Vom Promotionsausschuss des Fachbereichs Psychologie der Universität Koblenz-Landau zur Verleihung des akademischen Grades Doktor der Philosophie (Dr. phil.) genehmigte Dissertation

MITIGATION OF PLASTIC CONSUMPTION

Creating a 'window of opportunity'

to change habitual behavior

Lea Marie Heidbreder, M.Sc.

Vorsitzende des Promotionsausschusses:

Prof. Dr. Ingmar Hosenfeld

Universität Koblenz-Landau

Berichterstatter:

1. Prof. Dr. Manfred Schmitt
2. Prof. Dr. Gerhard Reese

Universität Koblenz-Landau

Datum der wissenschaftlichen Aussprache: 05.02.2021

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

"In the middle of every difficulty lies **opportunity.**" Albert Einstein

"We can **change** and people are ready for **change**." Greta Thunberg

I would like to thank my advisor Prof. Dr. Manfred Schmitt for his support. I am grateful that he shared his expertise at all time, giving helpful advice and simultaneously leaving me the freedom for personal development. My thanks also go to Prof. Dr. Gerhard Reese for scientific and activist discussions and integrating me in the team of environmental psychologists. For agreeing to lead the doctoral committee and her appreciative incentive for the 'final sprint', I would like to thank Prof. Dr. Michaela Maier.

I would also like to thank my additional co-authors: Josephine Tröger, Isabella Bablok, Julia Steinhorst and Stefan Drews. It always was a pleasure to work with you together. I especially thank Claudia Menzel for joint nature walks to discuss ideas and free the mind. Furthermore, I would like to thank Kristen Werling for reading my dissertation and giving me very valuable feedback – not only on English grammar.

And I would further like to thank my colleagues of 'IKM', 'LEPsyUnit' and 'DDPME' and, in particular, the interdisciplinary team 'IFG Umwelt' for fruitful discussions and supporting to think outside the box of one's own discipline.

Finally, I would like to thank my family, my parents Christine Heidbreder and Wolfgang Föste, and my partner Lucas Christoffer for more than I can say – for absolute support and taking me as I am. Last but not least thanks to Lisa Seelbach, my loyal friend since childhood, for sharing all that thoughts in endless letters.

SUMMARY

We are living in a world where environmental crises come to a head. To curb aggravation of these problems, a socio-ecological transformation within society is needed, going along with human behavior change. How to encourage such behavior changes on an individual level is the core issue of this dissertation. It takes a closer look at the role of individuals as consumers resulting in purchase decisions with more or less harmful impact on the environment. By using the example of plastic pollution, it takes up a current environmental problem and focuses on an understudied behavioral response to this problem, namely reduction behavior. More concrete, this dissertation examines which psychological factors can encourage the mitigation of plastic packaging consumption. Plastic packaging accounts for the biggest amount of current plastic production and is associated with products of daily relevance. Despite growing awareness of plastic pollution in society, behavioral responses do not follow accordingly and plastic consumption is still very high. As habits are often a pitfall when implementing more resource-saving behavior, this dissertation further examines if periods of discontinuity can open a 'window of opportunity' to break old habits and facilitate behavior change. Four manuscripts approach this matter from the gross to the subtle. Starting with a literature review, a summary of 187 studies addresses the topic of plastic pollution and human behavior from a societal-scientific perspective. Based on this, a cross-sectional study (N = 648) examines the determinants of plastic-free behavior intentions in the private-sphere and public-sphere by structural equation modeling. Two experimental studies in pre-post design build upon this, by integrating the determinants in intervention studies. In addition, it was evaluated if the intervention presented during Lent (N = 140) or an action month of 'Plastic Free July' (N = 366) can create a 'window of opportunity' to mitigate plastic packaging consumption. The literature review emphasized the need for research on behavioral solutions to reduce plastic consumption. The empirical results revealed moral and control beliefs to be the main determinants of reduction behavior. Furthermore, the time point of an intervention influenced the likelihood to try out the new behavior. The studies gave first evidence that a 'window of opportunity' can facilitate change towards pro-environmental behavior within the application field of plastic consumption. Theoretical and practical implications of creating the right opportunity for individuals to contribute to a socio-ecological transformation are finally discussed.

ZUSAMMENFASSUNG

Wir leben in einer Welt, in der sich Umweltkrisen immer weiter zuspitzen. Um diese Krisen zu entschärfen, braucht es einen sozial-ökologischen Wandel, der mit Verhaltensänderungen in verschiedenen Bereichen des täglichen Lebens einhergehen muss. Ausgehend von dieser gesellschaftlichen Aufgabe, befasst sich die vorliegende Dissertation mit der Frage, wie Verhaltensänderungen auf individueller Ebene angestoßen werden können. Mit dem weltweiten Problem von Plastik in der Umwelt wird ein aktuelles und sozialwissenschaftlich wenig erforschtes Themenfeld aufgegriffen. Es wird untersucht, welche psychologischen Faktoren einen Einfluss darauf haben, den eigenen Plastikkonsum zu reduzieren. Der Fokus liegt dabei insbesondere auf Plastikverpackungen, die den größten Anteil der derzeitigen Plastikproduktion ausmachen. Eine Barriere, die das Aufnehmen von neuen Verhaltensweisen erschwert, stellen die eigenen Gewohnheiten dar. Phasen von Umbrüchen, wie der Umzug in eine neue Stadt, gelten als vielversprechend zur Veränderung von Gewohnheiten. Die Dissertation untersucht daher, ob solche Phasen des Wandels ein Gelegenheitsfenster öffnen können, um alte Gewohnheiten zu durchbrechen und Verhaltensänderungen anzustoßen. Vier Manuskripte nähern sich diesem Thema von einem zunächst breiten Fokus einer Literaturstudie bis hin zu fokussierten Interventionsstudien an. Das Literaturreview (Manuskript 1) fasst 187 Studien zum Umgang mit Plastik aus sozialwissenschaftlicher Perspektive zusammen. Darauf aufbauend, untersucht eine Online-Studie (N = 648) plastikfreie Verhaltensintentionen (Manuskript 2). In einem Strukturgleichungsmodell werden Prädiktoren für Verhaltensintentionen im privaten sowie politischen Bereich analysiert. Zwei Experimentalstudien im Pre-Post-Design schließen an das Verhalten im Privaten an (Manuskript 3 + 4). Es wird untersucht, ob eine Intervention, die während der Fastenzeit (N =140) oder während eines Aktionsmonats (N = 366) präsentiert wird, ein Gelegenheitsfenster zur Konsumreduktion von Plastikverpackungen darstellen kann. Die Ergebnisse der empirischen Arbeiten weisen Moral- und Kontrollüberzeugungen als stärkste Prädiktoren für Verhaltensreduktionen aus. Der Zeitpunkt einer Intervention beeinflusst zudem die Wahrscheinlichkeit ein neues Verhalten auszuprobieren. Die Studien zeigen erste Belege, dass Gelegenheitsfenster umweltfreundliche Verhaltensänderungen im Kontext des Plastikkonsums erleichtern können. Theoretische und praktische Implikationen, wie Gelegenheitsfenstern zu einer sozial-ökologischen Transformation beigetragen können, werden diskutiert.

PART I

1 INTRODUCTION

During this twenty-first century, humanity is facing multiple environmental crises, such as climate change or biodiversity loss. These crises are human-made and will affect humanity as a whole if we carry on as before. Human behavior in the upcoming years will decide on the mitigation of these crises (IPCC, 2019). Joint efforts are required to maintain a world in which humanity can live safely. Such a "safe operating space for humanity" is described in the framework of planetary boundaries (Rockström et al., 2009, p. 2). To hold the stability of the earth system, planetary boundaries should not be exceeded (Rockström et al., 2009; Steffen et al., 2015). Using a metaphor for illustration: Exceeding these boundaries is comparable to a ball that rolls down a mountain and can no longer be stopped. When exceeding these boundaries, the earth system might be irreversibly changed. Therefore, we need to prevent the ball from rolling down and hold our societal actions within these planetary boundaries.

One of these current challenges is our extensive use of plastic and the accompanying plastic pollution. In the last decade, this topic has gained much political, medial and societal attention (European Commission, 2018; Hartley et al., 2018; Penca, 2018; UBA, 2017). And it is already handled as a new planetary boundary threat (Galloway, Cole, & Lewis, 2017; Zalasiewicz et al., 2016). As well as other environmental challenges, plastic pollution is human-made, and thus, it is also up to humans to solve this problem and provide solutions (Schultz, 2014). Thereby, not only product-based solutions or political strategies are relevant but also consumer behavior is crucial for contributing to a societal transition (Bilharz & Schmitt, 2011). Unfortunately, the change in human behavior can be a slow process, and we are running out of time (Levin, Cashore, Bernstein, & Auld, 2012). Therefore, empirical insights to facilitate a shift towards the mitigation of plastic use are urgent. This dissertation addresses the role of consumer behavior within the field of plastic consumption from an environmental psychology perspective and investigates approaches for behavioral change.

