reported organic waste recycling				-.05
5. Total amount of organic waste recycled				

Note. ** p < .01; * p < .05*;* The correlation with total amount of organic waste recycled are partial correlations controlling for the number of people living in one household

Table 11. Mediation Analyses perceived ease

General Model Path Estimates Study 2				
	Coefficient	SE	LL 95% CI	UL 95% CI
Ease CS general→ Ease Rec general	.50	.05	.40	.60
Ease CS plastics → Ease Rec plastics	.77	.04	.70	.85
Ease CS organic → Ease Rec organic	.58	.04	.51	.66

Direct effects of X on DVs				
	Coefficient	SE	LL 95% CI	UL 95% CI
Ease CS general → Rec general	.05	.03	-.02	.11
Ease CS plastics → Rec plastics	-.02	.03	-.08	.04
Ease CS organic → Rec Organic	.20	.05	.10	.29
Ease Rec general→ Rec general	.10	.03	.04	.16
Ease Rec plastics → Rec plastics	.13	.03	.07	.18
Ease Rec organic → Rec Organic	.15	.05	.05	.25

Total effects of X on DVs				
	Coefficient	SE	LL 95% CI	UL 95% CI
Ease CS general → Rec general	.09	.03	.04	.15
Ease CS plastics → Rec plastics	.08	.02	.04	.11
Ease CS organic → Rec Organic	.29	.04	.21	.36

Indirect effects of X on DVs				
	Coefficient	Boot SE	LL 95% CI	UL 95% CI
Ease CS general → Ease Rec general → Rec general	.05	.02	.01	.09
Ease CS plastics → Ease Rec plastics → Rec plastics	.10	.03	.04	.17
Ease CS organic → Ease Rec organic → Rec Organic	.09	.04	.01	.17

Notes. Ease CS general = Perceived ease to use the collection system in general; Ease CS plastics = Perceived ease to use the plastics collection system; Ease CS organic = Perceived ease to use the organic waste collection system; Ease Rec General= Perceived Ease to recycle in general; Ease Rec Plastics= Perceived Ease to recycle plastics; Ease Rec Organic= Perceived Ease to recycle organic waste; Rec general = Recycling in general; Rec plastics = Recycling plastics; Rec Organic = Recycling organic waste

To test Hypothesis 1 that perceived ease of recycling mediates the relationship between the perceived ease to use the collection system and self-reported recycling behaviour, we ran mediation analyses for recycling behaviour in general and for plastics and organic waste recycling behaviour specifically, respectively (see Table 11). We found that the indirect effect of perceived ease to use collection system in general on general recycling via perceived ease to recycle in general was positive and significant. Similarly, perceived ease to recycle plastics mediated the relationship between the perceived ease to use the plastics collection system and plastics recycling. The results also revealed a positive and significant indirect effect of perceived ease to use the organic waste collection system on organic waste recycling via perceived ease to recycle organic waste. Yet, all three indirect effects were relatively weak. In sum, in line with Hypothesis 1, the easier people perceived a collection system to use, generally and for plastics and organic waste collection systems specifically, the easier they perceived recycling to be, which, in turn, was positively related to recycling behaviour in general as well as on plastics and organic recycling behaviour.

To test Hypothesis 2a and 2b, we conducted a regression analysis including the main effects of perceived ease to recycle and biospheric values on self-reported recycling behaviour and their interaction effect. Again, we conducted the regression analyses for recycling behaviour in general, and for plastics and organic waste recycling separately. We found a marginally significant and negative interaction effect for recycling behaviour in general (see Table 12). Similar to Study 1, we used the Johnson-Neyman technique in the Hayes PROCESS macro (Hayes, 2013, 2016) to identify for which levels of perceived ease of general recycling biospheric values were significantly related to general recycling (Table 12). Biospheric values were positively related to recycling behaviour in general when the perceived ease to recycle was lower than 6.63, thus when recycling was not perceived as extremely easy (see Figure 7). The simple slopes (see Figure 8) suggest that when recycling was perceived to be very easy (1 SD above the mean), biospheric values were hardly related recycling behaviour. In this case, individuals recycled irrespective of their level of biospheric values. Yet, when recycling was perceived as not very easy (1 SD below the mean), the stronger one endorsed biospheric values, the more likely one was to recycle.

Table 12. Regression of perceived ease to recycle in general, biospheric values, and the interaction of perceived ease to recycle in general and biospheric values on recycling in general

	ß	t	p	R^2	F	df	p
				.09	11.42	3, 347	< .001
Perceived ease	.54	2.53	.012				
Biospheric values	.49	3.10	.002				
Perceived ease x biospheric values	-.55	-1.90	.06				

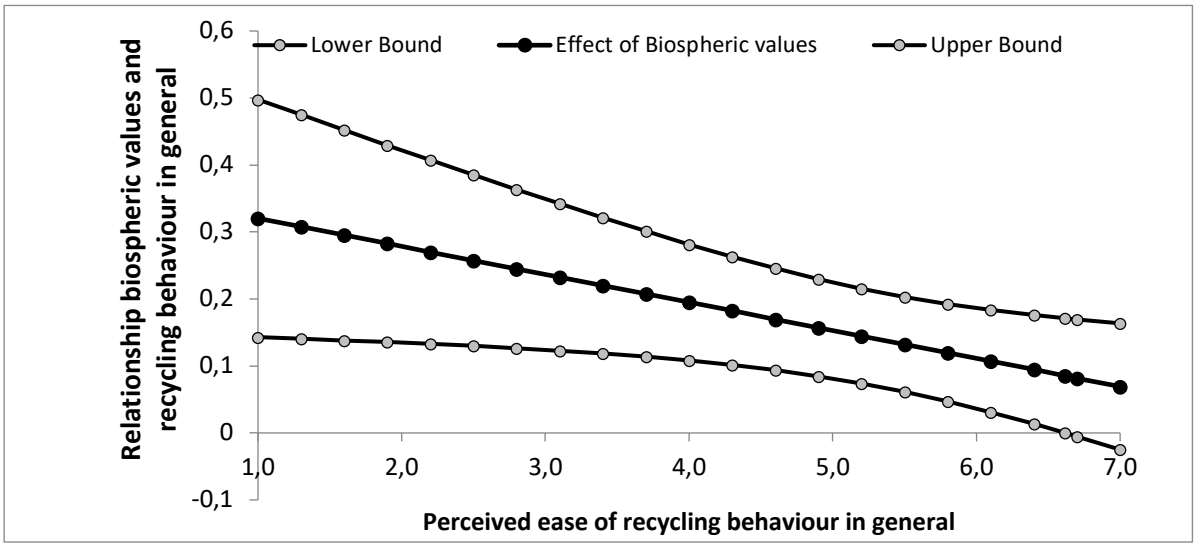

Figure 7. The relationship between biospheric values and recycling behaviour in general for different levels of perceived ease of recycling in general

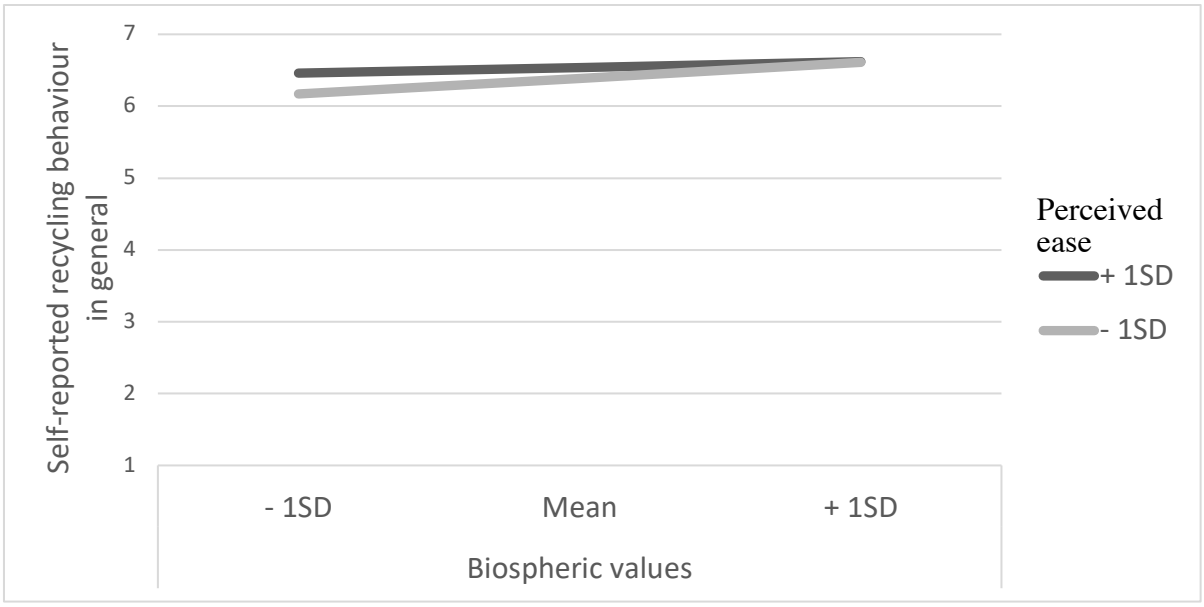

Figure 8. Plot of simple slope equation of the regression of biospheric values on self-reported recycling behaviour in general at two levels of perceived ease to recycle in general (low = 1SD below the mean; high = 1SD above the mean).

Second, Table 13 shows that people were more likely to recycle plastics when they perceived recycling as easy, and slightly more likely to recycle plastics when they more strongly endorsed biospheric values, while the interaction between biospheric values and perceived ease to recycle plastics did not explain unique variance in the extent to which respondents recycled plastics.

Table 13. Regression of perceived ease to recycle plastics, biospheric values, and the interaction of perceived ease to recycle plastics and biospheric values on recycling plastics

	ß	t	p	R^2	F	df	p
				.11	14.87	3, 346	<.001
Perceived ease	.57	2.36	.02				
Biospheric values	.37	1.75	.08				
Perceived ease x biospheric values	-.41	-1.20	.23				

Third, respondents were more likely to recycle organic waste when they perceived this behaviour as easy and when they more strongly endorsed biospheric values, while the interaction was negative and significant (see Table 14). We used the Johnson-Neyman technique to identify for which levels of perceived ease of organic waste recycling biospheric values were significantly related to organic waste recycling. Biospheric values were positively related to organic recycling behaviour when

the perceived ease to recycle organic waste was lower than 5.55, thus when recycling was not perceived as very easy. When perceived ease was rated as higher than 5.55, biospheric values were not significantly related to recycling of organic waste (see Figure 9 and 10). As with general recycling, the simple slopes of organic recycling show that when organic recycling was perceived as very easy, biospheric values were not significantly related to organic waste recycling behaviour. However, when organic waste recycling was not perceived as very easy, the stronger the biospheric values, the more one was likely to recycle organic waste.

Table 12. Regression of perceived ease to organic waste, biospheric values, and the interaction of perceived ease to recycle organic waste and biospheric values on recycling organic waste

	ß	t	p	R^2	F	df	p
				.15	20.09	3, 346	<.001
Perceived ease	.94	4.70	<.001				
Biospheric values	.60	3.76	<.001				
Perceived ease x biospheric values	.92	3.29	.001				

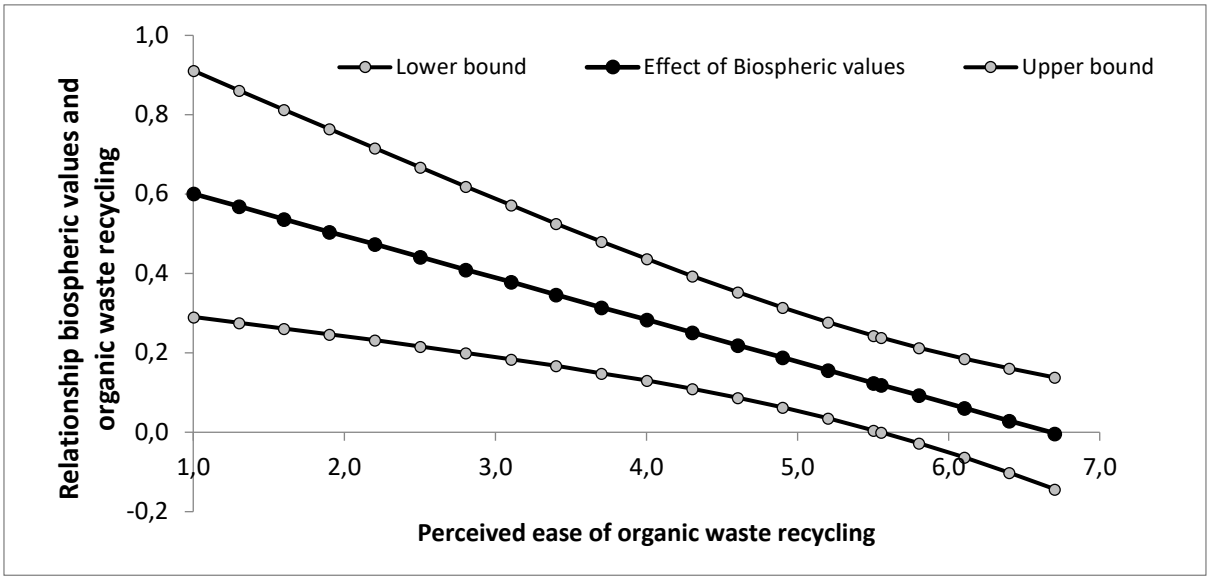

Figure 9. The relationship between biospheric values and organic waste recycling behaviour for different levels of perceived ease of organic waste recycling

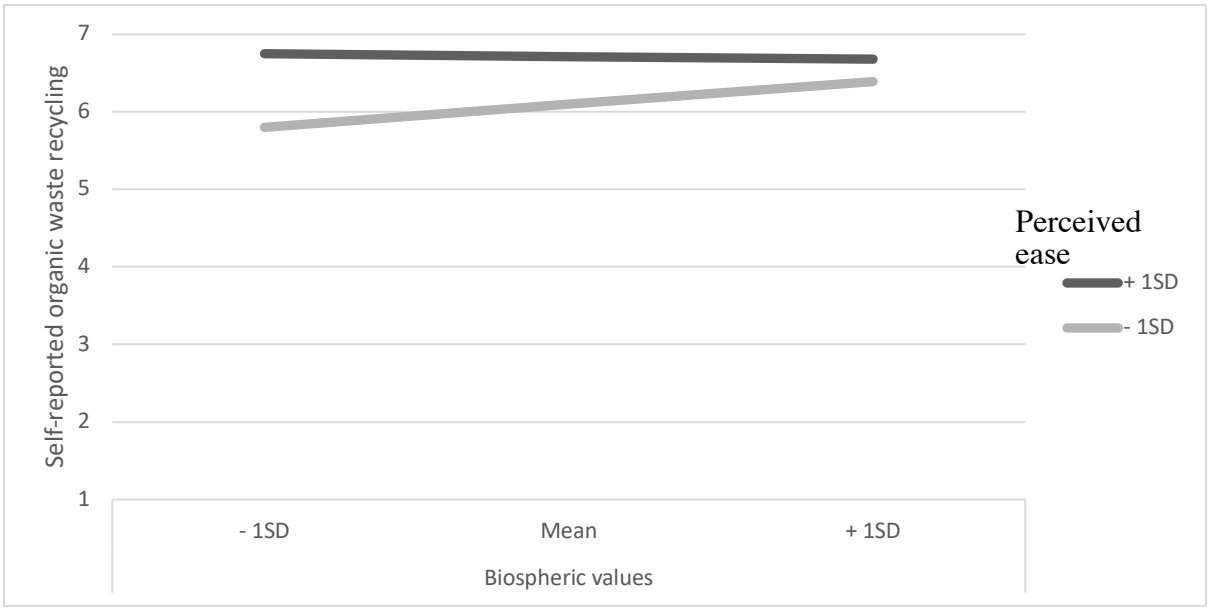

Figure 10. Plot of simple slope equation of the regression of biospheric values on self-reported organic waste recycling behaviour at two levels of perceived ease to recycle organic waste (low = 1SD below the mean; high = 1SD above the mean).

3.5.4. Discussion

As expected, we found that perceived ease to recycle mediated the relationship between perceived ease to use the collection system and self-reported recycling behaviour for all three indicators of recycling behaviour (Hypothesis 1). Regarding Hypothesis 2a and 2b, a negative interaction effect of perceived ease of recycling and biospheric values was found for recycling in general and for organic waste recycling but not for plastics recycling. In both cases, stronger biospheric values were particularly associated with more recycling in general and organic waste recycling when recycling was not perceived as very easy. When recycling was perceived as very easy, individuals generally recycled irrespective of their level of endorsement of biospheric values. These results are in line with the results of Study 1, suggesting that we did not find support for the low-cost hypothesis. Similar to Study 1, the means of perceived ease to recycle were very high, which suggests that we again found support for the right part of the A-B-C model: biospheric values were particularly related to behaviour when the behaviour was moderately easy, but not when it was perceived as very easy. Again, we cannot draw firm conclusions about the predictive power of biospheric values on recycling behaviour when one perceived recycling to be rather difficult, as respondents generally indicated to perceive recycling as rather easy. The fact that participants generally perceived plastics recycling as very easy, may explain why we did not find a significant interaction effect of perceived ease to recycle plastics and biospheric values on plastics recycling. Interestingly, we could not replicate neither the mediation nor the moderation effect for actual recycling behaviour, in this case the total amount of organic waste recycled.

3.6. General Discussion

Research has shown that both individual and contextual factors are related to recycling behaviour (Geiger et al., 2019; Schultz et al., 1995). In the present paper, we proposed that rather than the objective context, particularly the perception of the context in terms of perceived ease of using a collection system is crucial in influencing individuals' recycling behaviour. Our first aim was to test whether and how the perceived ease to use a collection system is related to recycling behaviour. We proposed that the perceived ease of using a collection system in place is indirectly related to individuals' recycling behaviour by enhancing the perceived feasibility of recycling. The second aim was to investigate whether and how the interaction between perceived feasibility to recycle and biospheric values (as an indicator of motivation to recycle) are related to recycling behaviour. Specifically, we tested whether the low-cost hypothesis (Diekmann & Preisendörfer, 2003) or the A-B-C model (Guagnano et al., 1995; Stern, 2000) is more plausible in explaining the interaction effect between biospheric values and perceived feasibility of recycling on recycling behaviour. The low-cost hypothesis proposes a linear relationship of biospheric values and recycling, with the relationship becoming stronger with increasing perceived feasibility, whereas the A-B-C model proposes a curvilinear relationship between biospheric values and recycling behaviour, with the relationship being the strongest when recycling is perceived as moderately feasible. To test the robustness of our findings, we conducted two questionnaire studies in municipalities with different collection systems and focused on different waste streams, including paper, glass, plastics and organic waste, and recycling in general. Additionally, in Study 2, we collected data on actual recycling behaviour, that is, the total amount of organic waste recycled. We will elaborate on our main findings below.

First, in line with our first hypothesis, we found that the perceived ease to use the collection system was indirectly related to recycling behaviour via perceived feasibility to recycle. Specifically, the easier one perceived the collection system to use, the more feasible one perceived recycling to be, which, in turn, was associated with more recycling. This result implies that the perception of the context in terms of perceived ease may affect the perception of the feasibility of the corresponding behaviour, which, in turn, influences the behaviour. We found this relationship for both indicators of perceived feasibility to recycle, namely for the perceived ability to recycle (Study 1) and for perceived ease to recycle (Study 2). Notably, we found similar results in two cities with different collection systems, thereby examining different waste streams, including paper, glass, plastics and organic waste, indicating that our results are rather robust. The results suggest that it is important to consider individuals' *perceptions* of the ease to use the collection system. Indeed, within the same collection system, individuals seem to perceive the ease of using the collection system differently, which affects the perceived feasibility of recycling that, and consequently leads to different recycling behaviour.