1.1 Plastic pollution as a socio-ecological problem

Plastic production has reached such an extent that our century is already called the "Plastic Age" (Thompson, Swan, Moore, & Vom Saal, 2009). In 2018, 359 million tons of plastic have been produced worldwide (PlasticsEurope, 2019), doubling the number of yearly productions within twenty years. Plastics per se offer a variety of positive characteristics explaining the high demand and production rate: Combined with the appropriate additives, plastic can be strong as well as flexible and break-proof, produced in different degrees of hardness, withstand a range of temperatures, and can lead to a replacement of glass with its transparent characteristics (Andrady & Neal, 2009). Furthermore, plastic packaging can reduce food waste, and due to its light weight, it can reduce transportation costs and emissions (Andrady & Neal, 2009). With its versatile applications, it has become ubiquitous in daily life.

However, problems start with the end of utilization. From the 8,300 million tons of plastic that have been produced so far, only 9% has been recycled and 79% ended up in landfills or the environment (Geyer, Jambeck, & Law, 2017). It is estimated that 4 to 12 million tons of plastic waste enter the ocean annually (Jambeck et al., 2015). While the characteristic of robustness makes plastic beneficial for its use, this characteristic becomes a problem when plastic ends up in the environment. As the commonly used plastics are not biodegradable, the plastic particles stay in the environment for a very long time (Geyer et al., 2017). In the meanwhile, plastic particles are found in the remotest parts of the world, such as polar regions (Barnes, Galgani, Thompson, & Barlaz, 2009; Obbard et al., 2014), in the southern hemisphere with low coastal population density (Eriksen et al., 2014) or the deep sea (Van Cauwenberghe, Vanreusel, Mees, & Janssen, 2013; Wagner et al., 2014). Plastic was also found in human bodies (Bergmann, Gutow, & Klages, 2015; Galloway, 2015) raising the issue of health effects. Primarily, health effects can be traced back to plastic additives rather than to plastic per se (Halden, 2010). Thus, in contrast to environmental issues, adverse health effects are less prominent and less meaningful for the public debate, in the media (Vogel, Werling, Barkela, & Milde, n.d.), or the adoption of political measures (Mederake & Knoblauch, 2019).

Keeping a close eye on the problematic outcomes of plastic in the environment, plastic poses risk to animals by ingestion and entanglement (Li, Tse, & Fok, 2016; Wilcox, Puckridge, Schuyler, Townsend, & Hardesty, 2018; Worm, Lotze, Jubinville, Wilcox, & Jambeck, 2017), pollutes beaches and waters (Jambeck et al., 2015), contributes to finite capacity for disposal of waste in landfills (Thompson, Moore, vom Saal, & Swan, 2009), and causes economic costs in waste management (Beaumont et al., 2019). After degradation, even as small particles, micro- or nano-plastic can cause harm to biota (Anbumani & Kakkar, 2018; Botterell et al., 2019; Triebskorn et al., 2019). Having these negative outcomes of plastic waste in mind, handling of plastic becomes problematic when the actual long-living material is produced for single use only. In Europe, 40% of the plastic demand can be traced back to packaging (PlasticsEurope, 2019), such as food packages, sweet wrappers, or shampoo bottles, which hold a very short service life. In recent years, unsustainable handling of plastics has been criticized as a symbol for the so-called 'throw-away society' (Gibb, 2019). Worldwide, consumers consider plastics to be the least sustainable kind of packaging, predominantly associating it with pollution (IPSOS, 2018). Nevertheless, the production rate is still increasing (PlasticsEurope, 2019).

1.2 The role of consumer behavior to mitigate plastic pollution

How and what people consume is the core of many environmental challenges (Ruby, Walker, & Watkins, 2020). Consumer decisions, e.g. with regard to product or packaging choice, relate to resource use, emissions, or waste occurrence. When aiming at reducing single-use plastic to mitigate plastic pollution, consumers play a significant role. There are various ways to express sustainable consumption in this context (Clayton & Myers, 2015): One can distinguish one-way decisions such as an investment in a reusable coffee-cup or more frequent behaviors such as regular consumption of loosely packed fruits or the use of a textile bag instead of plastic bags for shopping. Thus, doing less or doing things in a different way with less harmful impact are opportunities to mitigate plastic consumption (Barr, Gilg, & Ford, 2001; Clayton & Myers, 2015).

Sufficiency in terms of a sustainability strategy picks up this approach aiming at reducing levels of resource consumption (Reese & Tröger, n.d.; Samadi et al., 2017; Verfuerth, Henn, & Becker, 2019). In contrast, the efficiency sustainability strategy pursues another handling of material by improving the relation between input and output of resources, such as an improvement of recycling rates. Sufficiency focuses on reducing the demand to refrain from resource-intensive consumption (Samadi et al., 2017), following the idea: the best waste has not even arisen. Thus, the individual effort to reduce single-use plastic can account as an expression of sufficiency-oriented behavior. Fittingly, one goal of the Sustainable Development Goals relates to sustainable consumption and production (UN) aims at "doing more and better with less" (Reisch, Cohen, Thøgersen, & Tukker, 2016, p. 234).

With their decisions, consumers have a direct impact and also determine the demand for plastic products (Jefferson, 2019). They could put pressure on the purchasing sector to reduce plastic in their offering (Ma, Park, & Moultrie, 2020) or initiate political change (Bilharz & Schmitt, 2011). Thereby, sustainable consumption often requires a change in ingrained consumption patterns. As consumer behavior is often characterized by repetition and automaticity, it is crucial to take the role of habitual behavior into account when aiming at changing consumption patterns (Verplanken & Roy, 2015; Wood & Neal, 2009).

1.2.1 Habitual consumer behavior

Estimates suggest that half of our behaviors are habits (Wood, Quinn, & Kashy, 2002). In particular, consumption behavior often runs habitually (Wood & Neal, 2009). Consumers repeatedly purchase products of daily needs without thinking across shopping trips or consciously remembering afterward. By definition, habitual behavior can be understood as a recurring, automatic and unconscious reaction to stable circumstances (Verplanken & Wood, 2006; Wood, Tam, & Witt, 2005). Stable circumstances could be physical, temporal, or social contexts that automatically cue behavior (Orbell & Verplanken, 2018; Wood et al., 2005). For instance, going for shopping could be determined for every Thursday afternoon, and drinking a cup of tea

could be part of the morning routine, cued by the water boiler on the kitchen board (Wood & Neal, 2009). Also, neuroscience supports the idea that habits are responses to stable contexts and even nonconscious perception of a certain context can activate habitual responses (Wood & Neal, 2009; Yin & Knowlton, 2006).

1.2.2 Breaking habitual consumer behavior: Creating a 'window of opportunity'

As habits often run automatically and without conscious awareness, it is a difficult task to break habits (Neal, Wood, & Quinn, 2006; Orbell & Verplanken, 2010). In addition, people judge their behavior as better than alternatives when it is performed habitually (Wood & Neal, 2009). Information that counteracts the habitual behavior is hidden out and the search for information is reduced (Aarts, Verplanken, & Van Knippenberg, 1998). To break habits, individual's willingness alone is insufficient as intentions only determine non-habitual behavior (Triandis, 1977). Changing the intention regarding a particular behavior outcome does not necessarily indicate a change in behavior performance (Webb & Sheeran, 2006).

Breaking habitual behavior becomes easier when stable circumstances change and context cues no longer activate the habitual responses (Verplanken & Roy, 2015). The habit discontinuity hypothesis assumes that a change of context can facilitate behavior change (Verplanken & Roy, 2016; Verplanken, Walker, Davis, & Jurasek, 2008; Verplanken & Wood, 2006). Context changes could be discontinuities in one's life, such as moving to another city or having a baby. In such phases, old habits are interrupted due to contextual change and not applied to the new situation. Consideration of habitual behavior becomes easier (Verplanken et al., 2008). Therefore, these phases of discontinuity are called 'windows of opportunity' (Schäfer, Jaeger-Erben, & Bamberg, 2012).

With regard to interventions, this indicates that the timing of interventions is decisive. Interventions are expected to be more effective in phases of discontinuity (Verplanken & Roy, 2015). Various empirical studies have identified 'windows of opportunity' in phases of relocation increasing sustainable commuting behavior (Bamberg, 2006; Jones & Ogilvie, 2012;

Thøgersen, 2012; Verplanken et al., 2008; Walker, Thomas, & Verplanken, 2015) or general pro-environmental behavior (Verplanken & Roy, 2016). Thereby, behavior change only occurred if the intervention was presented in temporal proximity to the period of change, i.e., up to one month after relocation (Jones & Ogilvie, 2012).

Many interventions in the environmental context try to raise problem awareness aiming at changing intentions and subsequent behaviors. However, these campaigns often meet with little success (Verplanken & Roy, 2015). While persuasive messages alone fail to change habits (Webb & Sheeran, 2006), phases of discontinuity can give the opportunity to break old habits and adopt new ones. However, even in phases of discontinuity people would not adopt a new target behavior if they had no intention of that behavior before (Thompson et al., 2011). Thus, both, the opportunity and the willingness for change are needed. When the intention for behavior change does exist, the right occasion can "give it a go" to put such intention into practice and thus, behave in accordance to one's own beliefs (Thompson et al., 2011; Wood & Neal, 2009). Therefore, psychological factors of behavioral motivations should be considered as well.

1.2.3 Psychological determinants of consumer behavior

In the last decades, social-scientific literature has presented a variety of models to explain pro-environmental behavior and intentions. One prominent theory that is rooted in the rational choice approach (Little, 1991) is the theory of planned behavior (TPB; Ajzen, 1991). According to the rational choice paradigm, people evaluate the consequences of their behavior aiming at minimizing costs and maximizing benefits (Little, 1991). The TPB assumes that people make reasoned choices and behavior is based on volition. Thus, behavior results from the intention to show a certain behavior. According to the TPB, intention is determined by attitude, subjective norms[1], and perceived behavior control. Attitudes evaluate the target behavior based on beliefs about expected positive and negative consequences of this behavior. Subjective norms refer to the expectation of social pressure, thus, the extent to which people anticipate others to

[1] The terms "subjective norms" and "social norms" are used as synonyms in this thesis

appreciate the target behavior. Perceived behavior control reflects the perceived ease and difficulty of the target behavior, based on past experiences and beliefs regarding likely obstacles. The TPB postulates that perceived behavior control has also a direct impact on behavior (Ajzen, 1991).

The TPB has been widely applied to the context of environmental research and sustainable behavior (see for a review, Si et al., 2019). The applied topics range from sustainable transportation, green consumption to waste management. In the context of plastic handling and pollution, the main focus lies in recycling and separation. In the context of consumption, many studies have focused on green products. Very little attention has been paid to plastic use, avoidance, and reduction (Si et al., 2019). Only some studies referring to the TPB deal with the use of plastic bags (Muralidharan & Sheehan, 2016; Sun, Wang, Li, Zhao, & Fan, 2017) or reusable bags (Chang & Chou, 2018).

However, people do not only consider rational criteria in their decision processes. Armitage and Conner (Armitage & Conner, 2001) found evidence for the TPB in their meta-analysis, but expressed concern about the completeness of the theoretical approach. The TPB was often supplemented by further constructs (Si et al., 2019) or combined with other theories such as the norm activation model of Schwartz (NAM, 1977). The norm activation model postulates that the activation of personal norms[2] leads to altruistic behavior (Schwartz, 1977). Personal norms reflect the feeling of a moral obligation to act. In many studies, this assumption has been applied to pro-environmental behavior, and the TPB was augmented by the construct of personal norms (Bamberg, Hunecke, & Blöbaum, 2007; Klöckner, 2013; Rivis, Sheeran, & Armitage, 2009), in particular, in transportation behavior (Bamberg & Möser, 2007; Gardner & Abraham, 2008) but also for packaging choice (Thøgersen, 1999).

[2] The terms “personal norms” and “moral norms” are used as synonyms in this thesis

1.3 Research questions

Plastic use with a focus on avoidance or reduction has been given little consideration so far (Si et al., 2019). This dissertation aims to fill this gap by picking up the mitigation of single-use plastic as an example of sustainable behavior. It deflects the attention away from the end of the waste chain, i.e., recycling for better handling of plastic waste (efficiency strategy), towards the beginning of the waste chain, i.e., reduction to prevent the creation of waste and to mitigate resource use (sufficiency strategy).

With the applied perspective, this dissertation aims at contributing to an improvement of interventions to encourage pro-environmental and sufficiency-oriented behavior. This approach is two-folded. First, it provides insights for content-related design of interventions by exploring psychological factors that increase the willingness to change a behavior in this specific application field. Second, it considers potential time points to set an intervention by exploring 'windows of opportunity'. From a theoretical perspective, the role of an integrative framework including rational choice, moral choice, and habits are evaluated. Accordingly, the overarching research question of this dissertation states as follows:

RQ: How to encourage people to mitigate single-use plastic consumption?

Understanding the determinants of behavior provides the necessary insight to encourage change in regard to socio-ecological transformation (Schultz, 2014). Thus, the goal was to identify psychological variables that influence behavior directly or indirectly via intentions and determine the quantitative strengths of these relations. In keeping with this, the following research question arises:

RQ_a: Which psychological factors determine the intention and the behavior of single-use plastic mitigation?

Intervention studies have focused on different forms of measures to take action, ranging from financial incentives, over persuasive messages to commitment and social modeling, (see for an overview, Homburg & Lange, 2020). However, the time point of an intervention has been largely neglected until now. Thereby, the few empirical studies that have addressed different

time points have shown that it is promising to set interventions in a period of discontinuity. If context cues change, habitual behavior can be interrupted (Verplanken & Roy, 2015). To pursue these findings, a third research question for this dissertation states as follows:

> RQ_b: Can a period of discontinuity open a 'window of opportunity' to mitigate single-use plastic consumption?

As most of the periods of discontinuity (e.g., moving to another city) are rare and difficult to provoke, the question arises if more frequent periods of discontinuity can be created to facilitate behavior change. Considering such potential periods, the final research question asks:

> RQ_c: How can a period of discontinuity be created apart from physical context change?

The following chapter gives an overview of the structure of the three manuscripts that are used to answer these research questions.

2 Structure and outline of the manuscripts

Figure 1 presents an outline of the four manuscripts included in this dissertation. It illustrates how the manuscripts built upon each other, content-wise and from a methodological point of view. Originating from a broad perspective of a literature review, the three following manuscripts become more specific ending up in two experimental studies in the concrete application field of single-use plastic consumption.

In recent years, many studies from the natural science have shed light on the problems of plastic pollution, so that a wealth of reviews addressing this topic have been published in the meanwhile (Bucci, Tulio, & Rochman, 2020; Li et al., 2020). Some reviews have also addressed policies to reduce plastic pollution (Nielsen, Hasselbalch, Holmberg, & Stripple, 2020; Xanthos & Walker, 2017). However, a summarizing approach from social science considering perceptions, attitudes, and human behavior in this context has been missing.

The first manuscript bridges this gap by presenting a literature review from a social-scientific perspective in the field of plastic use and disposal (Heidbreder, Bablok, Drews, & Menzel, 2019). It covers a spectrum from humans' perception of advantages and disadvantages

of plastic, via psychological factors determining the handling of plastic towards solutions addressing the three R's of waste management: recycling, reuse, and reduction (Thompson et al., 2009).

The second manuscript build upon this broad approach by picking up identified research gaps and crucial findings. In contrast to recycling, reduction has been a weakly researched topic, and thus, the empirical studies in the following manuscripts focus on behavior to reduce plastic use. More precisely, the second manuscript (Heidbreder, Tröger, & Schmitt, n.d.) is dedicated to psychological factors determining the reduction of single-use plastic. Based on an extended version of the TPB as a theoretical framework, an online-survey examines the determinants of plastic-free behavior within the private-sphere and public-sphere (Stern, 2000).

On that basis, the last two manuscripts deepen the findings of the survey and pursue the private-sphere behavior in form of consumption in two experimental studies. The third manuscript picks up the two psychological determinants that have been most relevant in the survey and include them in an intervention setting (Heidbreder & Schmitt, 2020). The information-based intervention aims at strengthening the two determinants perceived behavior control and personal norms. Furthermore, the experimental study is supplemented by the finding of the literature review that habitual behavior plays a crucial role in plastic consumption. To examine interventions to break habits, the two experimental studies focus on potential 'windows of opportunity' that are expected to facilitate behavior change. The first intervention study focuses on the traditional period of Lent where people give up selected behavior patterns. The last study is proceeding with regard to the form of 'window of opportunity'. While Lent is considered to be well-known for consumption change, the last study considers the action month of 'Plastic Free July' as an arbitrary period of change (Heidbreder, Steinhorst, & Schmitt, 2020). In addition, the sample in the last manuscript applies to the general public, enlarging the focus from a sample of students which was applied in the study of Lent.

Summing up, the focus of this dissertation lies on the question of which factors determine the mitigation of single-use plastic consumption. The first manuscript approximates this question with a literature review. To get more precise, the second manuscript looks at psychological factors in an online-survey. The results are incorporated in the experimental study of the third manuscript. In addition to the psychological factors, the time point of the intervention is considered in form of a 'window of opportunity'. Finally, the fourth manuscript enlarges another 'window of opportunity' to examine more frequent periods of change. The previous chapters have provided the theoretical background for this dissertation in a nutshell. The further theoretical assumption for the empirical work, the specific application field, and methodological approach are elaborated in the respective manuscripts.