Interestingly, the perceptions of the ease to use the collection system and the feasibility to recycle were only weakly related to biospheric values, suggesting that how people perceive the context is not primarily reflecting a motivational process. This is an important contribution to the literature. As differences in perceptions of the ease of using the collection system do not seem to be strongly rooted in biospheric values, an interesting question for future research is to investigate why these differences in the perceived ease to use the collection system and the perceived feasibility of recycling occur. A relevant factor that may affect perceptions of the ease to use the collection system may be one's housing situation (e.g., Oskamp et al., 1991; Hage et al., 2009). For instance, people living in multi-storey dwellings may have less storage room for the recycled waste and face longer distances to the shared recycling containers than people living in single-storey dwellings. Consequently, recycling may be perceived as more difficult in multi-storey dwellings than in single-storey dwellings.

Second, overall, our two studies revealed an interaction effect between biospheric values and perceived feasibility to recycle on recycling behaviour, in addition to the main effects of biospheric values and perceived feasibility to recycle. Specifically, we found an interaction effect between biospheric values and the perceived ability to recycle in general and to recycle glass on recycling in general and glass recycling, respectively, in Study 1, and for biospheric values and the perceived ease to recycle in general and to recycle organic waste on recycling in general and organic waste recycling, respectively, in Study 2. Yet, we did not find an interaction effect between biospheric values and perceived ability to recycle paper on paper recycling in Study 1 and between biospheric values and perceived ease to recycle plastics on plastics recycling in Study 2. Interestingly, in both studies, biospheric values seemed to be particularly related to self-reported recycling behaviour when recycling was not perceived as very feasible. When recycling was perceived as very feasible, individuals recycled irrespective of the level of their biopsheric values. These results do not support the low-cost hypothesis (Diekmann & Preisendörfer, 2003), articulating that the predictive power of biospheric values would become stronger with increasing perceived feasibility to recycle. At a first glance, the findings do not seem to support the A-B-C model either (Guagnano et al., 1995; Stern, 2000), which articulates a curvilinear U-shaped relationship of biospheric values and recycling. Specifically, the A-B-C model predicts that the relationship is most strong when one perceives recycling as moderately feasible. Yet, a careful examination of the mean scores indicates that our findings may support the A-B-C model. Notably, the mean scores of perceived feasibility to recycle were rather high in the two studies. Participants generally perceived recycling of all types of waste as rather feasible and only a few participants indicated to perceive recycling as not very feasible. As mentioned earlier, one may therefore argue that our data do not allow to draw conclusions about the relationship between biospheric values and recycling behaviour when people perceive recycling as rather unfeasible. As such, our findings seem to support one half of the U-shaped function of the A-B-C-model, namely that

biospheric values were not significantly related to recycling when recycling was perceived as very feasible, but were related to recycling when it was perceived as moderately feasible, thus towards the middle range of the feasibility continuum. The mean scores of perceived feasibility to recycle paper in Study 1 and to recycle plastics in Study 2, for which we did not find a significant interaction effect of perceived feasibility to recycle and biospheric values on recycling behaviour, were very high in our sample, hinting towards a ceiling effect. Participants perceived paper and plastics recycling as very feasible and only a few participants indicated to perceive it as not feasible. Participants seemed to recycle paper in Study 1, and plastics in Study 2, irrespective of the strength of their biospheric values. This again suggests that biospheric values are not strongly related to recycling behaviour when the behaviour is perceived as rather feasible to engage in. Similar results were found in a study on the relationship between personal norms and acceptability of car-reduction policies, suggesting that personal norms, a different individual factor, are not significantly related to acceptability of these policies when the policy would imply very low costs for the individual, while personal norms are significantly related to policy acceptability when the policy would imply moderate costs for the individual (Keizer, Sargisson, Van Zomeren, & Steg, 2019). Future research is needed to further test the A-B-C model, particularly, the left part of the U-shaped function, and to examine the relationship between biospheric values and behaviour when people perceive the behaviour as not very feasible or even as relatively unfeasible. With this regard, future research could investigate how biospheric values are related to recycling behaviour of electronic waste, which is considered as a less feasible behaviour (e.g., Ylä-Mella, Keiski, & Pangrácz, 2015) or when the distance to the nearest recycling bin is rather far away, implying that recycling in those situations is perceived as less feasible.

Interestingly, we could not replicate our results for actual recycling behaviour, in particular, for the total amount of organic waste collected. Specifically, neither the perceived ease to use the collection system nor the perceived feasibility to recycle and biospheric values were significantly related to the total amount of organic waste recycled. The finding is in line with previous literature suggesting that it is easier to predict self-reported recycling behaviour than actual recycling behaviour (cf. Kollmus & Agyeman, 2002; Geiger et al., 2019). Yet, it could the case be that the indicator we used to measure actual recycling behaviour was not ideal. Notably, we used the weight of organic waste participants disposed of as an indicator of organic waste recycling, assuming that the more organic waste one discarded, the more pro-environmental one is. Yet, the total amount of organic waste recycled does not account for waste prevention behaviour, which is generally considered as more sustainable than recycling behaviour (European Union, 2015; Price & Joseph, 2000). Using the weight of organic waste assumes that the more waste individuals dispose of, the better they recycle. Yet, more organic waste may not always mean that one is more pro-environmental, as more organic waste may mean that one has thrown away more food, implying that one has acted in a more

environmentally harmful way. Similarly, individuals may have composted their waste rather than disposing of it in an organic collection system, which is also more pro-environmental.

Practical implications. These results have important practical implications, suggesting that practitioners could make recycling perceived to be more feasible. First, they could simply make the use of the collection system as easy as possible. This, in turn, increases the possibility that people experience the use of the collection system as easy and eventually perceive recycling as more feasible, which leads to more recycling. A recent meta-analysis indeed found that recycling can be promoted by establishing collection systems that are easier and more convenient to use (Varotto & Spagnolli, 2017), for example by increasing the frequency of collecting recycled waste from people's homes (Best & Kneip, 2011) or shortening the distance to drop-off location stations (Hage et al., 2009; Lange, Brückner, Kröger, Beller, & Eggert, 2014). Second, as perceptions of the collection system seem to matter, practitioners could ensure that individuals' perceptions of the ease of using a collection system are accurate. For this, communication strategies may be applied that aim at making people aware of the ease of using the collection system, such as easily accessible information on pick-up times of waste or on the nearest drop-off location.

Yet, there may be situations in which it is not possible to make the use of the collection system easier as there may be structural or economic constraints that cannot easily be overcome. For example, introducing more pick-up times or more bins can be rather costly. In situations in which it is not easy to better facilitate recycling and in situations in which people generally perceive recycling as not very feasible, our results suggest that the focus of interventions could shift towards biospheric values. Stronger biospheric values seem to be particularly related to recycling behaviour in situations in which recycling is perceived as relatively less feasible. The question remains which intervention can be effective in strengthening biospheric values (Steg, 2016). However, as many people rather strongly endorse biospheric values (Bouman & Steg, 2019), interventions could be implemented that make people focus on their biospheric values, thereby supporting people's biospheric values and increasing the likelihood that they act upon their biospheric values. This can be done by stressing the positive consequences of recycling for the environment, thus strengthening the extent to which recycling is associated with benefits for the environment (cf. Steg et al., 2014; Ruepert et al., 2017).

Limitations and future research. Given the correlational nature of our study design, we cannot draw firm conclusions on causality. To test causal relationships between the perceived ease to use the collection system and recycling behaviour, future research could change the quality of collection systems and examine whether this indeed affects the perceived ease of using the collection system, the perceived feasibility of recycling and subsequently recycling behaviour.

In the current article, we examined two indicators of perceived feasibility to recycle: perceived ability and perceived ease to recycle, and found that both were related to recycling behaviour. In

general, recycling was perceived in both studies as rather feasible. Future research could test our reasoning in other domains addressing behaviours that are generally perceived as less feasible and include other individual factors. In this way, future research can test the robustness of our results across different pro-environmental behaviours, implying different levels of feasibility to carry out these behaviours, and across different individual factors.

Conclusion. Our results suggest that the perceived feasibility to recycle is rooted in the perceived ease to use the collection system. The perceived ease to use the collection system was indirectly related to recycling behaviour via the perceived feasibility to recycle. Further, we found that stronger biospheric values were particularly related to more recycling when recycling was not perceived as very feasible. Yet, when recycling was perceived as very feasible, individuals recycled irrespective of the strength of their biospheric values, partially supporting the A-B-C model (Guagnano et al., 1995; Stern, 2000). We could not replicate these results for the total amount of organic waste recycled as an indicator of actual recycling behaviour, which may be due to the fact that we included an ambiguous measures of actual recycling behaviour.

4. Design for behaviour change – The influence of packaging design on recycling

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4.2. Abstract

Research has shown that design can drive socially desirable behaviour change, but little is known about why and when this is most likely the case. We aimed to study whether packaging design can influence recycling and if so, why and under which conditions packaging design does so. We proposed that theory-based packaging designs can stimulate recycling behaviour. Specifically, we tested whether packaging designs that aimed at making people focus on the environment would promote recycling, and whether the effects of packaging design depended on the extent to which people value the environment. Two online studies and one field experiment revealed that an environmental design can stimulate recycling, particularly when the packaging design is new. This effect was more pronounced among individuals with moderately strong to strong biospheric values. We discuss the implications of our findings.

Keywords: Design for behavioural change, biospheric values, packaging design, context, recycling

4.3. Introduction

Once a product is consumed, the consumer has to decide what to do with the package. Reuse or dispose of? Litter or recycle? In order to reduce the ultimate environmental impact of packages, it is important to encourage consumers' recycling of packaging materials (Kirchherr, Reike, & Hekkert, 2017; Wikström, Williams, Verghese, & Clune, 2014). We define recycling as individuals' waste separation intentions and behaviour to allow materials to be re-used. Recycling is critical to achieve a circular economy which aims to minimize waste and retain resources as much as possible (Corsten, Worrell, Rouw, & Van Duin, 2013; European Union, 2014), thereby reducing waste problems and the emerging scarcity of resources (European Environment Agency, 2015). To encourage recycling, it is important to understand which factors promote recycling.

We propose that the design of a package can affect recycling. Research on design for behaviour change has shown that design can drive socially desirable behaviour change (Tromp, Hekkert, Verbeek, 2011; Tromp & Hekkert, 2016; Niedderer et al., 2014). However, little is known about why and under which conditions such effects are most likely. Moreover, to our knowledge, research on the effect of packaging design on behaviour has focused, thus far, on purchase behaviour (Magnier & Schoormans, 2017; Magnier, Schoormans, & Mugge, 2016, Pancer, McShane, & Noseworthy, 2015; Steenis, Van Herpen, Van der Lans, Ligthart, & Van Trijp, 2017). These studies showed that consumers were more likely to purchase products with sustainable packaging than unsustainable packaging. In this paper, we aim to examine whether packaging design can also influence recycling. Moreover, extending previous studies, we aim to understand why and under which conditions packaging design is most likely to promote recycling. In collaboration with designers, we developed theory-based packaging designs, and systematically evaluated the impact of these packages on recycling.

On the basis of the Integrated Framework for Encouraging Pro-Environmental Behaviour (IFEP model; Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, Lindenberg, & Keizer, 2016), we propose that individuals who are focused on the environmental consequences of their behaviours and on benefiting the environment in a given situation (we refer to this as 'focus on the environment') are more likely to engage in a variety of pro-environmental behaviours, including recycling (Steg, 2016; Ruepert, Steg, & Keizer, 2017). The IFEP proposes that the extent to which individuals focus on the environment depends on contextual factors and biospheric values (Steg, 2016). We propose that a packaging design is an important contextual factor that can affect people's focus on the environment, thereby influencing recycling (Hypothesis 1). Biospheric values reflect the extent to which people care about the environment, and steer individuals' attention towards value-related consequences of their behaviour, thereby affecting the extent to which people are focused on the consequences of their behaviour for the environment (Perlaviciute & Steg, 2015; Steg, Perlaviciute, Van der Werff, & Lurvink, 2014; Verplanken & Holland, 2002). The stronger individuals' biospheric values, the more likely they

are to focus on the environmental consequences of their actions, and to act pro-environmentally, including recycling (Hypothesis 2; Feather, 1995; see Steg & De Groot, 2012 for a review).

Biospheric values may also influence the strength of the relationship between a packaging design and recycling. In particular, we propose that the effect of packaging design on recycling will be more pronounced among individuals with moderately strong biospheric values. Individuals with strong biospheric values may generally be more focused on the environment and thus recycle anyway. Individuals with weak biospheric values may generally not be focused on the environmental consequences of their behaviour, and not recycle in general. Yet, individuals with moderately strong biospheric values may be more responsive to a packaging design that makes them focus on the environment, as they care about the environment, but may not always focus on the environmental consequences of their behaviour. Hence, we expect an interaction between packaging design and biospheric values. This interaction effect should be curvilinear. Specifically, we propose that the effect of packaging design on recycling will be more pronounced among individuals with moderately strong biospheric values (Hypothesis 3; cf. Ruepert, Steg, & Keizer, 2017; Guagnano, Stern, & Dietz, 1995).

We tested our reasoning in three studies. We conducted two online studies among a student and a representative sample of the Dutch population to test the main and interaction effects of packaging design and biospheric values on likelihood of recycling. Moreover, we conducted a field experiment in which we tested the effects of packaging design and biospheric values on actual recycling behaviour.

To develop the packaging, we worked closely together with designers. We explained our theoretical reasoning introduced above to these designers, in particular that we expect that a design can affect recycling by making people focus on the environment. The designers translated our theoretical input into packaging designs that are aimed at making individuals focus on the environment; we will refer to these as environmental designs.

For Study 1, four industrial engineering students developed each an environmental design that aimed to make people focus on the environment. In particular, they redesigned a biscuit package that was available at Dutch supermarkets at the time of the study (see Figure 1). The first environmental design was only slightly different from the original design: the red bar on the front side was stretched to the right side and ‘Recycle Me’ was put in white ink on it. In the environmental design 2, the white background was changed into an unbleached carton background. The environmental design 3 included two main changes: the upper right corner showed a little sheet with the slogan ‘recycling makes the world a bit more beautiful’ and a green leaf. On the left side, another sheet in green was added on the package with information on how to recycle. The environmental design 4 included an unbleached carton colour and green as the prominent font colour. At the bottom of the box, a green piece was

placed depicting the sentence “This package is fully recyclable”. All verbal elements on the packaging designs were in Dutch.

Figure 1. Original biscuit package (control condition, left) and the four redesigned environmental packages (from left to right: environmental design 1, environmental design 2, environmental design 3, and environmental design 4) that were used in Study 1 and 2a.

To examine the effect of these environmental designs on recycling, 103 Dutch students (M_{age} = 20.54, SD_{age} = 3.33; 71.6% women) were randomly assigned to one of the four experimental conditions with the environmental designs or the control condition with the original package. Participants saw one of the designs on a computer screen, and were asked to imagine that they bought the product, finished it up at home and were to throw the package away. They were asked to indicate how likely it would be that they recycle the package with three items (scores ranged from 1 = very unlikely – 7 = very likely, α = .96; M = 5.47; SD = 1.73). We then measured participants’ biospheric values (Steg et al., 2014; scores could vary from -1 = opposed to the principles that guide you to 7 = extremely important; α = .87; M = 4.40; SD = 1.61).

To test the effect of the packaging design and biospheric values on likelihood of recycling, we conducted a two-step regression analysis. We computed dummy variables comparing all environmental designs to the control condition as the reference group. In Step 1, we examined the main effects of packaging design and biospheric values on recycling likelihood. The model explained 22% of the variance in recycling likelihood (F = (5, 96) = 5.55, p < .001). As predicted, stronger biospheric values increased the likelihood that the packaging was recycled (β = .46, t(96) = 5.00, 95% CI [.30, .68], p < .001). Yet, in contrast to our expectations, participants were not more likely to recycle any of the environmental design packages than the original package (original design: M = 5.42; SD = 2.00; environmental design 1: M = 5.08; SD = 2.00; β = -.02, t(96) = -.16, 95% CI [-1.06, .91], ns; environmental design 2: M = 5.37; SD = 1.90; β = .03, t(96) = .23, 95% CI [-.90, 1.13], ns; environmental design 3: M = 5.70; SD = 1.46; β = .05, t(96) = .43, 95% CI [-.75, 1.17], ns; environmental design 4: M = 5.77; SD = 1.35; β = .13, t(96) = 1.09, 95% CI [-.43, .1.49], ns). In Step 2, we added the interaction effect between packaging design and biospheric values (R^2 = .23, F = (9, 92) = 3.11, p = .003). Again, we only found a main effect of biospheric values. The interaction effect of any of the packaging designs and biospheric values was not significant (environmental design 1: β = -.16, t(96) = -.48, 95% CI [-.77,.48], ns; environmental design 2: β = -.02, t(96) = =.05, 95% CI [-.68, .65], ns; environmental design 3: β = .18,

t(96) = .45, 95% CI [-.51, .81], ns; environmental design 4: β = .04, t(96) = 1.11, 95% CI [-.63, .70], ns). Biospheric values thus did not moderate the effect of packaging design on likelihood of recycling.

The non-significant effects of packaging design on recycling may be due to a lack of power as we only included 20 participants in each condition. This notion is supported by the relatively large confidence intervals. To address these issues, we conducted a second study among a representative sample of the Dutch population. In Study 2a (N = 189, M_{age} = 56.65, SD_{age} = 13.65; 47.9% women), we only tested the environmental design 4 that had the highest mean score of recycling compared to the original design, to secure that the study would have sufficient power. In Study 2b (N=193, M_{age} = 56.79, SD_{age} = 15.04; 46.5% women), we tested the effects of another packaging design: a biodegradable carton to-go cup that can be fully recycled. A designer provided us with a cup that was aimed at making people focus on the environment (environmental design), and a cup that was not expected to make people focus on the environment (control condition; see Figure 2). Both cups included 6 vertical stripes. In the environmental design, every second stripe depicted a picture of tree bark, while the unbleached material of the cup was visible on the other set of stripes. Additionally, on one of the plain stripes the slogan "I'm green and you?" was printed, and another plain stripe included information on the material (100% recyclable, 100% paper) and a recycling logo; all text was printed in green. In the control design, mathematical formulae were printed in black ink on a white background on half of the stripes. The other stripes were in red; a colour that is not strongly associated with nature (e.g., Magnier & Crié, 2015). We printed the recycling logo on this cup as well to provide the minimal information needed to understand that the cup can be recycled, thereby ensuring that participants in both conditions understood that the cup could be recycled.

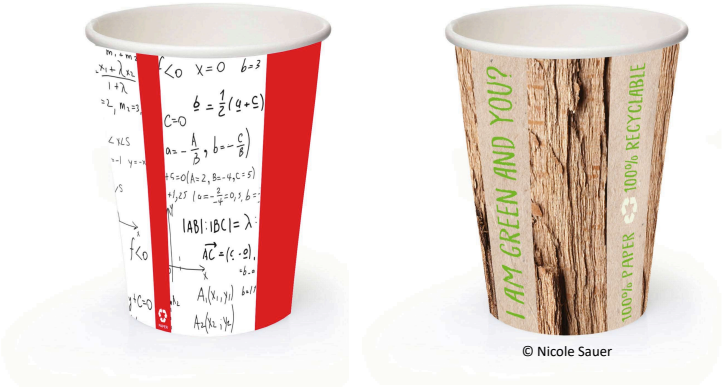

Figure 2. Control version (left) and environmental design (right) of the cup that were used in Study 2b and 3.

In both study 2a and 2b, participants were randomly assigned to evaluate either the environmental design or the control design. To measure biospheric values, participants first filled in the same validated value-questionnaire as in Study 1 (Study 2a: α = .87; M = 5.08; SD = 1.47; Study 2b:

α = .85; *M* = 5.03; *SD* = 1.30). They then saw one of the packaging designs (according to their condition, hence, either the environmental or the control design) on the screen and were asked to indicate how likely they were to throw the package in a glass, paper, plastics and organic waste bin, respectively, on a 7-point Likert scale (1 = very unlikely – 7 = very likely). We used the likelihood of disposing the package in the paper bin as the dependent variable, as this was the correct bin (Study 2a: *M* = 6.40, *SD* = 1.59; Study 2b: *M* = 6.40, *SD* = 1.43).