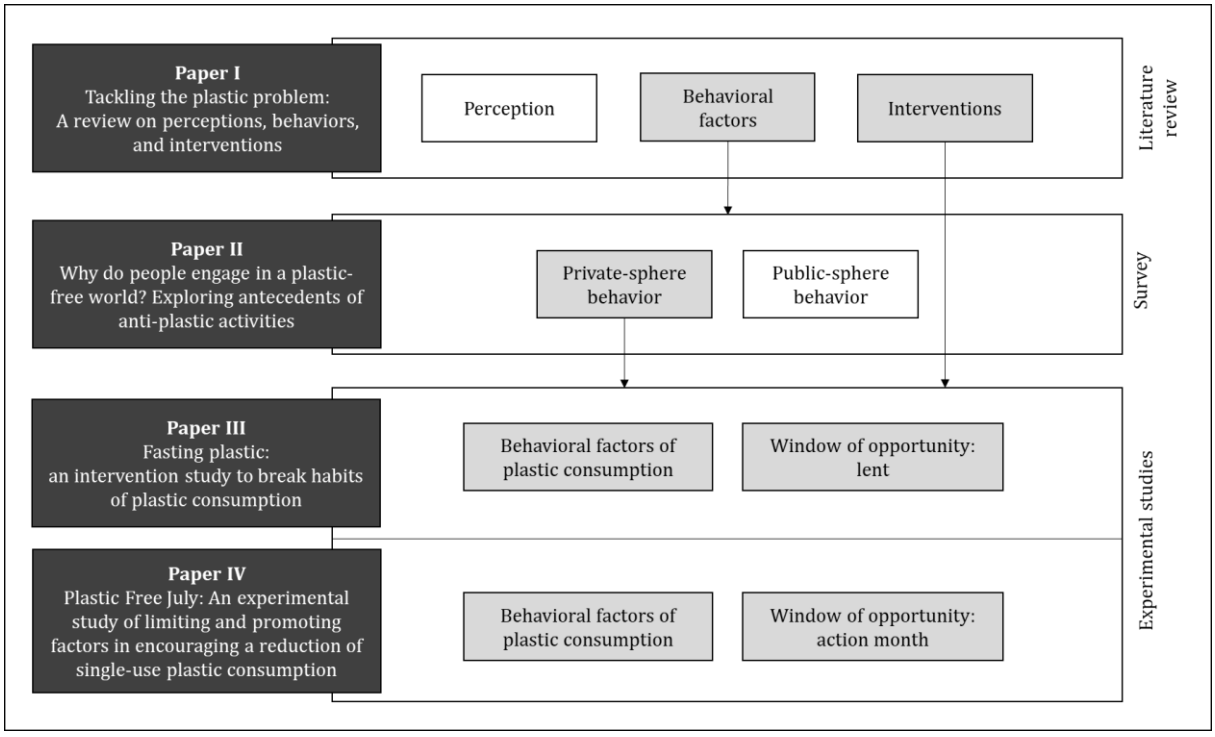

Figure 1 Outline of and relations between the four manuscripts

PART II

3 MANUSCRIPT 1 – TACKLING THE PLASTIC PROBLEM: A REVIEW ON PERCEPTIONS, BEHAVIORS, AND INTERVENTIONS

Heidbreder, L.M., Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of The Total Environment*, *668*, 1077–1093. https://doi.org/10.1016/j.scitotenv.2019.02.437

Date of submission: 8th of January, 2019
Date of Acceptance: 27th of February 2019

Abstract

The excessive production and consumption of plastic have serious consequences on the environment and human health. The reduction of plastic has therefore become a major global challenge. As technical solutions might be insufficient to curb the problem, a perspective highlighting the impact of human behavior is needed. The current literature review provides an overview of the existing social-scientific literature on plastic, ranging from risk awareness, consumers' preferences, and predictors of usage behavior to political and psychological intervention strategies. By reviewing the literature, we aim to identify potential factors for future interventions to reduce plastic consumption. The 187 studies reviewed show that people much appreciate and routinely use plastic, despite a pronounced awareness of the associated problems. Habits, norms, and situational factors seem to be especially predictive for plastic consumption behavior. Both political and psychological interventions are potentially effective, although long-term effects are often uncertain. The review closes with implications for behavior-based solutions and future research, which should combine interdisciplinary approaches and take into account cultural differences.

Keywords: Plastic pollution; Problem awareness; Consumer behavior; Behavior-based solutions; Environmental psychology

Introduction

Today we live in an era that some have called the "Plastic Age" (Thompson, Swan, Moore, & Vom Saal, 2009). The production of plastic has markedly increased over the last decades, currently reaching about 350 million tons per year (PlasticsEurope, 2018). Many advantages of the material, such as durability, flexibility, and cheapness, make plastic ubiquitous and indispensable in daily life, and thus it is distributed globally. However, there is growing evidence that the current use and disposal of plastic leads to substantial pollution of terrestrial and aquatic ecosystems (Bläsing & Amelung, 2018; Horton, Walton, Spurgeon, Lahive, & Svendsen, 2017), already discussing plastic waste as a new planetary boundary threat (Galloway & Lewis, 2016; Rockström et al., 2009). Over 250,000 tons of plastic are estimated to float in the sea (Eriksen et al., 2014), adversely affecting marine wildlife and humans by plastic entering the food chain (Li, Tse, & Fok, 2016; Rochman et al., 2016; Seltenrich, 2015; Sigler, 2014). In addition, the widespread use of plastic in agriculture has been postulated as a relevant source of soil degradation and microplastics (i.e., plastic particles smaller than 5mm) in soil (e.g., Liu, He, & Yan, 2014; Steinmetz et al., 2016). Furthermore, lab experiments demonstrate plastic to be a source of anthropogenic climate change as the most commonly used plastics might produce greenhouse gases when exposed to sunlight (Royer, Ferrón, Wilson, & Karl, 2018). Thus, plastic has a tremendous effect on various aspects of the environment, including wildlife, through diverse routes.

The most discussed risk to human health associated with the use of plastic is the exposure to harmful chemicals that are used as plastic additives (e.g., Hodson, Duffus-Hodson, Clark, Prendergast-Miller, & Thorpe, 2017; Rist, Almroth, Hartmann, & Karlsson, 2018; Smith, Love, Rochman, & Neff, 2018). Moreover, plastic particles may act as vehicles of persistent pollutants (Peng, Wang, & Cai, 2017). The potential danger to human health might therefore arise from the uptake of food products that were in contact with plastic or contain microplastic.

As the entire production and application of plastic is of human origin, human solutions to the plastic problem are both necessary and feasible. Therefore, various societal actors (e.g.,

consumers, producers, policy makers, industries) need to be involved in the solutions (e.g., Löhr et al., 2017). Although a number of technical approaches of alternative materials or infrastructure have been developed to curb the problem (e.g., the production of biodegradable plastic or appropriate recycling procedures), there are two major obstacles: First, it is unlikely that technical approaches will solve the plastic problem comprehensively and in the required time. Second, there are well-known psychological effects that often undermine technical solutions, such as increased usage after an intervention (i.e., rebound effects; Hertwich, 2005) or increased littering of biodegradable products (Haider, Völker, Kramm, Landfester, & Wurm, 2018). Thus, efficiency strategies (e.g., recycling) can save resources at first glance but may eventually lead to a change in people's behavior as they consume more and thus reduce the resource savings. Moreover, technical approaches require people's acceptance, thus bringing additional factors into play. Hence, although technical solutions are definitively needed, a focus on human behavior is necessary to tackle the plastic problem from a multidisciplinary approach. To develop effective solutions, insights on perceptions, attitudes, and behaviors related to plastic is needed. As there is, to our knowledge, no compilation of social-scientific literature on the described issue, we aim at providing one that is useful for researchers and stakeholders.

Aims

In the current review, we provide an overview of the existing empirical social-scientific literature on human perception and behavior related to plastic use and disposal. Plastic is defined as a synthetic material composed of polymers. In the review, we did not give special attention to plastic additives, such as Bisphenol A, although they might affect risk awareness. Since the research field of plastic-related perception and behavior is relatively new and very diverse, the review is of a narrative nature. The main part of this review summarizes the studies and their findings. In the discussion, we integrate these findings to identify promising factors important for behavior-based solutions to the plastic problem and to reveal research gaps that future studies should address. This review, thus, provides both an overview of the existing literature

helping to identify promising research questions, and useful information for practitioners and those developing interventions.

Methods

To identify relevant studies for the present review, we used several databases (PsychINFO, PsychArticles, Pubmed, and Web of Science). A first search using a set of keywords and their combinations (e.g., "plastic", "waste", "consumer behavior", "packaging", "recycling") led to an initial collection of studies. An article identified in the search was considered relevant if a) plastic was addressed as a material (ignoring other meanings, such as plastics in arts or plastic surgery), b) plastic was explicitly studied (and not just mentioned as an example or to specify the material of something that was not studied further), and c) attitudes, perceptions, or behaviors were examined. The list of studies was then extended using a snowball strategy of searching backward and forward citations (Wohlin, 2014) and again applying the above criteria. Only articles published before September 27, 2018 were considered. The final pool comprised 187 articles that were included in this review. Figure 2 shows the worldwide distribution of the samples described in the reviewed literature.

Results

Based on the literature found, we structured the review in three sections: problem awareness and perception of plastic, plastic consumption behavior, and solutions to the plastic problem.

Perception of plastic

As outlined above, the increasing use of plastic has a severe impact on the environment and involves certain risks for human health. In the first part of this section, we review available literature on the awareness of such impacts. In the second part, we examine the perception of plastic in the context of consumption. Knowledge about problem awareness and preferences helps to identify predictors of plastic consumption behavior and thus leads to potential starting

points for solutions. Note that within this chapter, perceptions were described and that these may not be in line with the real circumstances (e.g., the perceived environmental impact might diverge from the actual one).

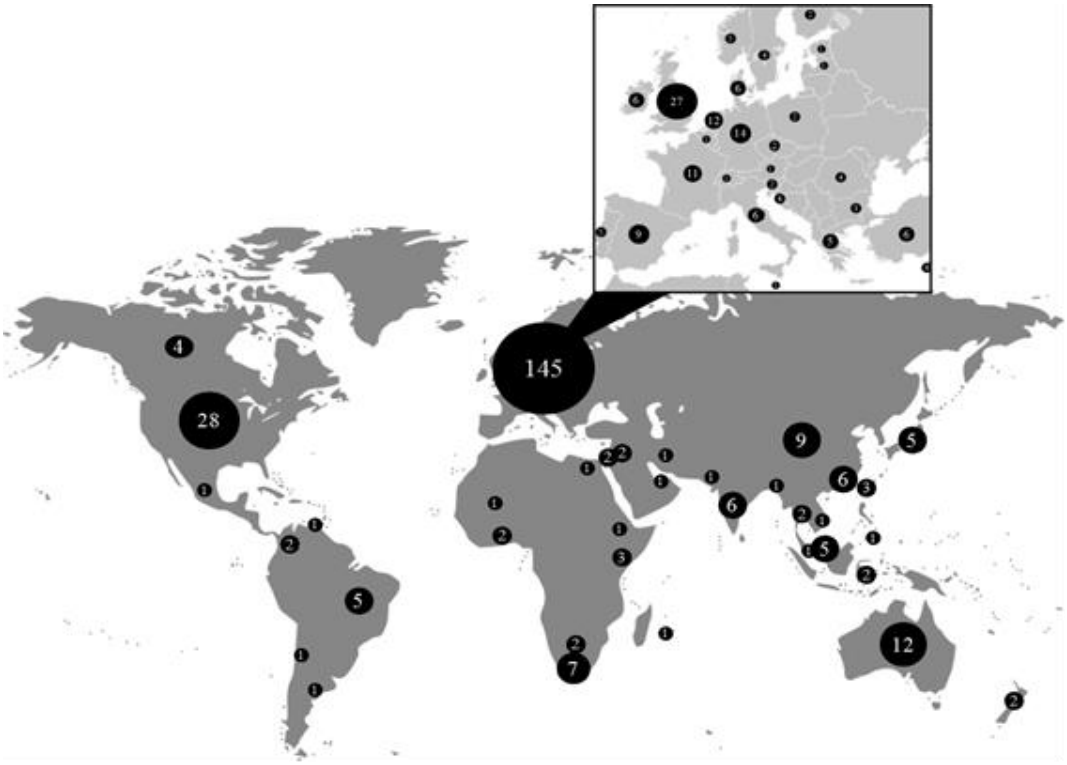

Figure 2 Countries represented by reviewed studies

Numbers indicate amount of studies investigating a sample from a particular country (several countries per article possible; same original sample might be counted repeatedly when presented in different articles). One article (Clapp et al., 2009) was excluded because no sample was investigated.

PROBLEM AWARENESS

PERCEIVED IMPACTS OF PLASTIC POLLUTION ON THE ENVIRONMENT

Plastic used as a material for packaging and bags is generally seen as environmentally problematic (e.g., Adane & Muleta, 2011; Fernqvist, Olsson, & Spendrup, 2015; Otsyina, Nguhiu-Mwangi, Mogoa, Mbuthia, & Ogara, 2018; van Dam & van Trijp, 1994). Furthermore, in social media "plastic" is discussed and associated with "sustainability" and "waste", indicating certain problem awareness (Richardson, Grose, Nelmes, Parra, & Linares, 2016). In an earlier Danish

study (Bech-Larsen, 1996), environmental problems due to (packaging) waste were considered as less serious compared to other societal and environmental issues. However, as might be expected by the increased use and disposal of plastic ever since, more recent and large-scaled surveys conducted on citizens in several countries (e.g., Portugal, UK, Germany, Canada, Kenya) show that pollution in general and plastic waste in particular are perceived as major environmental problems (Gelcich et al., 2014; Hartley, Pahl, Veiga, et al., 2018; Lotze, Guest, O'Leary, Tuda, & Wallace, 2018). The immense use of plastic (esp. in packaging) and related human behavior are perceived as significant causes of pollution (Hartley, Pahl, Veiga, et al., 2018; Santos, Friedrich, Wallner-Kersanach, & Fillmann, 2005). In fact, problem awareness is already high among school children from different countries (United Arab Emirates: Hammami et al., 2017; UK: Hartley, Thompson, & Pahl, 2015; Hong Kong: So, Cheng, Chow, & Zhan, 2016). Plastic litter is highly abundant at most coastlines worldwide and often beach visitors and locals are perceived to be the source of such litter (Beeharry, Bekaroo, Bokhoree, Phillips, & Jory, 2017; Brennan & Portman, 2016; Campbell, Slavin, Grage, & Kinslow, 2016; Hartley, Pahl, Veiga, et al., 2018; Kiessling, Salas, Mutafoglu, & Thiel, 2017; Rangel-Buitrago, Williams, & Anfuso, 2018; Santos et al., 2005). However, the amount of former fishing and aquaculture utensils (e.g., fishing lines, buoys, pipes) made from plastic is also very high both in the sea and at beaches, and this debris is perceived as a major threat for marine wildlife, boats, and humans (Barnett, Wiber, Rooney, & Curtis Maillet, 2016; Pearson, Mellish, Sanders, & Litchfield, 2014). Additionally, plastic waste is perceived to negatively affect terrestrial animals (Adane & Muleta, 2011; Otsyina et al., 2018).

Although microplastic has become a hot topic in media and environmental science, social-scientific studies on the perception of microplastic and its risks are rare to date. By definition, such plastic particles are small and thus difficult to see and retrieve from the environment compared to macrodebris (cf., Barnett et al., 2016, for such an observation by Candian fishermen). Interviews with beauticians, students, and environmentalists show that only the latter were aware of microplastics in facial scrubs (Anderson, Grose, Pahl, Thompson, & Wyles,

2016). The majority of participants indicated awareness that these particles will go into the ocean after use. After participants of this UK study were made aware of these issues, they reported environmental concerns, especially risks for marine fauna. However, for them these environmental problems are not as pressing as others (Anderson et al., 2016). Overall, (macro- and micro-) plastic is generally seen as an environmental hazard, though to a varying degree.

PERCEPTION OF HUMAN HEALTH AND WELL-BEING RISKS

Besides the perceived environmental risks, people are concerned about hazards related to their health and well-being. For example, litter is associated with reduced preference for and perceived restorative quality of a given place and this is especially true when the litter originates from the general public (e.g., plastic bottles) compared to fishing-related litter (e.g., fishing ropes; Ballance, Ryan, & Turpie, 2000; Kiessling et al., 2017; Wyles, Pahl, Thomas, & Thompson, 2016). Furthermore, potentially health-threatening litter items (e.g., syringes and condoms) were perceived as more offensive than other beach litter (Tudor & Williams, 2003). In general, coastal scenic quality seems to be negatively affected by the amount of (plastic) litter but it is noted that this appeal might be restored by beach clean-ups (Corraini, de Souza de Lima, Bonetti, & Rangel-Buitrago, 2018; Rangel-Buitrago et al., 2018; Williams, Rangel-Buitrago, Anfuso, Cervantes, & Botero, 2016), which are being carried out with increasing frequency nowadays (e.g., Loizidou, Loizides, & Orthodoxou, 2018; see also 4.3.2.3 for more information on clean-up interventions). In a Spanish study, beach litter was perceived as higher the more plastic was seen and the more often one visits the beach (Rayon-Viña, Miralles, Gómez-Agenjo, Dopico, & Garcia-Vazquez, 2018).