We again first included biospheric values and the designs of the biscuit package (environmental design coded as 1, control design coded as 0) as predictors of likelihood of correct recycling in the regression model. Interestingly, neither biospheric values (β = -.001, t(184) = -.01, 95% CI [-.16, .16], ns) nor packaging design ($M_{environmental}$ = 6.43, $SD_{environmental}$ = 1.57; $M_{original}$ = 6.36, $SD_{original}$ = 1.62; β = .02, t(184) = .29, 95% CI [-.40, .53], ns) were significantly related to recycling of the biscuit package (R^2 = -.01, *F* = (2, 184) = .04, ns). In the second step, no significant interaction effect was found of packaging design and biospheric values on recycling (β = -.02, t(184) = -.07, 95% CI [-.33, .31], ns; R^2 = .01, *F* = (3, 183) = .03, ns). These findings again show that the environmental design of the biscuit package did not stimulate recycling. One possible explanation for this result may be that the biscuits are an existing product from a well-known company. Consumers may have already developed inferences about the product and the packaging. Consequently, the packaging design may not have been strong enough to make people focus more on the environment. Future research may investigate the role of familiarity with a product and a packaging design in making people focus more on the environment.

In contrast, we found a significant main effect of packaging design on recycling of the cup ($M_{environmental}$ = 6.61, $SD_{environmental}$ = 1.00; $M_{original}$ = 6.20, $SD_{original}$ = 1.73; β = .15, t(190) = 2.10, 95% CI [.03, .83], *p* = .04), while biospheric values did not enhance the likelihood of recycling the cup (β = .10, t(190) = 1.35, 95% CI [-.05, .26], ns; R^2 = .03, *F* = (2, 190) = .2.95, *p* = .06). The cup with the environmental design was recycled more than the control cup. The results further revealed a significant interaction effect of packaging design and biospheric values on recycling (β = .65, t(189) = -4.00, 95% CI [.04, .66], *p* = .03; R^2 = .06, *F* = (3, 189) = 3.66, *p* = .01). We used the Johnson-Neyman technique to identify for which levels of biospheric values the packaging design was significantly related to recycling. Figure 3 depicts the bandwidth graph with the effect size of packaging design on recycling for different levels of biospheric values by using the floodlight technique (Spiller, Fitzsimons, Lynch Jr, & McClelland, 2013). This technique assumes that a statistically significant relationship between biospheric values and recycling is present when the 'band' does not encompass zero. Figure 3 shows that packaging design was positively related to recycling when scores on biospheric values were higher than 4.9 (the 90th percentile), while packaging design was not significantly related to the likelihood that the cup would be recycled when scores on biospheric values were lower than 4.9, thus when participants

rather weakly endorsed biospheric values. This implies that the effect of packaging design on recycling is more pronounced among participants with moderately strong to strong biospheric values.

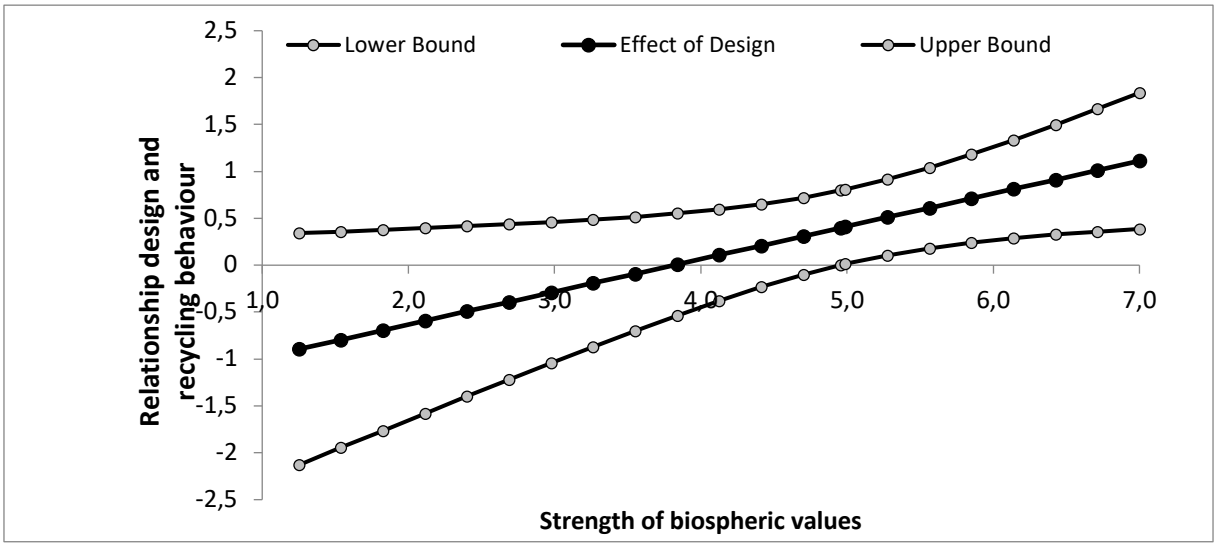

Figure 3. The relationship between packaging design and likelihood of recycling for different levels of biospheric values in Study 2b.

In Study 3, we tested our hypotheses in an experimental setting observing actual recycling behaviour of the two versions of the cup used in Study 2b. In total, 116 individuals participated in this experimental study (M_{age} = 20.27, SD_{age} = 3.84; 69% female). Participants were told that the aim of the study was to better understand participants' bad habits, to disguise the true aim of the study. Participants were asked to fill in an online questionnaire before they participated in the experiment, comprising the value scale, including biospheric values (α = .94; *M* = 4.46; *SD* = 1.89). Upon arrival for participating in the study, participants were told that the room was not prepared yet and were asked to wait in the hallway. As a compensation, the experimenter offered participants a free cup of a hot or cold beverage in either the environmental or the control version of the cup. A chair was positioned next to an open pantry in which a regular trash bin as well as a recycling bin were situated. From their seats, participants could see both bins (see Figure 4 and 5). The experimenter approached participants after approximately seven minutes and indicated that she would be ready to start the study at any time the participants had finished their drink. Importantly, participants were not explicitly told to recycle their cup. The paper bin (the correct recycling bin) was located in a container comprising a set of four bins (for cans, plastic, paper, and general waste) that was roughly five meters away on the right-hand side from the chairs where participants were asked to wait. On the way to these recycling bins, we placed another small residual bin. It was around the corner on the right-hand side to guarantee that participants would see it when they start looking for a possibility to discard their cup. Once participants entered the room and filled out a questionnaire, the experimenter checked in which bin participants disposed of their cup.

Figure 4. The setting of Study 3. The first picture shows the hallway, the place where participants waited and the residual bin close by. The second picture shows the setting of the residual bin close by and the recycling bin further away from the perspective of the participant. The third picture shows the recycling bin used in this study.

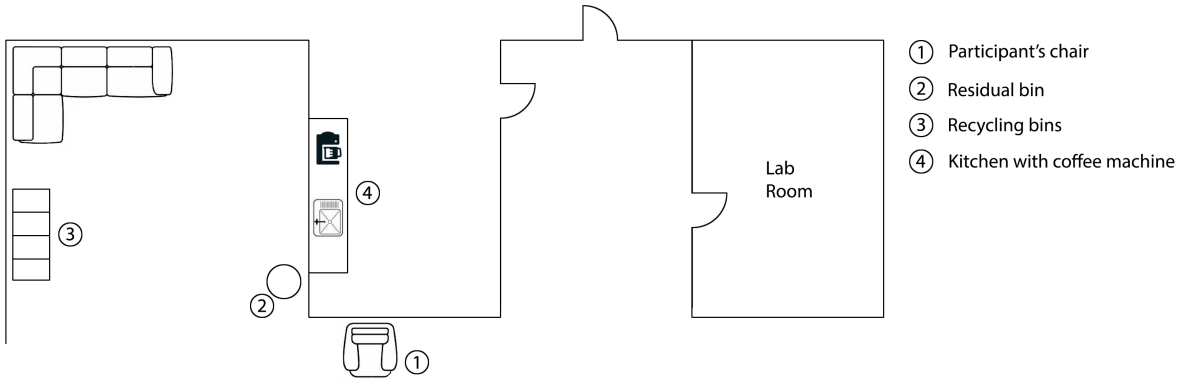

Figure 5. Floorplan of the setting of Study 3.

To test the effect of packaging design on actual recycling behaviour, we conducted a two-step logistic regression analysis. The regression model of Step 1, including the main effects of packaging design and biospheric values, was significant ($R^2_{Nagelkerk} = .14$, X^2 (2) = 11.19, $p = .004$). As expected, the cup with the environmental design was recycled more, by 58.8% of the participants, whereas the cup with the control design was only recycled by 28.3% of the participants ($b = -1.29$, OR = .27, Wald χ^2 (1) = 9.50, 95% CI [.12, .63], $p = .002$). Interestingly, we did not find a significant main effect of biospheric values on recycling behaviour ($b = .12$, OR = 1.12, Wald χ^2 (1) = 1.15, 95% CI [.91, 1.39], $p = .29$). The regression model of Step 2 including the interaction effect ($R^2_{Nagelkerk} = .19$, X^2 (3) = 15.48, $p = .001$) additionally revealed a significant interaction effect of packaging design and biospheric values ($b = -.46$, OR = .63, Wald χ^2 (1) = 4.20, 95% CI [.41, .98], $p = .04$). The Johnson-Neyman technique (Hayes, 2013, 2016; see Figure 6) revealed that the effect of packaging design on recycling was more pronounced among participants with moderate to strong biospheric values. Packaging design was positively related to recycling when scores on biospheric values were higher than 3.5 (the 90th percentile), while packaging design was not significantly related to recycling when scores on biospheric values were lower than 3.5, thus when participants rather weakly endorsed biospheric values. This

implies that the effect of packaging design on recycling was more pronounced among participants with moderately strong to strong biospheric values.

Hence, this study replicated the results of Study 2b in a natural setting: The packaging that aims at making people focus on the environment was recycled more than the packaging used in the control condition, with this effect again being more pronounced among participants with moderately strong to strong biospheric values.

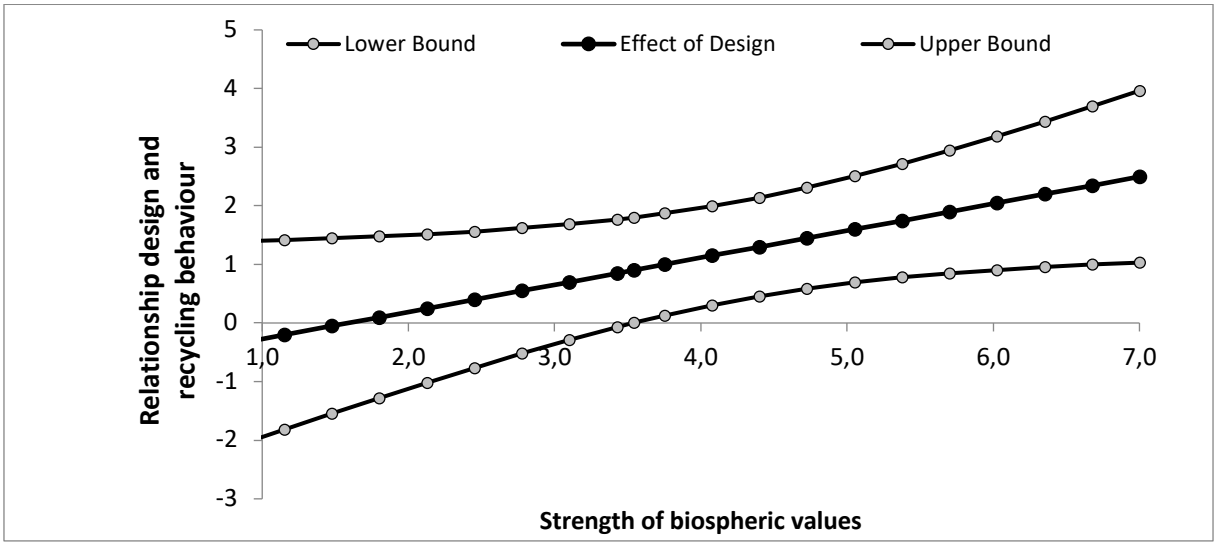

Figure 6. The relationship between packaging design and recycling behaviour for different levels of biospheric values in Study 3.

4.4. Conclusion

Our results suggest that packaging design can encourage pro-environmental behaviour, in our case recycling, when it makes people focus more on the environment, particularly when people moderately strongly to strongly endorse biospheric values. However, we did not find this effect for the biscuit package, in which case the environmental designs were adjustments of the existing packaging. Yet, we found a significant effect of the environmental design on both likelihood and actual recycling of the cup. In this case, we used a novel design rather than adjusting an existing design. One may therefore expect that the effects are more likely to occur among novel packages and products that people are unfamiliar with. Adjusting existing designs of familiar products and packages may not be as effective in making people focus on the environment. Future research is needed to test whether using a novel design is indeed more successful in making people focus on the environment and consequently in promoting recycling and if so, why this is the case. We suggest to particularly examine the role of novelty and familiarity with the package and the product in this process.

As the effect of the packaging design of the cup on recycling was more pronounced among individuals with moderately strong to strong biospheric values, it seems as if the environmental design of the cup succeeded in making people focus more on the environment, whereas the biscuit package did not. In case of the cup, participants with moderately strong to strong biospheric values now acted

more in line with their values. Our results partly support the IFEP model (Steg et al., 2014; Steg et al., 2016), suggesting that contextual factors, including design, can make people focus on the environment, thereby promoting pro-environmental behaviours, amongst these recycling. Our results suggest that design particularly stimulates recycling when the design used is novel. Yet, we did not find consistent support for our notion that biospheric values are related to more recycling. Future research could examine the role of biospheric values in the process of making people more focused on the environment.

Interestingly, the interaction effect of packaging design and biospheric values on recycling was not curvilinear. Particularly, the effect of packaging design was more pronounced among participants with moderately strong to strong biospheric values. This is an interesting finding as we expected the effect to be particularly pronounced among individuals with moderately strong biospheric values. A possible explanation may be that as not all to-go cups can be consistently recycled due to the different materials used in the packaging, also individuals with strong biospheric values may have needed a prompt that the cup can be recycled. Future research could investigate under which conditions the interaction effect of packaging design and biospheric values is curvilinear and under which conditions the effect is linear. In this article, we tested the effect of packaging design that makes people focus on the environment and whether the likelihood of recycling depends on biospheric values via moderation. As we did not include any process variables, we can only assume that the packaging design made people focus on the environment. Future research could investigate if environmental packaging designs indeed make people focus more on the environment, by using both implicit and explicit measures of the extent to which they make people focus on the environment.

The effect of the cup was not only found on self-reported recycling but also on actual recycling. This is an important finding as research usually finds that it is more difficult to predict actual behaviour than self-reported (recycling) behaviour (Geiger, Steg, Van der Werff, Ünal, 2019; Kollmus & Agyeman, 2002). This suggests that our results are rather robust as they hold across different operationalisations of recycling, namely across self-reported and actual recycling in a natural setting. If anything, the effect seemed to be even stronger for actual recycling behaviour in Study 3 than for self-reported behaviour in Study 2. A reason for this may be that participants make a deliberate choice in a questionnaire. Consequently, also participants in the control condition may have become aware of the importance of recycling. Hence, they indicated more frequently that they would recycle the package. In a real-life situation, on the contrary, the importance of recycling may have been easily forgotten or overseen in situations similar to the control condition as participants were not asked to recycle the package. More research on self-reported and actual recycling behaviour is needed to unravel this interesting finding.

Our results have important practical implications: only a small cue such as a packaging design can lead to more recycling. If practitioners aim to promote recycling behaviour of a certain package, it

seems important to not only adjust existing designs but to design new packages of products consumers are not familiar with. Our results suggest that new designs of packages are more likely to promote recycling by making people focus more on the environment. As a case in point, we used a packaging design in this study to examine whether a contextual factor that makes people focus on the environment can promote recycling behaviour. Practitioners could consider other contextual factors that may make people focus more on the environment and re-design, for example, recycling bins, in a way that they make people focus on the environment.

Our study extends previous research on design for behavioural change as our results suggest that a packaging design does not only influence purchase behaviour (e.g., Magnier & Schoormans, 2017; Magnier et al., 2016, Pancer et al., 2015; Steenis et al., 2017) but also recycling behaviour. Even more, our results revealed why and under which conditions design is most likely to stimulate recycling by developing theory-based designs and by systematically evaluating the impact of these packages on recycling. Specifically, a packaging design that makes people focus on the environment can promote recycling behaviour, particularly when people moderately strongly to strongly endorse biospheric values and particularly when a new packaging design is used. Future research could integrate other theories on behavioural change in the design and test the effects of these environmental designs on different pro-environmental behaviours. On the basis of such research, design principles can be derived that can be employed by designers to promote pro-environmental behaviour change.

4.5. Method section

4.5.1. Online study 1

In Study 1, we tested the effect of four environmental designs of a biscuit package that aimed at making people focus on the environment against the original design of the biscuit package available at Dutch supermarkets at the time of the study.

Participants and Procedure

A sample of in total 103 participants aged 17 to 38 (M_{age} = 20.55, SD_{age} = 3.32, 2 participants did not indicate their age) participated in this study. The majority of participants was female (71.6%); 1 participant identified as non-bipolar. Participants were first year psychology students who received course credits as compensation. The online study was in Dutch. Participants were randomly assigned to one of the five conditions (four environmental designs and original design). After participants gave informed consent, they were presented with a 3-D picture of the packages depicting the front-side, the left or right-hand side and the above side. Participants were asked to indicate how likely it was that they would recycle the package. Following a distraction task in which participants had to indicate how similar three geometrical figures were, participants filled in the value questionnaire and items on socio-demographics. Finally, they were given the option to leave comments on the packaging design and the study itself. The questionnaire contained also items on purchase behaviour, product characteristics and brand perceptions which were not relevant for the current study, and are thus not discussed further.

Manipulation

To develop the materials, we closely worked together with designers. We explained our theory that a packaging design that makes people focus on the environment is likely to stimulate recycling to designers and asked them to translate this theoretical input into an alternative design of a biscuit package. Specifically, we collaborated with were four students from the Bachelor programme Industrial Design and from the master Industrial Design Engineering at the University of Twente. They attended an extracurricular workshop that we gave on this topic. Students were provided with the original package of the biscuit package that was available at Dutch supermarkets at the time of the workshop, and were asked to redesign the package with the aim to make individuals focus on the environment. Each student developed one environmental design, resulting in four redesigned biscuit packages. As a control condition, we used the original package. This original package made out of carton mainly used a white-red design with the background being white. Two strawberries were placed in the centre of the design as well as a red bar on which the name of the product is placed (see Figure 1 for the designs). The material and the size were the same for the control and the environmental designs. In the environmental design conditions, the first design was only slightly changed. The designer stretched the red bar on the front side to the right side and put 'Recycle Me' in white ink on

it. For the second environmental design, the white background was changed into an unbleached carton background but the main colour red was kept. The third designer made two main changes: in the upper right corner, he placed a little sheet with the slogan 'recycling makes the world a bit more pretty' and a green leave. On the left side, the designer added another sheet in green with recycling information on it. The main characteristics of the fourth design were that it used muted colours, such as an unbleached carton colour instead of the original white background and green as the prominent font colour. At the bottom of the box, a green piece was placed depicting the sentence "This package is fully recyclable". The verbal elements on either packaging design were in Dutch.

Measures

Likelihood to recycle. We assessed likelihood that respondents would recycle the package with three items: To which extent do you (1) have the intention, (2) plan and (3) are you willing to recycle the package on a 7-point Likert scale (1 = not at all – 7 = very much). Cronbach's alpha was good (α = .96) and the mean score of this scale was relatively high (M = 5.47; SD = 1.73), suggesting that participants were generally very likely to recycle the packages.

Biospheric values were administered by a validated value questionnaire comprising 16 items representing hedonic, egoistic, altruistic and biospheric values (Steg et al., 2014). Participants rated the importance of each value as a guiding principle in their life. Biospheric values were measured with four items: respecting the earth; unity with nature; protecting the environment; preventing pollution. Scores could vary from -1 (opposed to the principles that guide you) to 7 (extremely important). The biospheric scale showed high internal consistency (α = .87), so mean scores were computed for further analyses (M = 4.40; SD = 1.61).

4.5.2. Online studies 2a and b

In Study 2a, we examined whether the environmental design 4 of the biscuit package that had the highest mean score of recycling in Study 1 would be recycled more the original design of the biscuit package. In Study 2b, we tested the effects of an environmental design of a biodegradable carton to-go cup that can be fully recycled against a control design of the same cup.

Participants and procedure

Study 2a on the biscuit package was conducted among 189 participants, aged 15 to 90 (M_{age} = 56.65, SD_{age} = 13.65); 47.9% of the participants were women. Study 2b testing the cup was conducted among 193 participants, aged 15 to 87 (M_{age} = 56.88, SD_{age} = 14.94); 46.5% of the participants were women.

The online study was conducted in Dutch. Participants were recruited from an online panel to participate in the study. In both studies 2a and 2b, participants were randomly assigned to one of the two conditions (environmental design vs. control design). After participants gave informed consent, they first completed the value questionnaire. They were then presented with a picture of the

package according to their condition. In Study 2a testing the biscuit package, the pictures depicted the front-side, the right-hand side, and the top side of the box. In Study 2b testing the to-go-cup, the pictures depicted the front side, the right-hand side and the backside of the cup. Then, participants were asked to indicate how they would dispose of the package, which was our measure of recycling behaviour. Next, participants evaluated the perceived sustainability, perceived attractiveness, perceived environmental consequences of the package and the product, their perceived difficulty to recycle the package and their purchase behaviour of the product. These items were not relevant for the purpose of the current study and will not be discussed further. Finally, participants filled in some socio-demographic variables, and were debriefed and thanked for their participation.

Manipulation

We used the same biscuit package that was included in the first online study. For the environmental design, we selected the environmental design 4 that had the highest mean score of recycling. This environmental design was tested against the original design.

The other package used in this study was a biodegradable carton cup of 180cc. These cups can be fully recycled as they do not contain a plastic foil. A plastic foil is commonly present in cups. The material and the size were the same for the environmental and control packaging designs, only the designs differed. For this study, we again collaborated with a designer to whom we explained the theory discussed in the introduction. In particular, we explained that a design that makes people focus on the environment is more likely to promote recycling. The designs were developed in two iterative rounds. First, the designer developed six environmental designs and explained her reasoning for developing these, which were shown to master students in the course *Introduction to Environmental Psychology.* These students were asked to choose the cup that they would be most likely to recycle; responses were provided anonymously to ensure independent responses. In the second round, the designer combined key features of the two designs that students indicated to most likely recycle and integrated it into several new design proposals. These were then shown to 15 environmental psychologists working at a Dutch university who discussed the design proposals and selected the design that they believed would be most likely to make people focus on the environment. Further, the designer also designed a cup that was supposed to not focus individuals on the environment. This design served as a control design. Based on these evaluations, the designer finalized the designs.

For the cup, the designer used a similar basic structure of the design across both conditions. In this way, the designs were similar and only differed in the extent to which they made participants focus on the environment. Specifically, the designer divided the cup into 6 vertical stripes in the environmental design condition as well as in the control condition. However, the design of these stripes was different in the two conditions. In the environmental design condition, every second stripe depicted a picture of tree bark, which was aimed at making people focus on the environment (e.g.,

Magnier & Crié, 2015; Magnier & Schoormans, 2015). On the other set of the stripes, unbleached carton, the material the cup was made of, was visible. The design also entailed verbal features: On one of the plain stripes the slogan "I'm green and you?" was printed. On one of the other plane stripes the designer provided information on the material (100% recyclable, 100% paper) and a recycling logo. All text was printed in green font, as this colour is most strongly associated with the environment (e.g., Lichtenfeld, Elliot, Maier, Pekrun, 2012, Pancer et al., 2015).

In the control condition, the stripes were red, a colour that is not associated with nature (e.g., Magnier & Crié, 2015). On the plane stripes, mathematical formulae were printed in black ink on a white background. We again printed the recycling logo on this cup to provide the minimal information needed to recycle the cup when participants intended to do so, thereby ensuring that participants in both conditions were aware that the cup could be recycled.

Measures

Biospheric values were administered by the same questionnaire as in Study 1. The scale again showed high internal consistency (Study 2a: α = .87; Study 2b: α = .85); mean scores were computed for further analyses (Study 2a: *M* = 5.08; *SD* = 1.47; Study 2b: *M* = 5.03; *SD* = 1.30).

Likelihood to recycle the package was measured by the question *How likely is it that you throw the package in one of the following bins?*. We provided participants the options glass, paper, plastics and organic bin, as these are common recycling bins in the Netherlands. Participants were asked to rate the likelihood to dispose of the package in each of the bins on a 7-point Likert scale (1 = very unlikely – 7 = very likely). The correct bin in all four conditions was the paper bin. We therefore used the item measuring the likelihood of disposing of the package in the paper bin as the dependent variable (Study 2a: *M* = 6.40, *SD* = 1.59; Study 2b: *M* = 6.40, *SD* = 1.43*)*.[12]

4.5.3. Study 3

In Study 3, we tested our hypotheses in an experimental setting observing actual recycling behaviour of the environmental design and the control design of the cup that was used in Study 2b.

Participants

[12] Studies suggest that sustainable packages may also be perceived as more sustainable and attractive, which may in turn affect preferences and purchases of sustainable packages (e.g., Luchs, Brower, & Chitturi, 2012; Magnier & Schoormans, 2015, Steenis et al., 2017). To explore whether our environmental designs would also have these additional beneficial effects we asked participants to indicate how sustainable and attractive they perceived the packages included in Study 2a and 2b. T-tests revealed that the environmental design of the biscuit package (*M* = 4.31, *SD* = 1.58) was perceived as more sustainable than the original design (*M* = 3.49, *SD* = 1.29; $t(174) = -3.78$, $p < .001$) but not as more attractive ($M_{environmental} = 4.40$, $SD_{environmental} = 1.45$; $M_{original} = 4.21$, $SD_{original} = 1.48$; $t(174) = -.85$, ns). The environmental design of the cup (*M* = 4.86, *SD* = 1.06) was perceived as more sustainable than the original design (*M* = 3.71, *SD* = 1.52; $t(187) = -6.04$, $p < .001$) and as more attractive ($M_{environmental} = 4.85$, $SD_{environmental} = 1.35$; $M_{original} = 3.70$, $SD_{original} = 1.55$; $t(187) = -5.47$, $p < .001$). This suggests that a design that makes people focus on the environment seems to be perceived as more sustainable and as more attractive as well.

An experimental study was conducted among 116 first-year Psychology students at a Dutch university (69% female, 3 participants did not indicate their gender) aged 17 to 53 (*M* = 20.27, *SD* = 3.84; 3 participants did not indicate their age); they received course credits for participating.

Procedure and design

As a prerequisite of the study, participants were asked to fill in a questionnaire online comprising the value scale. Participants could do this 2.5 months to 24 hours before the experiment. The actual study was conducted in a building where recycling bins were in place (and thus did not have to be installed for the purpose of this study), to make the study set-up as realistic as possible. To mask the actual aim of the research, we developed the following cover story. Upon arrival, participants were told to wait in the hallway, as the experimenter supposedly still needed to prepare the experimental room for the participant. As a compensation, the experimenter offered participants a free cup of coffee, tea, water, or a smoothie drink in one of the cups created for this study. After two attempts of offering participants something to drink, 5 participants still did not accept a drink and therefore had to be removed from further analyses. We further removed 7 participants from further analyses who came with another person to the study and waited together. Participants either received a drink in the environmental design cup or in the control design cup. The two conditions randomly varied across two times of the day (morning and afternoon). Participants did not see the cups of the other condition and we assured that there were no cups, neither from previous participants nor from other employees, in any of the bins when the experiment started. Once the participants had their drink, the experimenter told them to take a seat in the hallway and went back to the experimental room. Their chair was positioned next to an open pantry in which the trash bins were situated. From their seats, participants could see both the trash bin and the recycling bins (see Figure 5 for the floor plan). The paper bin was located in a set of four bins (cans, plastic, paper, and general) that were roughly five meters away on the right-hand side from the chairs where the participants waited. On the way to these recycling bins, there was another small residual bin placed. It was around the corner on the right-hand side to guarantee that participants would see it when they looked for a possibility to discard their cup.

As participants needed about 10 minutes to drink the beverage, the experimenter approached them after approximately seven minutes and handed them over the informed consent. She also indicated that she would be ready to start the study at any time the participants had finished their drink and had filled in the informed consent. To ensure that participants disposed of their cup, the experimenter mentioned that beverages were not allowed in the experimental room. Importantly, participants were not explicitly told to recycle their cup. To avoid social desirability, the experimenter went back to the experimental room and waited inside for the participant.

Once entered, participants completed a questionnaire. They first filled in questions on socio-demographics followed by the questions on intentions to engage in pro-environmental behaviours and

some other tasks irrelevant for this study to disguise the aim of the study. While participants were completing this bogus task, the experimenter checked in which bin participants had discarded their cup. Participants received the debriefing after completing the bogus questionnaire.

Manipulation

We used the same environmental design cup as in Study 2b, but the control packaging slightly differed from the version used in Study 2b. In particular, in this study the background was not white but one could see the unbleached material of the cup. This change was not due to theoretical considerations but practical matters regarding the printing. Further, on one of the red stripes, the logo of the university was printed to make the design more realistic in the university setting.

Measures

Biospheric values. Participants filled in the same value questionnaire as in Study 1. The scale had a high internal consistency (α = .94); mean scores were computed for further analyses (*M* = 4.46; *SD* = 1.89).

Recycling behaviour was measured by observing in which trash bin participants discarded their cup. The correct recycle bin for the cup was the paper bin. We coded recycling behaviour as 1 if participants disposed of their cup in the paper bin, and as 0 if participants discarded their cup in another bin or left it in the regular bin next to the chairs.

5. The art of behavioural change: The influence of experiencing art on pro-environmental behaviour

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5.2. Abstract

There has been a growing interest in using art to promote pro-environmental actions. This article aims at better understanding how art can promote pro-environmental actions, in particular recycling behaviour. We followed a theory-grounded approach to design an art installation and evaluate to what extent and why the art installation was effective in promoting pro-environmental actions. Specifically, an artist designed an art installation that aimed to strengthen environmental self-identity, by implementing theoretical insights of factors influencing environmental self-identity in the art installation. The effect of the art installation on recycling was tested in a field study conducted in two cities. As expected, we found that experiencing the art installation increased actual recycling and resulted in stronger intentions to recycle and to engage in other pro-environmental behaviours, indicating that art can drive behavioural change. Contrary to our expectations, we did not find that the art installation strengthened environmental self-identity, suggesting that other factors and processes may have played a role in driving the effect of art. We discuss the implications of our findings.

Keywords: art, pro-environmental behaviour, recycling, environmental self-identity, impact evaluation

5.3. Introduction

The negative impact of climate change will dramatically increase if we do not limit global warming to 1.5°C (IPCC, 2018). Climate change is anthropogenic (IPCC, 2018), therefore in order to minimize climate risks, it is crucial that humans consistently engage in pro-environmental behaviours. Hence, a key question is how to stimulate pro-environmental behaviours. Many disciplines have addressed the question on how to mitigate key environmental problems by promoting pro-environmental actions. Interestingly, there has been a growing interest in using design and art to do so (Niedderer et al., 2014; Tromp, Hekkert, & Verbeek, 2011). We will present some prominent examples below. Yet, the question remains to what extent, under which conditions, and why art may be effective in stimulating pro-environmental behaviours. Notably, artists may have implicit assumptions on what factors drive behaviour change which they address in their art installations (Hekkert & Van Dijk, 2014; Niedderer, 2007), but these assumptions are typically not tested (Niedderer et al., 2014; Aryana & Boks, 2012). Are observers of art installations that aim to promote pro-environmental behaviours indeed more willing to engage in pro-environmental behaviours afterwards or just impressed by a haptic, artistic and impressive realization of a message? We aim to address this question by examining whether an art installation that aims to promote pro-environmental behaviour by integrating scientific theory in the design of the art installation is effective in promoting pro-environmental behaviour. In doing so, we follow a novel interdisciplinary approach, integrating insights from art and environmental psychology. Specifically, psychologists will explicate theories on factors driving pro-environmental behaviour to the artist, the artist will embed one of these theories in the design of the art installation. Next, the psychologists will systematically evaluate the effect of the art installation on behaviour. Addressing these points can contribute to a better understanding of the extent to which, how and why art installations can promote pro-environmental actions. Such insights are important to understand the potential and to increase the impact of art in stimulating pro-environmental actions.

5.3.1. Art

Various artists have developed art installations to promote awareness of environmental problems and to encourage pro-environmental actions. One well-known example is WATERLICHT (water light) by Daan Roosegaarde, a Dutch artist, who aimed at making people experience the risks of rising sea levels through a gigantic virtual flood installed in different public places (https://www.studioroosegaarde.net/project/waterlicht). Furthermore, in the project 'Ice Watch', the Icelandic/ Danish artist Olafur Eliasson, aimed to raise awareness of the melting of artic ice due to climate change by directly making people experience the melting of artic ice (https://olafureliasson.net/archive/artwork/WEK109190/ice-watch). As part of this project, twelve ice blocks were shipped from Greenland and put in a clock formation in different European cities, where

they slowly melted. Another example is the work of French artist Gilles Cenazandotti who builds

Figure 1. Daan Roosegaarde, Waterlicht, 2015. Museumsplein, Amsterdam, 2015. © Studio Roosegaarde

Figure 2. Olafur Eliasson, Ice Watch, 2014. Twelve ice blocks. Place du Panthéon, Paris, 2015. Photo by Martin Argyroglo, © Olafur Eliasson

Figure 3. Gilles Cenazandotti, Marine Plastics Sculptures, 2016. © Gilles Cenazandotti

sculptures of endangered animals made out of marine plastics that are placed at the sea side. He aims at making people aware of our environmentally unfriendly consumption habits and lifestyle (https://gilles-cenazandotti.com/).

Interestingly, all three art installations aim at raising awareness of environmental problems such as climate change and plastic pollution by conveying the negative environmental consequences and by making observers directly and tangibly experience these consequences. The artists seem to assume that increasing awareness may lead to more pro-environmental behaviours. Yet, literature in environmental psychology suggests that raising awareness is mostly not sufficient to promote behavioural change (Abrahamse, Steg, Vlek, & Rothengatter, 2005). Awareness does not necessarily motivate people to act pro-environmentally. Consequently, art installations may be more effective in encouraging pro-environmental behaviour when they address important motivational antecedents of pro-environmental behaviour. We propose that one promising motivational antecedent is environmental self-identity, which is defined as the extent to which one sees oneself as a type of person who acts environmentally-friendly (Van der Werff, Steg, & Keizer, 2013a). We reason that an art installation that aims to strengthen environmental self-identity could have a positive effect on pro-environmental actions.

5.3.2. Environmental self-identity

Environmental self-identity can influence a wide range of pro-environmental actions including recycling (Van der Werff et al., 2013a; Geiger, Steg, Van der Werff, & Ünal, 2019). The stronger one's environmental self-identity, the more likely one is to engage in pro-environmental behaviours. Amongst others, environmental self-identity depends on past behaviour (Van der Werff et al., 2013a; 2014a). When people realize that they have engaged in pro-environmental behaviours in the past, they are more likely to see themselves as a pro-environmental person. Consequently, they are more likely to act pro-environmentally in the future. The reason for this is that people are motivated to be consistent and to act in line with how they see themselves (Van der Werff et al., 2014a, 2014b; Kashima, Paladino, & Margetts, 2014). The notion that environmental self-identity can be affected by

past pro-environmental behaviours is in line with the self-perception theory (Bem, 1972). Self-perception theory articulates that people form their identity based on their past behaviour. Consequently, the more people notice that they have engaged in pro-environmental behaviours in the past, the more likely they are to see themselves as a pro-environmental person. Hence, a way to stimulate recycling and other pro-environmental actions may be to strengthen people's environmental self-identity by reminding them of the pro-environmental behaviours they engaged in in the past.

In this paper, we aim to design an art installation based on the theorising of factors influencing environmental self-identity. Notably, we aim to test the effects of an art installation that is designed such that it reminds observers of their past pro-environmental actions. We expect that experiencing the art installation, and thus being reminded of one's past pro-environmental behaviours, will strengthen one's environmental self-identity, which should lead to more pro-environmental actions afterwards.

5.3.3. Current research

In the current project, we will integrate insights from art and environmental psychology to design an art installation that is based on the theorising of factors influencing environmental self-identity, a key antecedent of consistent pro-environmental behaviour. We will evaluate whether the art installation is successful in changing people's environmental self-identity and behaviour using quantitative research methods, thereby providing evidence for the positive influence of experiencing the art installation on pro-environmental behaviours and intentions as well as for the underlying process. As a case in point, we test the effects of the art installation on recycling behaviour. Recycling is a relevant type of pro-environmental action, as recycling can contribute to a circular economy by increasing resource efficiency and reducing greenhouse gas emission (Corsten, Worrell, Rouw, & Van Duin, 2013; European Union, 2014). Recycling can thereby combat today's waste problems and the emerging scarcity of resources (European Environment Agency, 2015).

We expect that experiencing an art installation that aims to remind people of their past pro-environmental behaviours will lead to more recycling behaviour as well as to stronger intentions to recycle and to engage in a range of pro-environmental actions in the future (Hypothesis 1). We further expect a mediation effect of environmental self-identity on these relationships. Specifically, we expect that experiencing the art installation strengthens environmental self-identity, which, in turn leads to more recycling behaviour and to higher intentions to recycle and to engage in other pro-environmental actions (Hypothesis 2).

5.3.4. Design of the Art Installation

The art installation was developed in close collaboration with an artist. In the initial phase of this project, we extensively discussed common theories in environmental psychology on how to promote pro-environmental behaviours with the artist. We exchanged thoughts and ideas on how

these theories could be implemented in an art installation. Hence, an ongoing dialogue was central at this phase. After this, the artist created and built the installation that was based on the theorising of factors influencing environmental self-identity. In line with the artistic freedom of the artist, other things were included in the art installation that did not target environmental self-identity but were related to other theories we explained. Hence, the art installation may have elicited other processes that may have affected recycling too.

The aim of the art installation was to strengthen environmental self-identity by reminding participants of their past pro-environmental behaviours. The art installation was a white case, around 4.50m x 3.80m big and entailed two small rooms (see Figure 4, 5 and 8). The installation was advertised as a selfie-booth and participants could take a free photo in the first room. The aim of this was to sensitize participants to their own identity (e.g., Beaman, Klentz, Diener, & Svanum, 1979; Wicklund & Duval, 1971). Thereafter, the main manipulation took place in the second room. Specifically, in the second room participants were reminded of their own past pro-environmental behaviours. In the following, we explain the installation in more detail.