Although the beaches investigated in an Australian study were relatively clean, about 22% of beach goers experienced injuries (e.g., small cuts) from litter which mainly consisted of plastic items (Campbell et al., 2016; see also Santos et al., 2005, for similar results). The majority of respondents, however, did not perceive plastic litter as a human (but rather an environmental) hazard, and previous injuries did not affect the perception of litter (Campbell et al.,

2016). However, in a similar – but older – study human risks were rated higher than or similar to environmental hazards (Santos et al., 2005). The difference between these two studies might illustrate the increased awareness of the environmental hazards described above.

Although US consumers of facial scrubs considered the products safe to use, most of them deny purchasing or using it when confronted with the fact that it contains plastic (Chang, 2015), and others reported both health (related to the skin while using the scrub and accumulation in the food chain) and environmental concerns (see above, Anderson et al., 2016).

Consumers from different countries (Turkey, Sweden, India, and Ghana) expressed concerns about health-affecting properties of plastic, such as harmful substances in plastic and reduced food quality due to the packaging (Aday & Yener, 2014; Fernqvist et al., 2015; Joseph, Kumar, Majgi, Kumar, & Prahalad, 2016; Omari & Frempong, 2016; Omari, Frempong, & Arthur, 2018). However, compared to cans made from metal, plastic is perceived as safe (e.g., Peters-Texeira & Badrie, 2005). In fact, compared to glass bottles or cans made from metal, plastic is reported to cause less injuries when opening a package (Caner & Pascall, 2010). In a Ghanaian study, the degree of worry about leaking substances from plastic packaging into food is similar to other chemical-related risks, such as those from pesticides or artificial coloring (Omari et al., 2018). While the majority of participants from a Hawaiian study on plastic alternatives preferred microwavable containers for takeout food (Barnes, Chan-Halbrendt, Zhang, & Abejon, 2011) other participants of a Swedish study reported concern related to plastic food packages designed for microwave use (Fernqvist et al., 2015). Additionally, plastic bag use is associated with health risks that were not further specified in an Ethiopian study (Adane & Muleta, 2011). Not only were consumers worried about potential health hazards of plastic but regulatory officials were also concerned and uncertain as pointed out in an UK case study (Rothstein, 2003). In general, the risk perception of plastic (pollution) has changed within the few last decades and some characteristics of plastic (e.g., its highly abundant and thus involuntary exposure, unnecessary use, and uncontrollable spread) have led to high risk perception (Syberg, Hansen, Christensen, & Khan, 2018).

CONSUMER PERCEPTION

Much of the plastic waste found in the environment consists of food-related packaging, including bottles, bags, and eating accessories (e.g., Carpenter & Wolverton, 2017; see also Marsh & Bugusu, 2007). Moreover, one third of the worldwide plastic production is for packaging (PlasticsEurope, 2017). Therefore, knowledge about the perception and preferences of consumers is necessary to tackle the plastic problem.

PERCEPTION OF THE ENVIRONMENTAL IMPACT OF PLASTIC PACKAGING AND BAGS

Packaging fulfills a number of functions, including protection of the product and communication of product characteristics (as reviewed by Lindh, Williams, Olsson, & Wikström, 2016; Marsh & Bugusu, 2007). Although the product itself and other aspects of production and transportation usually have a larger impact on the environment than the packaging per se (Jungbluth, Tietje, & Scholz, 2000; Wikström, Williams, Verghese, & Clune, 2014, but see also Pasqualino, Meneses, & Castells, 2011), unsuitable packaging increases the amount of food waste and therefore packaging should be appropriate to reduce environmental impacts (e.g., Silvenius et al., 2014; Williams, Wikström, Otterbring, Löfgren, & Gustafsson, 2012). For example, when Norwegian consumers were unsatisfied with the packaging, they may use their own plastic bag to maintain the freshness of bread and thereby reduce food waste (Østergaard & Hanssen, 2018).

Although appropriate packaging is important for the protection and environmental impact of a product, its material plays only a minor role in the preference of one product over another (Eldesouky & Mesias, 2014; Gelici-Zeko, Lutters, ten Klooster, & Weijzen, 2013; Silayoi & Speece, 2004, but see also Rokka & Uusitalo, 2008, for different results when recyclability of the material was made salient for the choice, and also Widaningrum, 2014, for divergent findings). Other properties of the product or package, such as price, visual and functional aspects of the package, size, and previous experience with the product or brand are rated as more important (Draskovic, Temperley, & Pavicic, 2009; Eldesouky & Mesías, 2014; Gelici-Zeko et al.,

2013; Isa & Yao, 2013; Koutsimanis, Getter, Behe, Harte, & Almenar, 2012; Peters-Texeira & Badrie, 2005; Scherer, Emberger-Klein, & Menrad, 2017; Silayoi & Speece, 2004; Young, 2008). When directly asked about the packaging material, respondents of a study from Thailand stated in interviews that it should be non-toxic, convenient, and prolong high product quality (Silayoi & Speece, 2004).

The negative environmental impacts of plastic packaging are considered disadvantageous (Aday & Yener, 2014; Fernqvist et al., 2015). Plastic-only packaging was ranked medium for environmental friendliness by both Dutch consumers and a life cycle analysis (Steenis, van Herpen, van der Lans, Ligthart, & van Trijp, 2017). In the same study, bioplastic (which was not specifically defined) and glass were rated as especially sustainable by consumers, while a life cycle analysis ascertains that carton and mixed carton-plastic packages are more sustainable in the example of a soup package. Similarly, respondents of other studies rated glass (and sometimes also paper-based materials) most environmentally friendly, while plastic and metal were rated most negative (Lindh, Olsson, & Williams, 2016; van Dam, 1996). Note, however, as mentioned in van Dam (1996, p. 612) that "consumers judge environmental friendliness only from their beliefs concerning the post-consumption treatment of the packaging waste", and therefore consumer perception and results of life cycle analyses may diverge (e.g., Jungbluth et al., 2000; Steenis et al., 2017; van Dam, 1996; Wikström et al., 2014).

In line with this focus on post-consumption, consumers focus more on recyclability, biodegradability, and reusability than on the origin of the raw material when evaluating the environmental friendliness of a material. However, there were also differences among the different nationalities investigated (Germany, USA, and France; Herbes, Beuthner, & Ramme, 2018). Recyclability of the package is generally perceived positively and in experimental studies consumers were willing to pay more for a product with recyclable (plastic) packaging material (Barnes et al., 2011; Klaiman, Ortega, & Garnache, 2016; Rokka & Uusitalo, 2008; Vones, Allan, Lambert, & Vettese, 2018; Young, 2008). However, recyclability of the package is rarely a reason to buy a product (Aday & Yener, 2014; Koutsimanis et al., 2012; but see Rokka & Uusitalo,

2008). This might have various reasons as, for example, post-consumer recycling is sometimes perceived as difficult (e.g., Venter, van der Merwe, de Beer, Kempen, & Bosman, 2011) or impossible (Li et al., 2010). The need to clean a package hinders people from recycling a package (irrespective of material; Klaiman, Ortega, & Garnache, 2017). Furthermore, the environmental attitudes of consumers affect their perception of a packaging made from recycled materials as was indicated by an experimental study showing that French participants with low environmental concern perceived it negatively (i.e., as 'green washing') when there was a claim "made from recycled material" on a plastic bottle compared to an ecologically looking non-plastic bottle (Magnier & Schoormans, 2015).

Generally, biobased materials (i.e., made from plant or other renewable material; irrespective of biodegradability) were preferred over conventional plastic (Kainz, Zapilko, Decker, & Menrad, 2013; Koutsimanis et al., 2012; Magnier & Schoormans, 2015, 2017). Similarly, biodegradable materials (i.e., degradable with the help of microorgansims and/or sunlight) were also preferred over conventional plastic and people may be willing to pay more for it (Muizniece-Brasava, Dukalska, & Kantike, 2011; Yue et al., 2010). The preference for biodegradable and other (seemingly) environmental friendly materials might be due to the perceived advantages of reduced pollution and health hazards (Magnier & Crié, 2015). However, a Romanian study indicated that biodegradable plastic (compared to paper, cardboard, or glass) was rated as the least preferred environmentally friendly packaging material (Orzan, Cruceru, Bălăceanu, & Chivu, 2018). This discrepancy highlights that consumers lack knowledge about the properties of both biodegradable and biobased plastic (Kainz et al., 2013; Koutsimanis et al., 2012; Mohamed, 2015). For example, consumers confound characteristics of bioplastic (i.e., biobased) and biodegradable materials and thus have incorrect associations to them (Blesin, Jaspersen, & Möhring, 2017; see also Young, 2008, for similar findings on recyclability vs. recycled source material). The lack of knowledge might further derived from the facts that those materials are both rarely in use and its environmental effects were understudied so far (Rujnić-Sokele & Pilipović, 2017; Spierling et al., 2018). Relatedly, a Bangladeshi study by Synthia and

Kabir (2015) showed that characteristics of plastic alternatives were unknown and the authors highlighted the need for more education when banning plastic products. Their study revealed that after a ban of certain plastic bags, new alternative bags (e.g., net, nylon, or polyethene bags designed differently to the banned ones) were used increasingly and considered more environmentally friendly although the latter was not always true.