On the roof of the installation, there were some plants placed and on the top of the installation there were some sentences sprayed such as 'become your better self', 'you are doing great', 'every start begins with a new perspective'. When people entered the art installation, there was a small room that conveyed the character of a photo-booth, including a pillar in which a tablet was integrated that took the selfie. Beige curtains were used as an entrance door (see Figures in the Supplementary material). When entering the first room, participants heard a child's voice telling them that she would help them to become a better version of themselves. Participants could take two pictures and chose the one they liked most. Participants could then knock on the door that was to their right-hand side and a research assistant welcomed them to the second room. The second room was a six-sided room with clean and white walls. A voice-over of the child started to play. The child mentioned several common pro-environmental behaviours that participants have possibly engaged in (see Figure 6 for the text). The message was supported by some visuals such as the sky and the earth that were displayed on the opposite side of the walls. While listening to the message, a research assistant printed out the photo; put it in a paper frame and handed it over to the participant. The background of the photo of participants was a picture of the Earth. On the right-hand side of the frame, there was text stating that participants could focus on what they already do for the environment and that they are doing great. On the backside, participants received some tips on how to lower their environmental impact, information about the goal of this project and contact details of the main investigator and the artist (see Figure 7). The background colour of the frame was carton bleached to have a pro-environmental look, thereby supporting the messages that participant heard and that we explained above. At the end, the child told participants that they could either choose the easy way out by going

through the door on the left side or the solution by going through the door on the right-hand side. The left side was locked, consequently no one could take the easy route; behind the door on the right-hand side was a mirror symbolizing that every individual is the solution to environmental problems.

Figure 4. The art installation from above.

Figure 5. The art installation from the front-side.

Hello,
Perhaps you are feeling a little misled right now. Because in reality I want to tell you something different.
On a daily basis we hear stories about climate change and environmental issues. We need to do something, right now, but we don't know how. We are suffering from environmental depression.

What if I told you that most of the times it is only our thoughts that literally stand in our way. Do you separate your glass, plastic or paper waste? Do you ever walk or cycle to your destination? Do you throw away your trash instead of litter? Then you are actually doing a good job.

Think about all the positive things you do for a better environment, no matter how small. And pat yourself on the back. We can't build sustainable world in a day, but all the small things add up.

Praise yourself for what you do. This creates a positive loop, in which sustainable behavior will become easier and more fun for everybody. Not because you have to, but because it feels good.

Nobody says that you aren't allowed to eat meat, or that you can never take a plane to go on holiday. But I can imagine that's what you might be thinking. Nice and easy can be fine. Discover what suits you. Before you know, it will suddenly become natural.

Figure 6. The text that was used as a manipulation in the second room of the art installation.

Figure 7. Picture of the paper frame that participants received upon leaving the art installation.

5.4. Method

Participants

In total 317 participants participated in this study. As the installation and the questionnaire were in Dutch, we excluded participants from the analyses who did not speak Dutch and filled in the questionnaire by means of dictionaries or asked help from others to translate the questionnaire for them (n = 9). We further removed participants of whom we observed that they did not fill in the questionnaire seriously, i.e., they were laughing with each other or joking while filling it in or were distracted by their friends waiting for them (n = 11). Among the remaining 297 participants, age ranged

from 16 to 77 (*M* = 29.42, *SD* = 13.49, 33 participants did not indicate their age). The majority of participants was female (66.4 %); two participants indicated to not know or to rather not give an answer and 26 did not indicate their gender. The study was conducted among 84 participants in the first city (Utrecht) and among 213 participants in the second city (Groningen). The experience of the installation and the questionnaires took around 10-15 minutes to complete. Participants could enter the installation alone (24.9%) or in a group of up to four people in total (two people: 55.4%; three people: 18.7%; four people: 1%). If participants were in a group, all group members filled in the questionnaire independently.

Procedure

The installation was placed on crowded public squares in two Dutch cities during two weekends. We approached passers-by and asked them whether they were interested in receiving a free photo of themselves and in experiencing the installation. We had two conditions: an experimental and a control condition. The procedure was slightly different in the experimental and in the control condition. Specifically, in the experimental group participants first provided their informed consent and completed a short questionnaire on values that was irrelevant for the purpose of the current study on a tablet (see Figure 8). Next, they entered and experienced the installation. At this point, they were also given an envelope which contained a second questionnaire to be filled in when leaving the art installation, including measures of intention to recycle different materials, intention to engage in several pro-environmental behaviours, environmental self-identity and socio-demographics. In order to ensure that participants would dispose of the envelope (our measure of actual recycling, see below) and would not hand in the envelope to the researchers, upon leaving the art installation, a research assistant explicitly told participants to open the envelope and to throw it away. The reason provided was that they would not need the envelope anymore. The research assistant gave participants a clipboard and a pen to fill in the questionnaire. Another research assistant, standing out of sight approximately 2m away, observed whether participants recycled the envelope before participants filled in the second questionnaire. When participants handed over the completed questionnaire to the experimenter, they received a debriefing form and could ask questions about the project to the artist and the researcher.

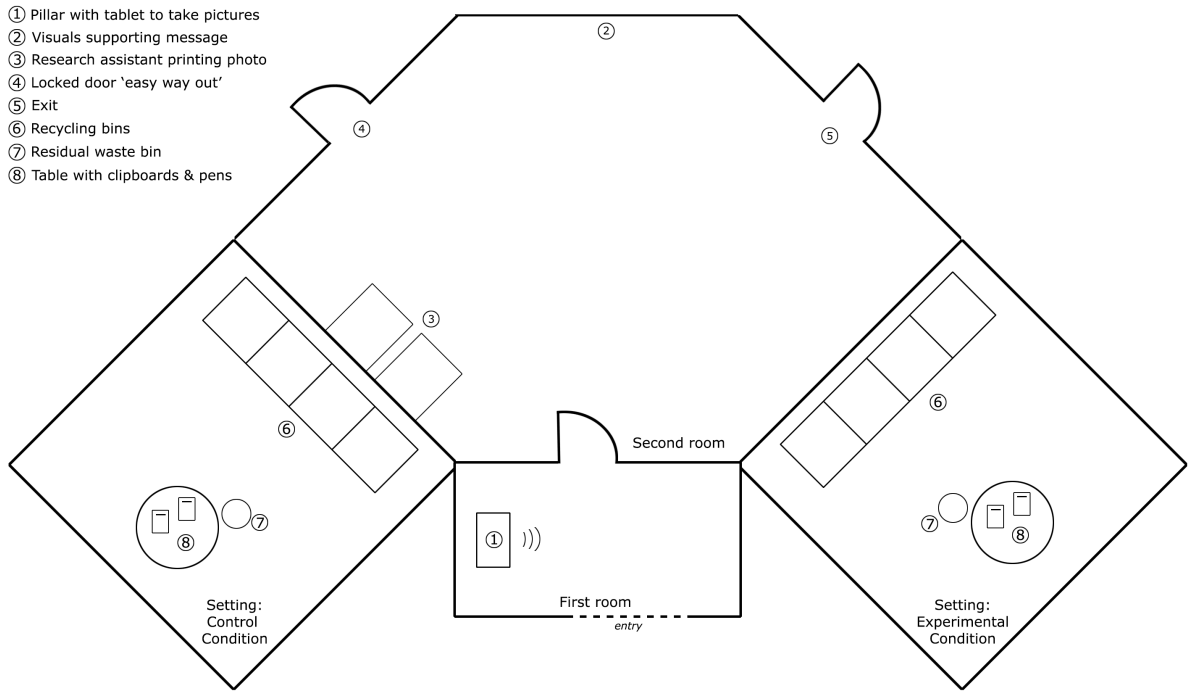

Figure 8. Floor plan of the art installation with the settings of the experimental and the control condition.

In the control condition, participants filled in all questionnaires before they entered and experienced the installation. In that way, experiencing the installation took place after filling in the questionnaires and therefore could not influence participants' responses. Again, the questionnaires were in an envelope, which participants had to open. A research assistant gave them a clipboard and a pen and another assistant observed whether and how participants disposed of their envelope. After filling in the questionnaire, participants could enter the installation and received the debriefing form upon leaving.

Hence, in the experimental condition, participants filled in the questionnaire and deposited the envelope after leaving the installation, whereas participants in the control condition filled in the questionnaire and deposited the envelope before entering the installation. The two conditions randomly varied across two times of the day (morning and afternoon). The questionnaires were filled out at different places (see Figure 8); we therefore had to relocate the bins in the two conditions. Importantly, we ensured the same setting with regard to the recycling bins in both conditions. In particular, the recycling bin was placed next to the wall of the installation; approximately 1.5 m away from a small table on which we put the pens and the clipboards that we gave to participants. In both conditions, we placed a small residual waste bin close to the table. Participants filled in the questionnaire close to the table. To avoid that the visible waste in the bins would be a confounding variable that could affect participants' recycling behaviour, we ensured that the waste in the bins was

always correctly disposed of, i.e., plastics in the plastic bin, and that a similar amount of waste was in the bins.

Measures

Environmental self-identity was measured by three items: Acting pro-environmentally is an important part of who I am; I am the type of person who acts in an environmentally-friendly way; I see myself as an environmentally friendly person (Van der Werff et al., 2013a; 2013b). The items were scored on a 7-point scale, ranging from totally disagree (1) to totally agree (7). The scale showed high internal consistency (α = .90). The mean score was computed for further analyses (*M* = 4.65, *SD* = 1.22).

Intention to engage in recycling was assessed with five items. Specifically, we asked participants to indicate to what extent they plan to recycle the following five materials in the near future: g*lass, paper and carton, textile, batteries and electrical waste* on a 7-point Likert scale (1 = never – 7 = always). Facilities to recycle these materials were present in both cities. We computed a composite score of these five materials, reflecting the intention to recycle; Cronbach's alpha was good (α = .81) and the mean score of this scale was relatively high (*M* = 5.47, *SD* = 1.38).

Intention to engage in pro-environmental behaviours was assessed with eight items. Participants were asked to indicate to what extent they plan to engage in the following eight pro-environmental behaviours on a 7-point Likert scale (1 = never – 7 = always): Showering shorter than three minutes; turning off the lights when no one is in the room; turning the heating off one hour before going to bed; turning the laptop or computer off at night instead of leaving it on stand-by; buying seasonal vegetables and fruits; eating meat at each warm meal; repairing broken items instead of throwing them away; avoiding products with unnecessary packaging. We reverse scored the item on 'eating meat at each hot meal' as it was negatively formulated, and calculated a composite score with these eight items to assess the intentions to engage in pro-environmental behaviours (α = .58, *M* = 4.36, *SD* = .83).

Recycling behaviour was measured by observing in which trash bin participants discarded the envelope. The correct disposal of the envelope in the paper bin was coded as 1, while it was coded as 0 if participants discarded the envelope in the wrong recycling bin, in the residual waste bin, or left it on the table. Overall, 32.2% recycled the envelope, whereas 67.8% did not.

5.6. Results

A Chi-square test revealed that participants in the experimental group recycled the envelope more often after experiencing the art installation (43.4%) than participants in the control group (19.7%; χ^2 (1, *N* =289) = 18.57, p < .001; φ = .25). We further found that experiencing the art installation significantly strengthened intentions to recycle (t(264) = 2.65, p < .01; *d* = .34) and intentions to engage in other pro-environmental actions (t(264) = 2.69, p < .01; *d* = .33). This suggests that participants intended to engage in more recycling and other pro-environmental behaviours after they experienced

the art installation (experimental group: recycling: *M* = 5.68; *SD* = 1.22; other pro-environmental behaviours: *M* = 4.49; *SD* = .76) than when they had not experienced the art installation yet (control condition: recycling: *M* =5.24; *SD* = 1.50; other pro-environmental behaviours: *M* = 4.22; *SD* = .88).[13] These positive effects of experiencing the art installation on actual recycling behaviour as well as on intentions support Hypothesis 1.

Yet, experiencing the art installation did not strengthen environmental self-identity (t(264) = 1.41, p = .16; $M_{experimental}$ = 4.76, $SD_{experimental}$ = 1.24; $M_{control}$ = 4.55, $SD_{control}$ = 1.19). We therefore did not test whether environmental self-identity mediated the effect of experiencing the art installation on recycling behaviour. This indicates that Hypothesis 2 was not supported.

Next, to examine whether a stronger environmental self-identity was related to stronger intentions to recycle and to engage in other pro-environmental behaviours and more recycling behaviour across the two conditions, we ran additional analysis. Table 1 shows that a stronger environmental self-identity was related to stronger intentions to recycle and to act pro-environmentally, but environmental self-identity was not significantly related to actual recycling behaviour.

Table 1. Correlations of biospheric values, environmental self-identity, intentions to recycle, intentions to engage in pro-environmental behaviours and actual recycling behaviour.

	2.	3.	4.
1. Environmental self-identity	.24**	.38**	.05
2. Intentions to recycle		.40**	.03
3. Intentions to engage in pro-environmental behaviours			-.001
4. Recycling behaviour			

Note. ** p < .01; * p < .05.

5.7. Discussion

There has been a growing interest in using design and art to encourage pro-environmental actions (Niedderer et al., 2014; Tromp et al., 2011). Yet, the question remains whether art can actually promote pro-environmental actions, as the effects of art on pro-environmental behaviour have not been systematically tested yet. We aimed to address this gap by investigating whether an art installation that is based on theorising of important motivational antecedents of pro-environmental behaviours is effective in promoting pro-environmental actions. In doing so, we followed a novel

[13] We also run the analyses separately for people who experienced the art installation alone and who experienced it in a group of people. The analyses revealed similar results. Thus, experiencing the art installation alone versus in a group did not have an effect on recycling behavior and intention to recycle and to act pro-environmentally.

interdisciplinary approach, integrating insights from art and environmental psychology. Specifically, psychologists explicated theories on factors driving pro-environmental behaviour to the artist, the artist embedded one of these theories in the design of the art installation. Next, the psychologists systematically evaluated the effect of the art installation on behaviour. We proposed that an art installation that aims at strengthening environmental self-identity, an important motivational antecedent of pro-environmental behaviours, will have a positive effect on recycling behaviour and on intentions to engage in recycling and other pro-environmental actions.

In line with our expectations, we found that people who experienced the art installation recycled more often the envelope, and showed stronger intentions to recycle and to engage in other pro-environmental actions than people who had not experienced the art installation. Importantly, we did not only find effects on intentions but also on actual behaviour. Experiencing the art installation thus promoted recycling behaviour and strengthened intentions to engage in recycling and other pro-environmental behaviours in the future, supporting our expectations that art that integrates psychological theory can lead to more pro-environmental behaviour. As such, our study provides empirical evidence that art can drive pro-environmental behavioural change (cf. Eldridge, 2014, Niedderer, 2007; Verbeek, 2010).

Yet, we did not find support for our proposed process on how the art installation affected behaviours and intentions. More precisely, whereas a stronger environmental self-identity was related to stronger intentions to recycle and to engage in other pro-environmental actions, experiencing the art installation did not strengthen one's environmental self-identity. This is an interesting finding as the artist designed the art installation with the purpose to strengthen environmental self-identity by reminding people of their past environmental behaviour. This is a strategy that proved to be effective in strengthening environmental self-identity (Van der Werff et al., 2013a; 2014a). Yet, the art installation included multiple components – experiencing it may have elicited other responses as well. As such, other factors may have played a role in encouraging participants to engage in more recycling, implying that the effect of the art installation on behaviour cannot be pinpointed to one single factor. For example, the art installation may have triggered emotional reactions (such as guilt), or increased awareness of and concern about environmental problems and concern for the future. Art is considered to express a message through stimulating emotions (Freeland, 2002). These emotional reactions can confront people with realities and stimulate them to grapple with current issues and with the role of oneself in these issues (Bertram, 2005). Research has shown that emotions are related to pro-environmental actions, including recycling (Taufik & Venhoeven, 2019; Geiger et al., 2019). An emotional reaction may have overruled the effect of the intended manipulation of environmental self-identity, or may have inhibited observers to cognitively reflect on their environmental self-identity (Petty & Cacioppo, 1986). Consequently, a possible explanation of our result may be that the art

installation particularly triggered emotional reactions among observers. Yet, we did not measure other possible process variables in the current project, as the art installation was not purposely designed to elicit these processes. Future research that aims at evaluating the effects of art on pro-environmental behaviour could also address other processes that may have been triggered by experiencing art, such as emotional processes, next to motivational and cognitive aspects like environmental self-identity in the current study.

One may argue that to test theory-based art, one would need to solely manipulate environmental self-identity and test the effect of this in a controlled experimental setting. Yet, such an approach would not allow to truly test the effect of art, as art aims at trying out new and original ways to convey a message, combining many different aspects (Freeland, 2002). This is related to a more general challenge of interdisciplinary research in which different interests do not always match and therefore compromises are needed. Different approaches and goals of artists, on the one hand, and researchers, on the other hand may complement each other but may also conflict. Artists take a holistic approach (Hekkert & Van Dijk, 2014; Niedderer, 2007), that may lead to art installations that entail many different concepts and ideas. Artists need freedom; as stringent guidelines inhibit the creative process (Hekkert & Van Dijk, 2014). Researchers seek for strong experimental control to test theories and for an understanding of underlying processes and boundary conditions of theories to work (Niedderer, 2007). As it is impossible to optimally serve both the need for freedom and the holistic approach of the artist and the need for control of the researcher. Compromises are crucial for a successful collaboration between artists and environmental psychologists. Importantly, our results suggest that art can stimulate recycling behaviour and intentions to engage in recycling and other pro-environmental behaviours, but we cannot provide a definite answer to the question on *how* and *why* art may have promoted recycling and intentions.

To our knowledge, this study is one of the first collaborations between environmental psychology and art aiming at designing art that promotes pro-environmental behaviours. Future research is needed to further test whether, how and why art can stimulate pro-environmental actions. Similar approaches could be employed to test the effects of other art pieces, based on different theories, targeting different behaviours and evaluating the short-term as well as the long-term effects on pro-environmental actions and process factors. On the basis of such new research line, design principles may be derived that can be employed by designers and artists interested in promoting behaviour change. Such insights are important to understand the potential and to increase the impact of art in stimulating pro environmental actions.

In conclusion, we found that experiencing the art installation led to more recycling behaviour afterwards as well as stronger intentions to engage in recycling and other pro-environmental behaviours in the future, supporting our expectations that art can drive behavioural change. Yet, we

did not find that the art installation strengthened environmental self-identity, suggesting that other factors and processes may have played a role in driving the effect.

5.9. Supplementary material

Figure 1. The art installation from the back-side.

Figure 2. The first room of the art installation.

Figure 3. Pillar with the tablet that took the photo of participants in the first room.

Figure 4. Second room of the art installation in which the manipulation took place.

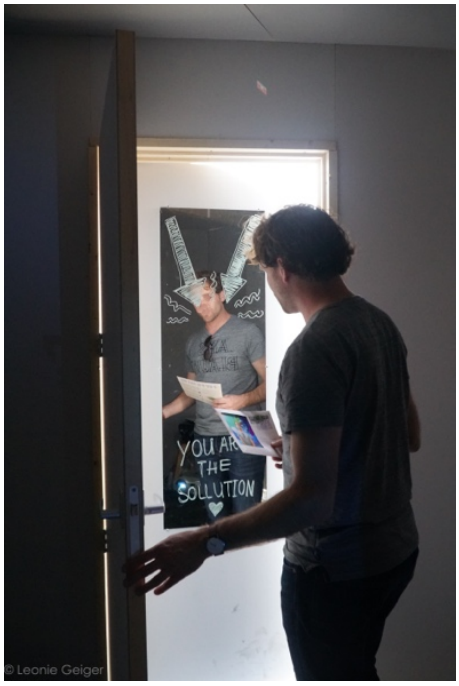

Figure 5. Exit door of the art installation with the mirror.

Figure 6. Setting of the residual and recycling bin at one side of the installation at the exit of the art installation (experimental condition).

Figure 7. Setting of the residual and recycling bin at one side of the installation at the exit of the art installation (experimental condition).

6. General discussion

To combat today's waste problems and the emerging scarcity of resources, recycling is crucial (Corsten, Worrell, Rouw, & Van Duin, 2013; European Union, 2014). Recycling is not only a technical, but also a behavioural issue, as it is crucial that consumers consistently separate the waste they produce (Kirchherr, Reike, & Hekkert, 2017). In this dissertation, we aimed to better understand which individual and contextual factors influence recycling, and to what extent they do so. Our focus was particularly on different roles contextual factors could play. We argued that a systematic examination of whether, how, and under which conditions contextual factors affect recycling behaviour is understudied. To address this gap, we examined how contextual factors influence recycling behaviour, and how contextual factors interact with individual characteristics, in particular biospheric values, in influencing recycling, using different methods. We argued that the context can influence recycling in three different ways. Specifically, Chapter 2 and 3 examined the context as a factor that can facilitate or inhibit recycling, Chapter 4 investigated whether the context can stimulate recycling by making people focus on the environment, while Chapter 5 studied whether the context can promote recycling by strengthening individual factors, in particular environmental self-identity. In this chapter, we discuss the main results and the theoretical and practical implications of our studies.