PERCEIVED ADVANTAGES OF PLASTIC PACKAGING AND BAGS

Preference for plastic as a packaging material is based on its functional aspects (e.g., Bech-Larsen, 1996). Several studies from all over the world showed that plastic is preferred due to its convenience, light weight, transparency, resistance, option for resealability, as well as hygienic and protective properties (e.g., Aday & Yener, 2014; Draskovic, 2010; Draskovic & Guszak Cerovecki, 2014; Draskovic et al., 2009; Hollywood, Wells, Armstrong, & Farley, 2013; Phillips, 2016; Venter et al., 2011). The consumers' perception of these advantages is in line with those of Croatian employees of a soft drink company and Australian salespersons (Drašković, 2010; Phillips, 2016). For bags, plastic is the preferred material, because such bags are perceived as convenient, easily available, waterproof, and cheap (Adane & Muleta, 2011; Madara, Namango, & Wetaka, 2016; Musa, Hayes, Bradley, Clayson, & Gillibrand, 2013; Negussie & Mustefa, 2017; Nittala, 2014; Prendergast, Wai Ng, & Lee Leung, 2001).

PACKAGING PREFERENCES DEPENDING ON CONTEXTUAL FACTORS

Although plastic is generally appreciated for several advantages (see above), preference for a certain packaging differs depending on several factors, such as the product category. For example, fruits and vegetables are preferred to be bought loose without any packaging (Ali & Kapoor, 2008; van Herpen, Immink, & van den Puttelaar, 2016). If participants were asked to choose between several materials for fruit and vegetable packaging, they preferred biobased and degradable materials (e.g., cotton or paper) over conventional plastic (Ali & Kapoor, 2008; Fernqvist et al., 2015; Koutsimanis et al., 2012). These findings are in contrast to the approach

used by many supermarkets. When Danish consumers were asked to rate different packages for fresh carrots (plastic bag, plastic or cardboard box with plastic foil), they preferred the boxes over the bag due to higher perceived value and quality (and thus favoring over-packaging; Nørgaard Olesen & Giacalone, 2018). The majority of these respondents mentioned the transparency of the packaging as most important, while environmental friendliness was only mentioned by 15% of the participants. Note that these results were not compared to no packaging. Willingness to pay for less packaging of shampoo was rather low (Yamaguchi & Takeuchi, 2016). Thereby, the motivation to buy a refill-shampoo bottle was mainly a price argument rather than concern for the environment. In addition, these Japanese participants perceived refillable bottles as unsightly or troublesome when reusing them (Yamaguchi & Takeuchi, 2016).

When explicitly confronted with different kinds of cheese packages, Spanish consumers preferred plastic – mainly because of its transparency (Eldesouky, Mesías, Elghannam, Gaspar, & Escribano, 2016; Eldesouky & Mesías, 2014; see Peters-Texeira & Badrie, 2005, for a similar result on fruit preserves). However, some consumers indicated in a word completion task a disfavor of a particular cheese when packed in plastic, likely due to perceived overpackaging and hence its contribution to pollution (Eldesouky, Pulido, & Mesías, 2015). Additionally, Malaysian consumers preferred vinegar in glass rather than plastic bottles although they liked plastic lids more than metal ones (Latiff, Mokhtar, Soon, & Ayob, 2018). For milk and other cold chain products, plastic (and glass) bottles or Tetra Briks (i.e., typical cuboid plastic-coated carton of the Tetra Pak company) with a cap were the preferred packaging materials (Gómez, Martín-Consuegra, & Molina, 2015; Hollywood et al., 2013; Van der Merwe, Viljoen, De Beer, Bosman, & Kempen, 2013 but see also van Dam & van Trijp, 1994, for divergent findings when consumers were asked for perceived environmental friendliness). However, as indicated above, packaging preference depends partly on the context. For drinks, plastic bottles are preferred generally, and especially on the go, but clearly not in the context of cafés and restaurants

where glass is preferred, as was suggested by Croatian studies (Drašković, 2010; Drašković & Cerovečki, 2014; Draskovic et al., 2009).

Besides the described contextual and product-related factors, the consumers' cultural background, age, and environmental attitude influence preferences for plastic as a packaging material (e.g., Draskovic et al., 2009; Lal, Yambrach, & McProud, 2015; van Dam & van Trijp, 1994), see also below in 4.2 for predictors of plastic-related behavior).

PRIMING EFFECTS OF PLASTIC

The material of a package provides more than its functionality; it also affects the consumers' perception of the product and subsequent consumption. For example, plastic packaging is associated with different characteristics of the product such as higher (compared to carton) or lower (compared to glass) hygienic properties (Drašković & Cerovečki, 2014; Venter et al., 2011). Some Croatian and South African consumers perceive products packed in plastic as relatively expensive and assume retained food quality, while others associate it with being cheaper and of lower quality (Drašković & Cerovečki, 2014; Venter et al., 2011). The product itself is perceived as more environmentally friendly when packed in biobased material compared to a plastic alternative as suggested by a French study (Magnier & Schoormans, 2017). Another French study showed that while over-packaging seems to be associated with better quality of the product, it is also perceived as environmentally unfriendly (Elgaaïed-Gambier, 2016).

Besides these more general associations evoked by the packaging, it directly affects the taste and quality of a product. Croatian consumers stated that plastic negatively affects the taste and quality of carbonated drinks due to gas migration (Draskovic et al., 2009). Furthermore, the material of eating utensils influences the perception of a product, whereby plastic is often perceived as less favorable compared to other materials (Piqueras-Fiszman & Spence, 2011; Schifferstein, 2009; Spence & Wan, 2015; Tu, Yang, & Ma, 2015). In addition, tactile perceptions differ between plastic and other bottle materials (Lefebvre et al., 2010).

Moreover, waiving plastic consumption by bringing one's own shopping bag instead of using offered plastic bags affects subsequent behavior by priming (i.e., buying organic food) or licensing (i.e., buying indulgent products) effects, as was shown by an US study (Karmarkar & Bollinger, 2015). Relatedly, an Indian study showed that positive attitudes towards plastic bags negatively affect the willingness to buy environmentally friendly products (Nittala, 2014).

Plastic-related behavior and its antecedents

Despite high awareness of the problem, usage rates of plastic products such as bags are generally high (Arı & Yılmaz, 2017; Musa et al., 2013; Shao, Cai, & Chen, 2014; Sharp, Høj, & Wheeler, 2010). When investigating the relationship between awareness and behavior explicitly, awareness of harmful effects of plastic had no effect on usage behavior (Hammami et al., 2017). To identify predictors of plastic-related behavior, we review studies that investigated possible predictors for the consumption, avoidance, and waste behavior related to plastic.

FACTORS INFLUENCING PLASTIC CONSUMPTION BEHAVIOR

SOCIODEMOGRAPHIC VARIABLES

Gender differences were reported for plastic bag use in a study by Hohmann et al., (2016), though without specifying in which direction. Other studies reported in more detail that women were more willing to accept and apply alternatives to plastic bags than men (Madigele, Mogomotsi, & Kolobe, 2017; Ryan & Jewitt, 1996; Sharp et al., 2010), and showed overall more practices of reusing, reducing, and recycling than men – as do older people in most cases (Kurisu & Bortoleto, 2011).

Older participants were more likely to participate in a no-plastic-bag-campaign (Afroz, Rahman, Masud, & Akhtar, 2017). In contrast, a study on overpackaging showed that younger participants were more willing to give up their convenience in order to help the environment (Elgaaïed-Gambier, 2016). A Croatian study reported that younger participants favored plastic

and carton bottles over glass and metal, while older participants were not concerned about the packaging material during purchase (Draskovic et al., 2009).

Higher educated people were less willing to pay for plastic bags (Madigele et al., 2017) and more likely to participate in a no-plastic-bag-campaign (Afroz et al., 2017), thus showing stronger plastic avoidance than less educated people.

ENVIRONMENTAL ATTITUDES

People (esp. women) with higher environmental attitudes and education stated that they more often avoided disposable plastic packaging (Jeżewska-Zychowicz & Jeznach, 2015). Food-related environmental attitudes were also associated with avoiding plastic packaging and bags (and thus bringing one's own bag more often; Lea & Worsley, 2008). Notably, in another study on reusable bags, social desirability significantly predicted environmental attitudes (Yeow, Dean, & Tucker, 2014). Therefore, it is always advisable to take social desirability into account when looking at self-reported plastic-related behavior (see also below in 4.2.1.7).