6.1. Individual and contextual factors influencing recycling behaviour

We first systematically examined the relative importance of individual and contextual factors in explaining recycling behaviour. To address this, we conducted a meta-analysis across 91 studies on recycling behaviour in Chapter 2 to identify the most robust and important factors that are related to recycling. A meta-analysis allows researchers to systematically review and synthesize the literature on recycling, thereby assessing the magnitude of the association between different factors and recycling.

Following the IFEP model (Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, Lindenberg, & Keizer, 2016), we proposed that both individual and contextual factors can influence recycling behaviour (see Figure 1). In particular, the IFEP model states that both individual and contextual factors as well as their interaction are important to consider when aiming at better understanding pro-environmental behaviours. *Individual factors* may explain why in a similar situation, one person recycles and another person does not. *Contextual factors* can be defined as characteristics of the circumstances in which recycling behaviour takes place and may explain why one person recycles in one situation, whereas s/he does not recycle in another situation. For example, a person may be more likely to recycle his or her paper waste when it is picked up regularly from the kerb than when s/he has to bring it to a paper container that is rather far away.

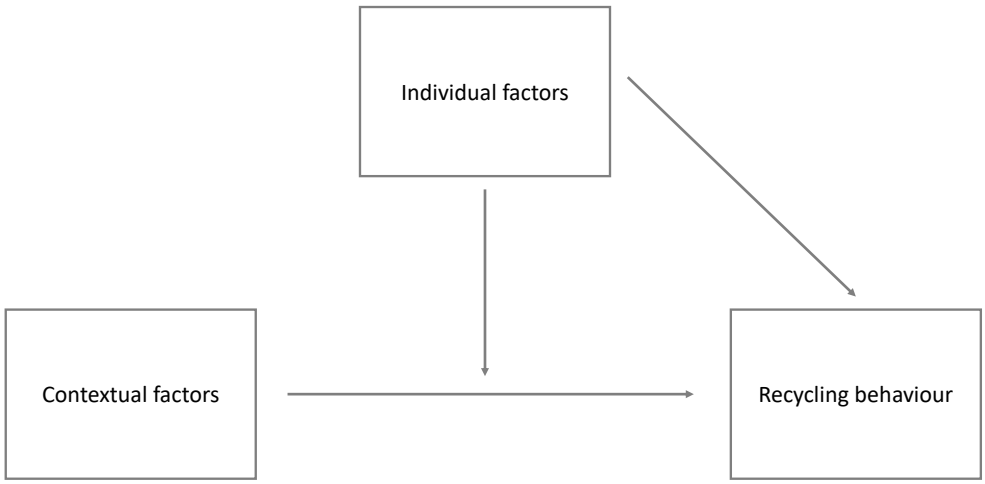

Figure 1. Conceptual model tested in this dissertation.

Individual factors. The meta-analysis revealed that different individual factors were related to recycling behaviour, including identity, past recycling behaviour, personal and social norms, perceived behavioural control, attitudes and anticipated affect. The confidence intervals around the effect sizes were relatively small, suggesting that our results were rather robust. Consistent with the compatibility principle (Ajzen, 1996), the results of the meta-analysis indicated that behaviour-specific factors, such as attitudes towards recycling, were better predictors of recycling than general predictors, such as environmental attitudes. Among the behaviour-specific factors, one's recycling self-identity and past recycling behaviour were most strongly related to recycling, suggesting that people are more likely to recycle their waste when they see themselves as the type of person who recycles, and when they did so before. Next, both personal and social (descriptive and injunctive) norms towards recycling were positively related to recycling, all showing large effect sizes. This suggests that people are more likely to recycle when they feel morally obliged to do so, and when they think that others recycle or expect them to recycle. Furthermore, a relatively higher perceived behavioural control over recycling and positive attitudes towards recycling were related to more recycling. Anticipated affect was related to recycling as well: people were more likely to recycle if they anticipated this would yield positive feelings, or if they anticipated that not recycling would elicit negative feelings. This finding highlights the fact that besides different types of motivation to recycle, emotional factors may also be important to explain recycling (Haidt, 2001; Taufik & Venhoeven, 2019; Zajonc, 1980). Interestingly, knowledge about how to recycle was less strongly related to recycling than the motivational factors we discussed above. This finding is in line with research showing that knowledge is not enough to change behaviour, people also need to be motivated to engage in pro-environmental behaviours (Hornsey, Harris, Bain, & Fielding, 2016; Ünal, Steg, & Gorsira, 2018).

Our results further suggest that all general individual factors were significantly related to recycling. Interestingly, the overall pattern of these results was comparable to those of individual factors that were assessed at the specific level. Yet, the relationships were generally weaker. A

stronger environmental self-identity appeared to be related to more recycling, reflecting that recycling is more likely the more one sees oneself as a person who acts pro-environmentally. This finding is in line with previous research revealing that environmental self-identity is an important predictor of a wide range of pro-environmental behaviours (Van Der Werff, Steg, & Keizer, 2013a; Van Der Werff, Steg, & Keizer, 2013b; Whitmarsh & O'Neill, 2010), among which recycling (e.g., Gatersleben, Murtagh, & Abrahamse, 2014; Nigbur, Lyons, & Uzzell, 2010; Peters, Van der Werff, & Steg, 2018). Biospheric values, reflecting the extent to which people generally care about nature and the environment, were also positively related to recycling behaviour. This finding is in line with previous studies that generally showed that the more strongly individuals endorse biospheric values, the more likely they are to engage in pro-environmental behaviour such as recycling (De Groot & Steg, 2007, 2008). Furthermore, descriptive norms as well as injunctive norms towards pro-environmental behaviours in general were related to recycling, with a medium effect size. People are thus more likely to recycle when they think others act pro-environmentally, or when they think others expect them to act pro-environmentally. Knowledge about environmental problems and general environmental attitudes were also positively related to recycling behaviour. Interestingly, personal norms to engage in pro-environmental behaviour were only weakly related to recycling, suggesting that general feelings of moral obligation to act pro-environmentally hardly motivate recycling. Yet, behaviour-specific factors were more studied than general factors. Hence, one should be careful to draw strong conclusions based on these findings. Particularly the relationships between general social norms (descriptive and injunctive social norms), personal norms and recycling should be interpreted with care as they were only based on two studies.

Importantly, our results suggest that recycling not only depends on individual costs and benefits, as reflected in attitudes and perceived behaviour control, but also on moral, environmental and social costs and benefits, as reflected in environmental self-identity, values and personal and social norms. This is in line with other research showing that pro-environmental behaviour is not primarily motived by individual costs and benefit considerations, but that social norms, and normative and environmental concerns play a key role (e.g., Steg et al., 2014; Steg, Perlaviciute, & Van der Werff, 2015; Whitehead & Cherry, 2007).

Contextual factors. The meta-analysis further showed that contextual factors were consistently related to recycling. More precisely, our meta-analysis revealed that the possession of a recycling bin was relatively strongly related to more recycling. The size of the neighbourhood and the distance to a drop-off location were also, although less strongly, related to recycling: bigger neighbourhoods and longer distances to drop-off stations reduce the likelihood of recycling. Interestingly, the recycling facilities in place were not significantly related to recycling. House ownership and house type were relatively weakly related to recycling, with a small to medium effect

size, suggesting that that these factors are less relevant for recycling. Specifically, people owning a house are somewhat more likely to recycle than those renting a house, while people living in a single-family house are somewhat more likely to recycle compared to people living in an apartment.

Building on the results of the meta-analysis, we developed three empirical follow-up papers. In these papers, we particularly addressed three points that the meta-analysis revealed to be important to consider. In particular, the number of studies including contextual factors was low and the confidence intervals of the effect sizes were rather large, suggesting that we can be less confident about the relationship between contextual factors and recycling. In view of this result, we systematically examined whether, how, and under which conditions contextual factors affect recycling behaviour. Particularly, as will be further explained below, we tested three possible ways of how contextual factors may affect recycling in Chapter 3, 4, and 5.

Next to the direct relationships between either individual or contextual factors and recycling behaviour, the IFEP model (Steg et al., 2014; Steg et al., 2016) suggests that individual and contextual factors may also interact in influencing recycling behaviour (see Figure 1). Interestingly, the interplay between individual and contextual factors has hardly been studied, with a few exceptions (Best & Kneip, 2011; Tabernero, Hernández, Cuadrado, Luque, & Pereira, 2015; Vining & Ebreo, 1992). Studying the interplay of individual and contextual factors may reveal under which conditions individual and contextual factors are most likely to affect recycling. In Chapter 3 and 4, we proposed and tested whether and how individual and contextual factors interact in influencing recycling behaviour (see Figure 1). Specifically, we aimed to address this gap in the literature by examining the interplay of different contextual factors and biospheric values as an individual factor in Chapter 3 and 4.

Moreover, the results of the meta-analysis revealed that recycling is operationalized in different ways and that relationships between individual and contextual factors and recycling may vary depending on the conceptualisation of recycling. Specifically, intentions to recycle seem to be better explained than self-reported recycling and particularly better than observed recycling behaviour. This result may point to an intention-behaviour gap, suggesting that motivation is more likely to be related to intentions than to actual behaviour (Kollmus & Agyeman, 2002). This suggests that future research should clearly distinguish between the different outcome variables as this may lead to different results. Moreover, it highlights the importance of not only studying intentions to recycle and self-reported recycling behaviour but that it is essential to also assess actual recycling behaviour. In response to this finding, we examined actual recycling behaviour in all three empirical chapters next to intentions to recycle and self-reported recycling behaviour.

In three empirical articles, we addressed the points that need more attention based on the meta-analysis by examining different ways in which contextual factors can influence recycling, and

whether effects of contextual factors depend on individual factors, particularly biospheric values. We tested this across different indicators of recycling. In the following, we will describe the main findings of these studies and the implications for theory and practice.

6.2. Perceived feasibility of recycling

We proposed that the first way of how the context may influence recycling behaviour is by facilitating or inhibiting recycling behaviour. In this respect, the collection system in place may be a relevant contextual factor (Derksen & Gartrell, 1993; Best & Kneip, 2011; Best & Kneip, 2019). We reasoned that particularly people's perceptions of the ease of using the collection system are likely to affect their recycling behaviour (cf. Weber, 2018). Specifically, we proposed that the perceived ease to use the collection system affects recycling behaviour indirectly, via the perceived feasibility of recycling, which reflects the perceived ability to recycle (cf. IPCC, 2018) and the perceived ease of recycling (Rodgers, Conner, & Murray, 2008; see Figure 2).

We further reasoned that perceived feasibility to recycle interacts with biospheric values in affecting recycling behaviour (see Figure 2). Specifically, we tested whether the low-cost hypothesis (Diekmann & Preisendörfer, 2003) versus the A-B-C model (Guagnano, Stern, & Dietz, 1995; Stern, 2000) is more plausible in explaining the interaction effect between perceived feasibility of recycling and biospheric values on recycling behaviour. The low-cost hypothesis proposes a linear relationship between biospheric values and recycling, with the relationship becoming stronger with increasing perceived feasibility of recycling. That is, biospheric values would be more strongly related to recycling, the more feasible people perceive recycling to be. In contrast, the A-B-C model proposes a curvilinear relationship between biospheric values and recycling behaviour, with the relationship being strongest when recycling is perceived as moderately feasible. When recycling is perceived as very feasible, people would recycle anyway, irrespective of the strength of their biospheric values. If recycling is perceived as very unfeasible, individuals would generally not recycle, irrespective of their endorsement of biospheric values. We tested our reasoning in two questionnaire studies conducted in three municipalities with different collection systems, thereby focusing on different waste streams, including paper, glass, plastics and organic waste, as well as on recycling behaviour in general. We collected data on self-reported recycling and on actual recycling behaviour, that is, the total amount of organic waste recycled.

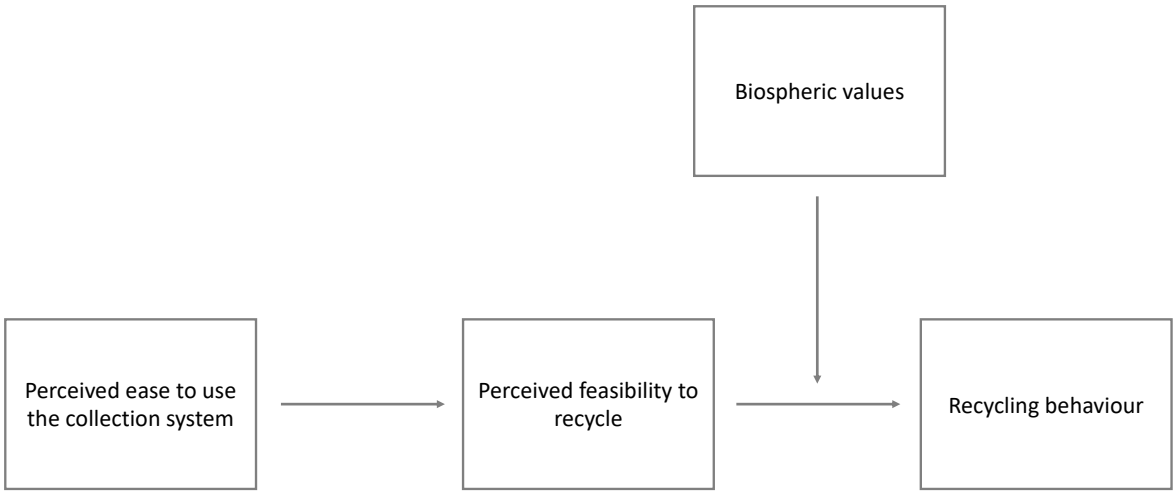

Figure 2. Conceptual model tested in Chapter 3

In line with our expectations, we found that the perceived ease to use the collection system was indirectly related to recycling behaviour via perceived feasibility to recycle. Specifically, the easier one perceived the collection system to use, the more feasible one perceived recycling to be, which in turn was associated with more recycling. This result implies that the perception of the context, in this case the perceived ease to use a collection system, may affect the perception of the feasibility of the corresponding behaviour, which in turn influences the behaviour. We found this relationship for both indicators of perceived feasibility to recycle, namely for the perceived ability to recycle (Study 1) and for the perceived ease to recycle (Study 2). Notably, we found similar results in two cities with different collection systems, thereby examining different waste streams, including paper, glass, plastics and organic waste and recycling behaviour in general. This indicates that our results are rather robust. The results suggest that it is important to consider individuals' *perceptions* of the context, in this case the ease to use the collection system. Indeed, within the same collection system, individuals seem to perceive the ease to use the collection system differently, which, in turn, leads to different recycling behaviours.

Interestingly, the perceptions of the ease to use the collection system and the feasibility to recycle were only weakly related to biospheric values, suggesting that how people perceive the context does not depend on people's motivation to recycle. This is an important contribution to the literature. As differences in perceptions of the ease of using the collection system do not seem to be strongly rooted in individual factors, notably biospheric values, an interesting question for future research is to investigate why these differences in perceived feasibility of recycling occur.

Furthermore, both studies revealed an interaction effect between perceived feasibility to recycle and biospheric values on recycling behaviour, in addition to the main effects of perceived feasibility to recycle and biospheric values. In both studies, stronger biospheric values seemed to particularly promote self-reported recycling behaviour when recycling was not perceived as very

feasible. When recycling was perceived as very feasible, individuals recycled irrespective of the strength of their biospheric values. These results do not support the low-cost hypothesis (Diekmann & Preisendörfer, 2003), articulating that the predictive power of biospheric values would become stronger when perceived feasibility to recycle increases. At a first glance, the findings do not seem to support the A-B-C model either (Guagnano et al., 1995; Stern, 2000), which articulates a curvilinear U-shaped relationship with biospheric values and recycling. Specifically, the A-B-C model predicts that the relationship is strongest when one perceives recycling as moderately feasible. Yet, a careful examination of the mean scores of perceived feasibility indicated that our findings may support the A-B-C model. Notably, the mean scores of perceived feasibility to recycle were rather high in both studies. Participants generally perceived recycling of all types of waste as rather feasible, and only a few participants indicated to perceive recycling as not very feasible. One may therefore argue that our data do not allow to draw conclusions about the relationship between biospheric values and recycling behaviour when people perceive recycling as rather unfeasible. As such, our findings support one half of the U-shaped function of the A-B-C-model, namely that biospheric values were not significantly related to recycling when recycling was perceived as very feasible, but they were related to recycling when it was perceived as moderately feasible, thus towards the middle range of the feasibility continuum. Our results are in line with a study on the relationship between personal norms and acceptability of car-reduction policies, suggesting that personal norms, a different individual factor, are not significantly related to acceptability of these policies when the policy implies very low costs for the individual, while personal norms are significantly related to policy acceptability when the policy implies moderate costs for the individual (Keizer, Sargisson, Van Zomeren, & Steg, 2019).

Interestingly, we could not replicate our results for actual recycling behaviour, in particular the total amount of organic waste collected. Specifically, neither the perceived ease to use the collection system nor the perceived feasibility to recycle and biospheric values were related to the total amount of organic waste recycled. The finding is in line with previous literature suggesting that it is easier to predict self-reported recycling behaviour than actual recycling behaviour (cf. Kollmus & Agyeman, 2002; Geiger et al., 2019). Yet, a more plausible explanation could be that the indicator we used to measure actual recycling behaviour was not ideal. Notably, we used the weight of organic waste participants disposed of as an indicator of recycling, assuming that the more organic waste one discarded, the more pro-environmental a person is. Yet, the total amount of organic waste recycled does not account for waste prevention behaviour, which is generally considered as more sustainable than recycling behaviour (European Union, 2015; Price & Joseph, 2000). Using the weight of organic waste assumes that the more waste individuals dispose of, the better they recycle. Yet, more organic waste may not always mean that one is more pro-environmental, as more organic waste may mean that one has thrown away more food, implying that one has acted in a more environmentally harmful

way. Similarly, individuals may have composted their waste rather than disposing of it in an organic collection system, which is also more pro-environmental.

6.3. Packaging design making people focus on the environment

In Chapter 4, we tested a second approach of how the context may influence recycling behaviour, namely by making people focus on the environment. We proposed that a packaging design can affect recycling by making people focus on the environment. Research on design for behaviour change had shown that design can drive socially desirable behaviour change (Tromp, Hekkert, Verbeek, 2011; Tromp & Hekkert, 2016; Niedderer et al., 2014), but little is known about why and under which conditions behaviour change is most likely. We proposed that a sustainable packaging design may not only affect purchase behaviour, as revealed in previous research (Magnier & Schoormans, 2017; Magnier, Schoormans, & Mugge, 2016, Pancer, McShane, & Noseworthy, 2015; Steenis, Van Herpen, Van der Lans, Ligthart, & Van Trijp, 2017), but may also stimulate recycling. We tested our reasoning in three studies. We conducted two online studies among a student and a general sample of the Dutch population to examine the main and interaction effects of packaging design and biospheric values on likelihood of recycling. Moreover, we conducted a field experiment in which we tested the effects of packaging design and biospheric values on actual recycling behaviour. To develop the packaging, we worked closely together with designers. We explained our theoretical reasoning to these designers, in particular, that we expect that a packaging design can affect recycling by making people focus on the environment. The designers translated our theoretical input into packaging designs that are aimed at making individuals focus on the environment.

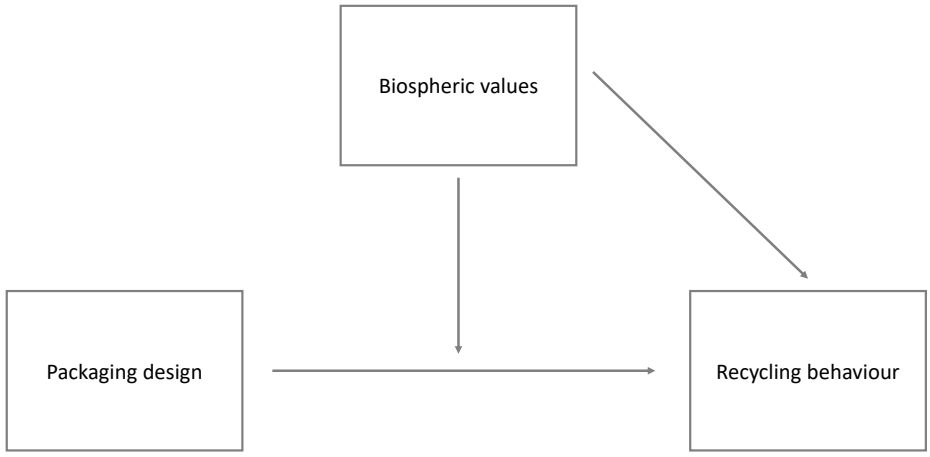

Figure 3. Conceptual model tested in Chapter 4

Our results suggest that packaging design can encourage pro-environmental behaviour, in our case recycling, when it makes people focus more on the environment, particularly when people moderately strong to strongly endorse biospheric values. However, we did not find this effect for the biscuit package, in which case the environmental designs were adjustments of the existing packaging. Yet, we found a significant effect of the environmental design on both likelihood and actual recycling

of the cup. In this case, we used novel designs rather than adjusting an existing design. It is therefore likely that the effects are more likely to occur among novel packages and products that people are unfamiliar with. Adjusting existing designs of familiar products and packages may not be as effective in making people focus on the environment. Future research is needed to test whether using a novel design is indeed more successful in making people focus on the environment and if so, why this is the case. We suggest to particularly examine the role of novelty and familiarity with the package and the product in this process.

As the effect of the packaging design of the cup on recycling was more pronounced among individuals with moderately strong to strong biospheric values, it seems as if the environmental design of the cup succeeded in making people focus more on the environment, whereas the biscuit package did not. In case of the cup, participants with moderately strong to strong biospheric values now acted more in line with their values. Our results partly support the IFEP model (Steg et al., 2014; Steg et al., 2016), suggesting that contextual factors, including design, can make people focus on the environment, thereby promoting pro-environmental behaviours, amongst these recycling. Our results suggest that design particularly stimulates recycling when the design used is novel. Yet, we did not find consistent support for our notion that biospheric values are related to more recycling. Future research could examine the role of biospheric values in the process of making people more focused on the environment.

Interestingly, the interaction effect of packaging design and biospheric values on recycling was not curvilinear. Particularly, the effect of packaging design was more pronounced among participants with moderately strong to strong biospheric values. This is an interesting finding as we expected the effect to be particularly pronounced among individuals with moderately strong biospheric values and less when people weakly or strongly endorse biospheric values. A possible explanation may be that as not all to-go cups can be consistently recycled due to the different materials used in the packaging, also individuals with strong biospheric values may have needed a prompt that the cup can be recycled. Future research could investigate under which conditions the interaction effect of packaging design and biospheric values is curvilinear and under which conditions the effect is linear. In this article, we tested the effect of packaging design that makes people focus on the environment and whether the likelihood of recycling depends on biospheric values via moderation. As we did not include any process variables, we can only assume that the packaging design made people focus on the environment. Future research could investigate if environmental packaging designs indeed make people focus more on the environment, by using both implicit and explicit measures of the extent to which they make people focus on the environment.

The effect of the cup was not only found on self-reported recycling but also on actual recycling. This is an important finding as research usually finds that it is more difficult to predict actual behaviour

than self-reported (recycling) behaviour (Geiger, Steg, Van der Werff, Ünal, 2019; Kollmus & Agyeman, 2002). This suggests that our results are rather robust as they hold across different operationalisations of recycling, namely across self-reported and actual recycling in a natural setting. If anything, the effect seemed to be even stronger for actual recycling behaviour in Study 3 than for self-reported behaviour in Study 2. A reason for this may be that participants make a deliberate choice in a questionnaire. Consequently, also participants in the control condition may have become aware of the importance of recycling. Hence, they indicated more frequently that they would recycle the package. In a real-life situation, on the contrary, the importance of recycling may have been easily forgotten or overseen in situations similar to the control condition as participants were not asked to recycle the package. More research on self-reported and actual recycling behaviour is needed to unravel this interesting finding.

Our study extends previous research on design for behaviour change as it does not only show that a packaging design can promote recycling behaviour, but we potentially reveal how and under which conditions design can stimulate recycling by developing theory-based designs and systematically testing the impact of such designs on recycling behaviour. In particular, design may make people focus on the environment, particularly when people moderately strongly to strongly endorse biospheric values and particularly when the packaging design is novel. A second way in which the context may influence recycling is therefore by making people focus on the environment.

6.4. Art strengthening individual factors

A third way of how the context may affect recycling behaviour is by strengthening individual factors. As a case in point, we examined the effect of experiencing an art installation that aimed to strengthen environmental self-identity and thereby to promote recycling behaviour. There has been a growing interest in using design and art to encourage pro-environmental actions (Niedderer et al., 2014; Tromp, Hekkert, & Verbeek, 2011). Yet, the question remains whether art can actually promote pro-environmental behaviour, as the effects of art on behaviour have not been systematically tested. We aimed to address this gap by examining whether art can stimulate pro-environmental actions, particularly recycling behaviour. Specifically, we aimed to test whether an art installation that is based on scientific theory on how to stimulate pro-environmental actions is effective in promoting such actions. In doing so, we followed a novel interdisciplinary approach, integrating insights from art and environmental psychology. Specifically, we as psychologists explicated different theories on factors driving pro-environmental behaviour to an artist and decided together to focus on environmental self-identity. The artist embedded this theory in the design of the art installation. The artist included other aspects as well, which were related to other theories we explained. Next, we systematically evaluated the effect of the art installation on behaviour. We proposed that an art installation that aims at strengthening environmental self-identity, an important motivational antecedent of pro-

environmental behaviours, will have a positive effect on actual recycling behaviour and on intentions to engage in recycling and other pro-environmental behaviours.

Figure 4. Conceptual model tested in Chapter 5

The installation was placed on crowded public squares in two Dutch cities during two weekends and was advertised as a selfie-booth. Participants could take a free photo in the first room. The aim of letting participants take a free photo was to sensitize participants to their own identity (e.g., Beaman, Klentz, Diener, & Svanum, 1979; Wicklund & Duval, 1971). Thereafter, the main manipulation took place in the second room. In this room, among others, participants were reminded of their own past pro-environmental behaviours. A child's voice mentioned several common pro-environmental behaviours that participants have possibly engaged in. We expected that reminding them of the pro-environmental behaviours they have been doing would strengthen their environmental self-identity (Van der Werff, Steg, & Keizer, 2014a, 2014b).

In line with our expectations, we found that people who experienced the art installation recycled more and showed stronger intentions to recycle and to engage in other pro-environmental behaviours than people who had not experienced the art installation. Importantly, we did not only find these effects on intentions but also on actual recycling behaviour. As such, our study provides empirical evidence that art can drive pro-environmental behavioural change (cf. Eldridge, 2014, Niedderer, 2007; Verbeek, 2010).

Yet, we did not find support for our proposed process on how the art installation affected behaviours and intentions. More precisely, a stronger environmental self-identity was related to stronger intentions to recycle and to engage in other pro-environmental actions, yet, experiencing the art installation did not strengthen one's environmental self-identity. This is an interesting finding as the artist designed the art installation with the purpose to strengthen environmental self-identity by reminding people of their past environmental behaviour. This is a strategy that proved to be effective in strengthening environmental self-identity (Van der Werff, Steg, & Keizer, 2014a, 2014b). However, the art installation included multiple components, hence, it may have elicited other processes as well. As such, different factors may have played a role in encouraging participants to engage to recycle, implying that the effect of art on behaviour cannot be pinpointed to one single factor. For example, experiencing the art installation may have triggered emotional reactions, or increased awareness of and concern about environmental problems and concern for the future. More generally, art is considered to express a message through stimulating emotions (Freeland, 2002), and such emotional

responses may have promoted recycling as well. Yet, we did not measure such alternative process variables in the current project, as the art installation mainly aimed at strengthening environmental self-identity. We wanted to keep the questionnaire as short as possible, therefore, we purposely did not include other possible items that were not part of our theoretical reasoning. We advise future research that aims at evaluating the effects of art on pro-environmental behaviour to also address other processes that can be triggered by art, such as emotional processes, next to motivational and cognitive aspects such as environmental self-identity.

In conclusion, we found that experiencing the art installation led to more actual recycling behaviour as well as to stronger intentions to engage in recycling and other pro-environmental behaviours in the future, supporting our expectations that art can drive behavioural change. Yet, we did not find that the art installation strengthened environmental self-identity, suggesting that other factors and processes may have played a role in driving the effect.

6.5. Theoretical implications and future directions

The results of this PhD dissertation highlight the importance of the context in explaining recycling behaviour. Next to individual factors, we showed that it seems crucial to consider the context when studying recycling behaviour and identified three different ways of how the context can influence recycling behaviour. In particular, the context can affect recycling by facilitating or inhibiting recycling, by making people focus on the environment and potentially by strengthening individual factors that promote recycling. Our studies suggest that it is particularly important to consider the psychological implications of contextual factors for an individual. Not contextual factors as such are important when explaining recycling behaviour but how individuals perceive these factors.

We only studied a limited set of contextual factors, namely the collection system as a factor that facilitates recycling, packaging design as a factor that makes people focus on the environment and an art installation as a factor that could strengthen individual factors. Future research could examine to what extent other contextual factors can facilitate recycling, make people focus on the environment or can strengthen individual factors. With respect to factors facilitating or inhibiting recycling, the recycling facilities people have in their homes to recycle may be a relevant contextual factor to investigate. Additionally, a packaging design that clearly conveys that it can be recycled may also facilitate recycling. Concerning contextual factors that make people focus on the environment, not only a packaging design but also recycling bins may induce the focus on the environment. Other relevant contextual factors next to an art installation that may strengthen individual factors may be a packaging design or a recycling bin. In particular, the design of a packaging or of a recycling bin may creatively be adjusted in a way that it strengthens individual factors. Testing the different processes of how the context can affect recycling behaviour with different contextual factors may allow to draw firmer conclusions regarding the robustness and the generalizability of our results that the context is

crucial to consider when explaining recycling behaviour. Furthermore, we only focused on strengthening environmental self-identity as an individual factor that may be strengthened via the context. Future research could test whether the context can also affect other individual factors that are related to recycling, such as personal norms. Moreover, future research may also test the effects of different contextual factors based on different theories, targeting different pro-environmental behaviours and including multiple process variables in the questionnaire.

We investigated the interaction between individual and contextual factors, but one may also argue that different contextual factors interact with each other. The A-B-C model (Guagnano et al., 1995; Stern, 2000) proposes that individual factors are particularly related to recycling when recycling is perceived as moderately feasible, thus in the middle range of the feasibility continuum. In future research, it may be interesting to investigate whether the influence of contextual factors that make people focus on the environment also depends on the level of perceived feasibility. One may argue that contextual factors that make people focus on the environment are particularly successful in promoting recycling when recycling is in the in the middle range of the feasibility continuum. That is, when recycling is perceived as moderately feasible. When recycling is perceived as very feasible or very unfeasible, one may expect that the perceived feasibility has a strong direct influence on recycling behaviour. When recycling is perceived as very feasible, one may expect most people to recycle and when recycling is perceived as very unfeasible, one may expect that hardly no one recycles. Consequently, at the lower or upper end of the feasibility continuum, contextual factors that make people focus on the environment could be of little added value. Yet, when recycling is perceived as moderately feasible, contextual factors that make people focus on the environment may affect to what extent someone recycles or not. Future research could test whether perceived feasibility and other contextual factors, such as contextual factors that make people focus on the environment interact.

The meta-analysis revealed that individual and contextual factors were more strongly related to intentions to recycle than to self-reported recycling and particularly compared to actual recycling behaviour. To examine this further, we included in all three empirical chapters different indicators of recycling, including actual behaviour. The aim to also include measures of actual recycling behaviour next to intentions and self-reported recycling was to cross-validate our findings with different indicators. Overall, we could find similar results across different indicators of recycling, suggesting that similar individual and contextual factors explain intentions to recycle, self-reported and actual recycling behaviour. This implies that our results do not support the notion and the result of the meta-analysis that intentions can be better explained than actual recycling behaviour.

In Chapter 4 and 5, we followed a novel interdisciplinary approach, notably integrating insights from design, art and environmental psychology, by explicating assumptions on which factors drive pro-environmental behaviour and by embedding this in the packaging designs and in the art installation,

and systematically evaluating the effect of these on recycling behaviour. Integrating scientific theory into design and art, and evaluating the impact of the packaging designs and the art installation can contribute to a better understanding of the extent to which, how and why design and art can promote pro-environmental actions. As far as we know, we initiated one of the first collaborations between designers, artists and environmental psychologists, and showed that design and art are effective ways to stimulate recycling behaviour. Yet, interdisciplinary research projects like ours may imply a challenge as interests and approaches of different disciplines do not always match and therefore compromises are needed. Specifically, different approaches and goals of designers and artists, on the one hand, and researchers, on the other hand may complement each other but may also conflict. For example, artists take a holistic approach (Hekkert & Van Dijk, 2014; Niedderer, 2007), that may lead to designs and art pieces that entail many different concepts and ideas. Designers and artists need freedom, as stringent guidelines inhibit the creative process (Hekkert & Van Dijk, 2014). Researchers typically seek for strong experimental control to test theories (Niedderer, 2007). One may argue that to test theory-based art, one would need to solely manipulate environmental self-identity and test the effect of this in a controlled experimental setting. Yet, such an approach would not allow to truly test the effect of art, as art aims at trying out new and original ways to convey a message, combining many different aspects (Freeland, 2002).

In two chapters, we showed the positive effects of design and art on recycling behaviour. However, replications of these effects are needed in future research to be able to generalize our results. Environmental psychologists could initiate interdisciplinary collaborations with designers and artists to test the effects of other designs and art pieces, based on different theories, targeting different behaviours and evaluating the short-term as well as the long-term effects of these designs and art pieces on pro-environmental actions. On the basis of such research, design principles can be derived that can be employed by designers and artists interested in promoting behaviour change. Such insights are important to understand the potential and to increase the impact of design and artistic interventions in stimulating pro-environmental actions.

6.6. Practical implications

Our studies provide important suggestions for campaign and policy makers aiming at promoting recycling behaviour. Across four chapters, we found that next to individual factors, also contextual factors can influence recycling behaviour. This result implies an important potential for policy as many contextual factors may be readily changed, thereby influencing recycling. Our results suggest that changing the context can stimulate individuals' recycling behaviour in three different ways.

First, practitioners could implement good recycling facilities as to enhance the perceived feasibility of recycling. For instance, they could simply make the use of the collection system as easy

as possible. A recent meta-analysis indeed found that recycling can be promoted by establishing collection systems that are easier and more convenient to use (Varotto & Spagnolli, 2017), for example by increasing the frequency of collecting recycled waste from people's homes (Best & Kneip, 2011) or shortening the distance to drop-off location stations (Hage, Söderholm, & Berglund, 2009; Lange, Brückner, Kröger, Beller, & Eggert, 2014). This, in turn, increases the likelihood that people experience the use of the collection system as easier and eventually perceive recycling as more feasible, which should lead to more recycling. Second, as perceptions of the collection system seem to matter, practitioners could ensure that individuals' perceptions of the ease of using a collection system are accurate. For this, communication strategies may be applied that aim at making people aware of the ease of using the collection system, such as easily accessible information on pick-up times of waste or on the nearest drop-off location.

Yet, there may be situations in which it is not possible to make the use of the collection system easier as there may be structural or economic constraints that cannot be easily overcome. For example, introducing more pick-up times or more bins can be rather costly. In situations in which it is not easy to further facilitate recycling and in situations in which people generally perceive recycling as not very feasible, our results suggest that interventions could target individual factors such as biospheric values, environmental and recycling self-identity, personal- and social norms towards recycling. Stronger biospheric values seem to be particularly related to recycling behaviour in situations in which recycling is perceived as moderately feasible. The question remains which interventions can be effective in strengthening biospheric values as biospheric values form in early childhood and thereafter are relatively difficult to change (Steg, 2016). However, as many people rather strongly endorse biospheric values (Bouman & Steg, 2019), interventions could be implemented that make people focus on their biospheric values, thereby supporting people's biospheric values and increasing the likelihood that they act upon their biospheric values. This can be done by stressing the positive consequences of recycling for the environment, thus strengthening the extent to which recycling is associated with benefits for the environment (cf. Steg et al., 2014; Ruepert et al., 2017). Indeed, the results of Chapter 4 suggest that design, such as a packaging design, can be developed in a way that it makes people focus more on the environment. Practitioners may also change other cues with the aim to make people focus on the environment, such as the design of recycling bins. The design of these bins, for example, may stress the positive consequences of recycling for the environment. This, in turn, may lead to more recycling. Interestingly, making people focus on the environment seems to be particularly successful when people moderately strongly to strongly endorse biospheric values. This implies a great opportunity as a design that aims at making people focus on the environment does not only lead to more recycling among individuals with strong biospheric values who generally are more likely to engage in pro-environmental behaviours anyway, but also among people with

moderately strong biospheric values who do not consistently engage in recycling and other pro-environmental behaviours. Hence, practitioners can promote recycling by making people focus on the environment also among individuals who do not consistently engage in recycling.

A third way of how practitioners may promote recycling behaviour may be to use new ways to convey a message, such as using art. A characteristic of art is that art is not restricted to familiar notions, art can create original and new ways to convey a message (Freeland, 2002), and there the power of art lies. Practitioners can place art pieces, such as an art installation, in public space and passers-by can experience these. Extending this approach, practitioners may also design art pieces that individuals can put in their houses – the place where most of the recycling takes place. In that way, art can encourage recycling in daily life as people would be exposed to the art pieces whenever they need to recycle at home. Examples of art to promote recycling at home may be redesigned recycling bins or redesigned recycling facilities on the streets. For creating such art pieces, a collaboration between artists and environmental psychologists may be of added value. Besides the aesthetic aspects that the artist can bring in the design, the art installation could integrate scientific theory on important antecedents of pro-environmental behaviours.

6.7. Conclusion

Following the notion of the IFEP model (Steg et al., 2014; Steg et al., 2016), we proposed that both individual and contextual factors and their interaction can influence recycling behaviour. We first conducted a meta-analysis to examine the relative importance of individual and contextual factors on recycling and found that both individual and contextual factors are relevant in explaining recycling. However, contextual factors and their interaction with individual factors were understudied. To address this gap, we studied three ways of how contextual factors can influence recycling behaviour. First, we addressed whether the context can influence recycling by facilitating or inhibiting recycling. In this respect, we examined individuals' perceptions of the ease to use the collection system. We found that the easier individuals perceived the collection system to use, the more feasible they perceived recycling to be, which led to more recycling. Biospheric values particularly influenced recycling when recycling was perceived as not very feasible. Second, we argued that the context can influence recycling by making people focus on the environment. We found that a packaging design that made people focus on the environment could stimulate recycling behaviour, particularly among individuals with moderately strong to strong biospheric values and particularly when novel designs were used. Third, we reasoned that the context can stimulate recycling by strengthening individual factors and found that an art installation that aimed to strengthen environmental self-identity promoted recycling behaviour. Yet, we could not find support for our proposed underlying process, suggesting that the art installation may have triggered other motivational processes, such as emotions. In summation, this dissertation studied three ways of how contextual factors can influence recycling.

By systematically investigating the influence of contextual factors and their interaction with biospheric values, this dissertation addresses an important gap in existing literature on recycling and highlights the importance of considering contextual factors in explaining recycling behaviour, next to individual factors.

7. Nederlandse samenvatting

Recycling is belangrijk om afvalproblemen en schaarste aan grondstoffen te verminderen (Corsten, Worrell, Rouw, & Van Duin, 2013; Europese Unie, 2014). Recycling is niet alleen een technisch, maar ook een gedragsprobleem, omdat het cruciaal is dat consumenten hun afval consequent scheiden (Kirchherr, Reike, & Hekkert, 2017). In dit proefschrift hebben we geprobeerd beter te begrijpen welke individuele en contextuele factoren van invloed zijn op recycling, met speciale aandacht voor de verschillende rollen die contextuele factoren kunnen spelen. We betoogden dat systematisch onderzoek naar hoe en onder welke omstandigheden contextuele factoren het recyclinggedrag beïnvloeden, onderbelicht is gebleven. Om deze leemte op te vullen, hebben we onderzocht hoe contextuele factoren het recyclinggedrag beïnvloeden, en in welke mate het effect van contextuele factoren op recycling afhangt van individuele factoren, in het bijzonder van biosferische waarden. We stelden dat de context recycling op drie verschillende manieren kan beïnvloeden. Ten eerste kan de context een factor zijn die recycling gemakkelijker of moeilijker kan maken. Ten tweede hebben we onderzocht of de context recycling kan stimuleren door mensen meer te laten focussen op het milieu. Ten derde hebben we onderzocht of de context recycling kan bevorderen door het versterken van de invloed van individuele factoren, in het bijzonder van de milieu-identiteit.

Individuele en contextuele factoren die recyclinggedrag beïnvloeden

Op basis van het IFEP-model (Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, Lindenberg, & Keizer, 2016) veronderstelden we dat zowel individuele als contextuele factoren, en de interactie tussen beide, recycling kunnen beïnvloeden. Individuele factoren kunnen verklaren waarom in een vergelijkbare situatie de ene persoon wel en de andere niet recyclet. Contextuele factoren kunnen verklaren waarom een persoon in de ene situatie wel en de andere niet recyclet. We hebben eerst een meta-analyse uitgevoerd om systematisch na te gaan wat het relatieve belang van individuele en contextuele factoren is bij het verklaren van het recyclinggedrag.

Individuele factoren. Uit de meta-analyse bleek dat verschillende individuele factoren samenhangen met recyclinggedrag, waaronder (recycling- en milieu-)identiteit, biosferische waarden, recyclinggedrag uit het verleden, persoonlijke en sociale normen, waargenomen gedragscontrole, houdingen, en geanticipeerde emoties. In overeenstemming met het compatibiliteitsprincipe (Ajzen, 1996) gaven de resultaten van de meta-analyse aan dat gedragsspecifieke factoren, zoals de houding ten opzichte van recycling, betere voorspellers waren voor recycling dan algemene voorspellers, zoals de houding ten opzichte van het milieu.

Contextuele factoren. De meta-analyse toonde verder aan dat contextuele factoren, zoals het bezit van een recyclingbak, de grootte van de wijk en de afstand tot afvalcontainers, samenhangen met recycling: mensen recyclen meer als ze in bezit van een recyclingbak zijn, als ze in een kleine wijk

wonen, en als de afstand tot afvalcontainers kleiner is. De aanwezigheid van recycling faciliteiten, of men een woning bezit of huurt, en het type woning hingen echter niet sterk samen met recycling.

Voortbouwend op de resultaten van de meta-analyse hebben we in drie hoofdstukken empirische studies uitgevoerd. In deze studies hebben we ons vooral gericht op de invloed van contextuele factoren op recycling en of de effecten van contextuele factoren afhankelijk zijn van individuele factoren, in het bijzonder van biosferische waarden, omdat de meta-analyse heeft aangetoond dat de invloed van contextuele factoren en hun interactie met individuele factoren in de literatuur over recycling onderbelicht zijn gebleven.

Context als factor die recycling mogelijk maakt of belemmert

De eerste manier waarop de context recyclinggedrag kan beïnvloeden is door recycling gemakkelijker of moeilijker te maken. In dit verband hebben we de invloed van het gebruiksgemak van een inzamelingssysteem onderzocht (Derksen & Gartrell, 1993; Best & Kneip, 2011; Best & Kneip, 2019). We stelden dat vooral de perceptie van het gebruiksgemak van een inzamelsysteem invloed heeft op recyclinggedrag, meer dan het inzamelsysteem als zodanig (zie Weber, 2018). Uit de resultaten blijkt dat, zoals verwacht, het waargenomen gebruiksgemak van het inzamelsysteem het recyclinggedrag indirect beïnvloedt, via het waargenomen gemak van recycling. Hoe gemakkelijker men het gebruik van een inzamelsysteem ervaart, hoe gemakkelijker men recycling vindt, wat vervolgens leidt tot meer recycling. Deze resultaten suggereren dat het belangrijk is om rekening te houden met de perceptie van het gebruiksgemak van het inzamelsysteem. Binnen hetzelfde inzamelsysteem lijken individuen het gebruiksgemak van het inzamelsysteem verschillend te ervaren, wat invloed heeft op recyclinggedrag.

Verder redeneerden we dat het effect van biosferische waarden afhangt van waargenomen gemak van recycling. Uit de twee studies blijkt inderdaad dat er sprake is van een interactie-effect tussen waargenomen gemak van recycling en biosferische waarden op het recyclinggedrag. Sterkere biosferische waarden leken vooral recyclinggedrag te bevorderen wanneer recycling niet als heel gemakkelijk werd ervaren. Wanneer recycling heel gemakkelijk wordt gevonden, recyclen mensen ongeacht de sterkte van hun biosferische waarden. Deze resultaten ondersteunen een deel van het A-B-C-model (Guagnano, Stern, & Dietz, 1995; Stern, 2000), namelijk dat de biosferische waarden niet significant gerelateerd zijn aan recycling wanneer recycling als heel gemakkelijk wordt ervaren, maar wel gerelateerd zijn aan recycling wanneer het als redelijk gemakkelijk wordt ervaren. We konden echter niet testen of biosferische waarden ook niet of nauwelijks zijn gerelateerd aan recycling als men recycling heel moeilijk vindt, omdat uit beide studies bleek dat men recycling redelijk tot heel gemakkelijk vindt, en dat er nauwelijks mensen zijn die aangaven dat recyclen heel moeilijk is. Toekomstig onderzoek is nodig om te testen in welke mate biosferische waarden zijn gerelateerd aan recyclinggedrag als recycling als erg moeilijk wordt ervaren.

Context als factor die de focus op het milieu versterkt

In hoofdstuk 3 hebben we een tweede manier getest waarop de context van invloed kan zijn op het recyclinggedrag, namelijk door de focus van mensen op het milieu te versterken. Deze veronderstelling is gebaseerd op het IFEP-model (Steg et al., 2014; Steg et al., 2016), die stelt dat de context en individuele factoren bepalen in welke mate mensen gericht zijn op de gevolgen van hun gedrag voor het milieu, en milieuvriendelijker handelen. We stelden dat een verpakkingsontwerp invloed kan hebben op recycling door mensen te laten focussen op het milieu. Onze resultaten suggereren dat als een verpakkingsontwerp mensen meer laat focussen op het milieu het inderdaad tot meer recycling kan leiden, vooral wanneer men matig sterke tot sterke biosferische waarden heeft. Dit blijkt vooral het geval te zijn als het gaat om een nieuw ontwerp, in ons geval de to-go cups, en niet als een bestaande verpakking wordt aangepast (in ons geval koekjesverpakking).

Context als factor die mogelijkerwijs individuele factoren kan versterken

Een derde manier waarop de context het recyclinggedrag kan beïnvloeden, is door het versterken van individuele factoren. We hebben onderzocht wat het effect is van kunst op recyclinggedrag, en of kunst individuele factoren die samenhangen met recycling kan versterken. Er is een groeiende belangstelling voor het gebruik van design en kunst om milieuvriendelijk gedrag te stimuleren (Niedderer et al., 2014; Tromp, Hekkert, & Verbeek, 2011), maar de effecten van kunst op gedrag zijn niet systematisch getest. In een veldexperiment hebben we getest of een kunstinstallatie die gericht is op het versterken van de milieu-identiteit, een belangrijke motivatie voor milieuvriendelijk gedrag, daadwerkelijk recyclinggedrag kan stimuleren, en leidt tot een sterkere intentie om te recyclen en ander milieuvriendelijk gedrag te vertonen. Daarbij hebben we een nieuwe interdisciplinaire aanpak gevolgd, waarbij we inzichten uit de kunst en omgevingspsychologie hebben geïntegreerd. De kunstinstallatie werd tijdens twee weekenden geplaatst op drukke openbare pleinen in twee Nederlandse steden.

In overeenstemming met onze verwachtingen vonden we dat mensen die de kunstinstallatie hebben ervaren meer recyclen, en een sterkere intentie hadden om te recyclen en ander milieuvriendelijk gedrag te vertonen dan mensen die de kunstinstallatie niet hebben ervaren. Ons onderzoek levert dan ook empirisch bewijs dat kunst milieuvriendelijk gedrag kan stimuleren (zie Eldridge, 2014, Niedderer, 2007; Verbeek, 2010).

We vonden echter geen bewijs voor het voorgestelde proces over hoe de kunstinstallatie het gedrag en de intenties beïnvloedt. Om precies te zijn, we vonden dat een sterkere milieu-identiteit gerelateerd is aan sterkere intenties om te recyclen en andere milieuvriendelijke acties te ondernemen, maar het ervaren van de kunstinstallatie leidde niet tot een sterkere milieu-identiteit. Een mogelijke verklaring hiervoor is dat de kunstinstallatie via andere processen recycling en intenties heeft beïnvloed. Zo kan de kunstinstallatie emoties hebben opgeroepen, die vervolgens invloed

hebben gehad op recycling en gedrag. Toekomstig onderzoek dat gericht is op het evalueren van de effecten van kunst op milieuvriendelijk gedrag zou daarom alle relevante variabelen die kunnen worden beïnvloed door een kunstinstallatie moeten meten om meer inzicht te krijgen in de vraag waarom kunst milieuvriendelijk gedrag kan stimuleren.

Theoretische implicaties en aanbevelingen voor toekomstig onderzoek

De resultaten van dit proefschrift benadrukken het belang van contextuele factoren bij het verklaren van het recyclinggedrag. We hebben drie verschillende manieren getest waarop de context het recyclinggedrag kan beïnvloeden: de context kan recycling gemakkelijker of moeilijker maken, de context kan mensen laten focussen op het milieu, en de context kan mogelijkerwijs invloed hebben op motivaties die samenhangen met recyclen, zoals de milieu-identiteit.

Toekomstig onderzoek is nodig om na te gaan in welke mate andere contextuele factoren recycling kunnen vergemakkelijken, de aandacht van mensen op het milieu kunnen versterken en mogelijkerwijs individuele factoren kunnen versterken. De recyclingfaciliteiten die mensen thuis hebben zouden bijvoorbeeld een relevante contextuele factor kunnen zijn die het recyclen gemakkelijker of moeilijker kan maken. Daarnaast kan een verpakkingsontwerp dat duidelijk laat zien dat het kan worden gerecycled, ook recycling gemakkelijker kunnen maken. Met betrekking tot contextuele factoren die mensen focussen op het milieu, zou niet alleen een verpakkingsontwerp maar ook bijvoorbeeld het ontwerp van afvalbakken de focus van mensen op het milieu kunnen versterken

We hebben de interactie tussen individuele en contextuele factoren onderzocht, maar men kan ook stellen dat verschillende contextuele factoren op elkaar inwerken. Het A-B-C model (Guagnano et al., 1995; Stern, 2000) stelt dat individuele factoren vooral gerelateerd zijn aan recycling wanneer recycling als niet heel gemakkelijk en niet heel moeilijk wordt ervaren. Toekomstig onderzoek kan nagaan of de invloed van contextuele factoren die de aandacht van mensen op het milieu vestigen ook afhangt van hoe gemakkelijk of moeilijk men recycling vindt. Men kan beargumenteren dat contextuele factoren die ervoor zorgen dat mensen zich meer richten op het milieu vooral invloed hebben op recycling als men recycling niet heel gemakkelijk of niet heel moeilijk vindt. Wanneer men denkt dat recycling heel gemakkelijk is, zal iedereen recyclen, en als men het heel moeilijk vindt zal bijna niemand recyclen, ook niet als de context mensen meer laat focussen op het milieu. Echter, wanneer recycling als redelijk gemakkelijk wordt ervaren, kunnen contextuele factoren die de aandacht van mensen op het milieu richten, meer invloed hebben op de mate waarin iemand zijn afval scheidt of niet.

We volgden een nieuwe interdisciplinaire aanpak, waarbij we inzichten uit kunst, design en omgevingspsychologie integreerden, waarbij we het ontwerp van verpakkingen en kunst baseerden op psychologische theorie, en het effect van kunst en design op het recyclinggedrag systematisch hebben geëvalueerd. Deze werkwijze draagt bij aan een beter begrip van de mate waarin, hoe en

waarom design en kunst milieuvriendelijk gedrag kunnen bevorderen. Voor zover we weten hebben we een van de eerste samenwerkingsverbanden tussen ontwerpers, kunstenaars en milieupsychologen geïnitieerd en laten we zien dat design en kunst effectieve manieren zijn om recyclinggedrag te stimuleren. Toekomstig onderzoek is nodig om systematisch na te gaan in welke mate, hoe en wanneer design en kunst duurzaam gedrag kan stimuleren. Op basis van deze bevindingen kunnen ontwerpprincipes worden afgeleid die kunnen worden toegepast door ontwerpers en kunstenaars die geïnteresseerd zijn in het stimuleren van gedragsverandering. Dergelijke inzichten zijn belangrijk om te begrijpen hoe de impact van design en kunst op het stimuleren van milieuvriendelijke acties kan worden vergroot.

Praktische implicaties

Onze studies geven belangrijke suggesties voor beleid gericht op het bevorderen van recyclinggedrag. We vonden dat contextuele factoren recyclinggedrag kunnen beïnvloeden. Onze resultaten suggereren dat de context op drie verschillende manieren kan worden veranderd om het recyclinggedrag van individuen te stimuleren.

Ten eerste kunnen recyclingfaciliteiten worden verbeterd zodat men recycling gemakkelijker gaat vinden. Men kan bijvoorbeeld het gebruik van het inzamelsysteem zo eenvoudig mogelijk maken, waardoor men het gebruik van het inzamelsysteem en recycling gemakkelijker gaat vinden, wat leidt tot meer recycling. Ten tweede kan informatie worden gegeven over hoe gemakkelijk recycling is, omdat de perceptie van het inzamelsysteem van belang lijkt te zijn. Hiervoor kunnen communicatiestrategieën worden toegepast die erop gericht zijn mensen bewust te maken van het gebruiksgemak van het inzamelsysteem, zoals gemakkelijk toegankelijke informatie over de ophaaltijden van afval of over de dichtstbijzijnde afgifteplaats.

Er kunnen situaties zijn waarin het niet mogelijk is om het gebruik van het inzamelsysteem te vergemakkelijken, omdat er structurele of economische beperkingen kunnen zijn die niet gemakkelijk kunnen worden overwonnen. Zo kan het frequenter inzamelen of meer afvalbakken plaatsen te kostbaar zijn. In dat geval kunnen interventies zich richten op individuele factoren die recycling stimuleren, zoals biosferische waarden, milieu- en recycling identiteit, en persoonlijke normen en sociale normen met betrekking tot recycling. Sterkere biosferische waarden lijken vooral samen te hangen met recycling in situaties waarin recycling als niet te moeilijk en niet te gemakkelijk wordt ervaren. De vraag blijft welke interventies effectief kunnen zijn in het versterken van biosferische waarden, aangezien biosferische waarden in de vroege kinderjaren worden gevormd en daarna relatief moeilijk te veranderen zijn (Steg, 2016). Veel mensen hebben echter vrij sterke biosferische waarden (Bouman & Steg, 2019). Daarom kunnen interventies worden ontwikkeld die de focus op biosferische waarden versterken waardoor de kans groter wordt dat mensen handelen naar hun biosferische waarden. Dit kan door de nadruk te leggen op de positieve gevolgen van recycling voor het milieu. Dit

zou er vervolgens voor zorgen dat mensen zich meer op het milieu richten en handelen in overeenstemming met hun biosferische waarden (zie Steg et al., 2014; Ruepert, Keizer, & Steg, 2017). Onze resultaten suggereren inderdaad dat design, zoals een verpakkingsontwerp, zodanig kan worden ontwikkeld dat mensen zich meer op het milieu gaan richten. Ook andere contextuele factoren kunnen mensen meer gericht laten zijn op het milieu, zoals het ontwerp van recyclingbakken. Interessant genoeg lijkt het vooral succesvol te zijn om mensen te laten focussen op het milieu wanneer mensen redelijk sterke of sterke biosferische waarden hebben. Dit betekent dat een ontwerp dat erop gericht is om mensen te laten focussen op het milieu leidt niet alleen tot meer recycling bij individuen met sterke biosferische waarden die over het algemeen al meer geneigd zijn om milieuvriendelijk gedrag te vertonen, maar ook bij mensen met matig sterke biosferische waarden die niet consequent recycling en ander milieuvriendelijk gedrag vertonen.

Een derde manier om recyclinggedrag te bevorderen kan zijn om nieuwe manieren te gebruiken om een boodschap over te brengen, zoals het gebruik van kunst. Kenmerkend voor kunst is dat kunst zich niet beperkt tot vertrouwde begrippen, maar dat kunst originele en nieuwe manieren kan creëren om een boodschap over te brengen (Freeland, 2002). De kracht van het gebruik van kunst ligt onder andere in het vinden van originele en nieuwe manieren om een boodschap over te brengen om recyclinggedrag te stimuleren. Kunst kan in de openbare ruimte worden geplaatst, maar ook bij mensen thuis, de plek waar het grootste deel van recycling plaatsvindt. Voorbeelden van kunst om recycling thuis te bevorderen zijn herontwerpen van recyclingbakken of recyclingfaciliteiten op straat.

Conclusie

Op basis van het IFEP-model (Steg et al., 2014; Steg et al., 2016) veronderstelden we dat zowel individuele als contextuele factoren en hun interactie het recyclinggedrag kunnen beïnvloeden. We hebben eerst een meta-analyse uitgevoerd om het relatieve belang van individuele en contextuele factoren bij recycling te onderzoeken en vonden dat zowel individuele als contextuele factoren relevant zijn voor het verklaren van recycling. Vervolgens bestudeerden we drie manieren waarop contextuele factoren het recyclinggedrag kunnen beïnvloeden. Ten eerste gingen we na of de context recycling kan beïnvloeden door recycling te faciliteren of moeilijker te maken. We vonden dat hoe gemakkelijker men het gebruik van een inzamelsysteem vindt, hoe gemakkelijker mensen het vinden om te recyclen, wat leidt tot meer recycling. Sterkere biosferische waarden leiden ook tot meer recycling, vooral als men recycling niet heel gemakkelijk vindt. Ten tweede stelden we dat de context recycling kan beïnvloeden door mensen meer te laten focussen op het milieu. We vonden dat een verpakkingsontwerp dat mensen meer laat focussen op het milieu inderdaad recyclinggedrag kan stimuleren, vooral bij individuen met matig sterke en sterke biosferische waarden, en vooral als het gaat om nieuw ontworpen verpakkingen (in plaats van aanpassen van een bestaande verpakking). Ten derde veronderstelden we dat de context recycling kan stimuleren door het versterken van individuele

factoren. We vonden dat een kunstinstallatie inderdaad leidt tot meer recycling, maar dit effect werd niet veroorzaakt doordat de kunstinstallatie de milieu-identiteit versterkte. Dit suggereert dat kunst andere individuele factoren heeft versterkt, zoals emoties. Samenvattend laat dit proefschrift drie manieren zien waarop contextuele factoren recycling kunnen beïnvloeden. Dit proefschrift benadrukt het belang van contextuele factoren bij het verklaren van recyclinggedrag, naast individuele factoren.

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