CONVENIENCE

As outlined in 4.1.2.2, convenience is associated with plastic. Convenience is also a main reason for plastic bag usage (Braun & Traore, 2015) with respondents especially emphasizing easy availability and low price of such bags (Adane & Muleta, 2011; Otsyina et al., 2018). Similarly, having no alternative option at hand was the most frequently reported reason for using plastic bags (Avallone, Giraldi, & de Oliveira, 2012). Convenience outperformed the classical factors of the theory of planned behavior (i.e., attitudes, subjective norms, and perceived behavioral control; Ajzen, 1991) by being most strongly associated with the intention of using plastic bags (Sun, Wang, Li, Zhao, & Fan, 2017). Relatedly, alternatives to plastic products (e.g., zero packaging grocery stores) were seen as inconvenient and thus rendering the plastic option more attractive (Beitzen-Heineke, Balta-Ozkan, & Reefke, 2017).

CONTEXT FACTORS

Generally, the perceived advantages of plastic products seem to be more important than other psychological variables at the moment of making a decision as was indicated by a Taiwanese study on plastic bags (Lam & Chen, 2006). While both buying and reusing intentions were related to attitudes, environmental concern, and personal norms, the actual purchase behavior was not correlated with such psychological variables. Instead, only situational variables (e.g., the amount of goods being greater than expected) had predictive value (Lam & Chen, 2006). Notably, here the perceived advantages of using plastic bags are probably not inherent to plastic itself but rather due to its availability compared to alternatives. In other conditions, specific characteristics of plastic were reported to be more relevant (e.g., transparency of plastic packaging; Nørgaard Olesen & Giacalone, 2018).

HABITS

Additionally and related to convenience, habits are important for plastic consumption. In a study on Brazilian immigrants in Canada, the participants indicated that plastic usage in their homeland had been "just a habit" (Romero, Laroche, Aurup, & Ferraz, 2018, p. 8). Having moved, they changed their behavior by showing greater plastic bag avoidance and waste separation (Romero et al., 2018). Notably, pro-environmental attitudes remained unchanged throughout the process of habitual change (Romero et al., 2018). Changed norms and/or external conditions might have facilitated a change of habits in this case (see also below in 4.2.1.7), which highlights the importance of cultural factors for the emergence of habits.

Even when participants were willing to reduce their plastic consumption, they partly failed because they were not able to apply new habits, as was suggested by two studies in which the most common reason reported for the use of plastic bags was forgetting to bring one's own bag (Bartolotta & Hardy, 2018; Musa et al., 2013). Similarly, in a Malaysian study on a plastic-free-day-campaign, about 60% of the respondents regularly forgot to bring their own bags during the campaign (Zen, Ahamad, & Omar, 2013).

DIFFUSION OF RESPONSIBILITY

Another reason that consumers do not act in line with their risk perception might be that they shift responsibility to other actors like politicians (Synthia & Kabir, 2015). In interviews on plastic bag pollution, Malian women emphasized structural problems (e.g., the lack of appropriate waste collection services) and called for political solutions (Braun & Traore, 2015). Intriguingly, when policy makers were interviewed, they emphasized the consumers' responsibility (Braun & Traore, 2015).

SOCIAL FACTORS

Several studies suggested that social pressure is an important variable influencing the use of plastic (Arı & Yılmaz, 2017; Carrigan, Moraes, & Leek, 2011; Musa et al., 2013). Furthermore, social desirability seems to be relevant for reporting plastic avoidance behavior (Sharp et al., 2010; Yeow et al., 2014).

Initial evidence showed that guilt affects plastic avoidance (Muralidharan & Sheehan, 2017). For example, people reported both feelings of guilt and the fear of being judged or criticized by other customers, when taking plastic bags at a counter (Cherrier, 2006).

Avoidance of plastic is further utilized as a symbolic action conveying a certain social identity, as suggested by Australian consumers reporting to use reusable bags to be visibly identified as part of an environmentally friendly group (Cherrier, 2006). Similarly, avoiding plastic might be a deliberate act to firm one's cultural identity, as it was reported by women in Mali (Braun & Traore, 2015). This effect was influenced by age, as older women were more concerned about preserving their cultural heritage by avoiding plastic bags, while younger women felt rather proud of being "modern" by using plastic bags (Braun & Traore, 2015). Relatedly, fans of a certain shoe brand that promotes its plastic shoes as especially flexible and robust due to its material, form their own identity including their own name (Ferreira & Scaraboto, 2016). Similar to the emotionality of these fans of the plastic shoes, another study indicated that emotions play a larger role than rational evaluations for purchasing a product in an

environmental-friendly package (Koenig-Lewis, Palmer, Dermody, & Urbye, 2014; see also Phillips, 2016, for qualitative data on affective responses towards plastic use).

Since social desirability and identity are relevant for plastic use and avoidance, it is likely that related norms are important too. When analyzing the case of a town in England where a plastic bag ban had been enforced by local traders, Carrigan and colleagues (2011) reported a shift in community norms for plastic bags throughout the process of becoming plastic bag free. Additionally, ethical evaluations had a direct (R. Y. K. Chan, Wong, & Leung, 2008) or indirect influence on the intention to bring one's own bag (Chang & Chou, 2018).

Clapp and Swanston (2009) pointed out that anti-plastic norms first occurred in Southern countries, driven by simultaneous, non-networked bottom-up initiatives. Notably, changes in anti-plastic-norms usually go hand in hand with structural changes. Therefore, it is often difficult to attribute behavioral changes to changed norms or to facilitating external conditions as was shown in the study on immigrants by Romero and colleagues (2018; see above).

FACTORS INFLUENCING PLASTIC WASTE HANDLING

Dealing with plastic does not only include the consumption or avoidance of plastic products but also handling its waste, which includes recycling, littering, and reusing. The behavior shown depends strongly on the respective country and its cultures and infrastructure. For example, open dumping or burning is reported to be common in African countries or China (e.g., Madigele et al., 2017; Otsyina et al., 2018), whereas studies from Europe usually rate plastic as one of the most commonly recycled materials (e.g., Jones, Jackson, Bates, & Tudor, 2016). In an Indian study, households with lower income reused waste themselves, while households with higher income gave it away for reuse and recycling, suggesting that socioeconomic differences within a country might play a role as well (Pandey, Surjan, & Kapshe, 2017). There are further studies on creative waste disposal (e.g., the production of art from of recycled plastics; McKay & Perez, 2018), which are not reported here due to their individual case character. As the majority of studies addressed recycling or littering, we will focus on these.

RECYCLING

Several studies focused on predicting recycling behavior or its intention using the theory of planned behavior. By doing so, between 29% (Knussen, Yule, MacKenzie, & Wells, 2004) and 44% (Chan, 1998) of the variance of recycling intention could be explained. Contrary to the findings mentioned above on the avoidance of plastic, subjecs had no (Knussen et al., 2004; Pakpour, Zeidi, Emamjomeh, Asefzadeh, & Pearson, 2014; Tonglet, Phillips, & Bates, 2004; Tonglet, Phillips, & Read, 2004) or only weak (K. Chan, 1998; Tih & Zainol, 2012) influence on recycling intention and behavior. Examining norms further, one study found that descriptive (i.e., perception of how others actually behave) but not injunctive (i.e., perception of how others expect somebody to behave) norms predicted the intention to engage in household recycling (White, Smith, Terry, Greenslade, & McKimmie, 2009).

Constructs having an influence exceeding the constructs of the theory of planned behavior were past behavior (Knussen et al., 2004; Pakpour et al., 2014; Tonglet, Phillips, & Bates, 2004), habits (Klöckner & Oppedal, 2011; Knussen et al., 2004; Ofstad, Tobolova, Nayum, & Klöckner, 2017), action planning (Pakpour et al., 2014), moral norms, and self-identity (Pakpour et al., 2014; White et al., 2009), as well as green practice consequences (i.e., knowledge of the outcomes associated with one's green practices; Tih & Zainol, 2012).

Tonglet, Phillips, and Bates (2004) reported that recycling attitudes are the main determinant of recycling behavior, and that opportunities, knowledge, and not feeling deterred by behavior costs are antecedents of pro-recycling attitudes. Similarly, convenience or cost of recycling (e.g., the necessity of cleaning packaging before recycling; Ahmad, Bazmi, Bhutto, Shahzadi, & Bukhari, 2016; Klaiman et al., 2016), and context factors, such as the availability of waste bins (Madigele et al., 2017) or waste bins being overloaded (Vogt & Nunes, 2014), were considered important. Mass communication was identified as an antecedent of subjective norms (Chan, 1998). Unlike individual personal decisions, where environmental reasons seemed more relevant than financial incentives (Afroz et al., 2017), financial considerations played a crucial role in company decisions (Meng, Klepacka, Florkowski, & Braman, 2015).

LITTERING

Sociodemographic variables predicting littering are gender, income, and education. Men took stronger action against littering (Rayon-Viña et al., 2018) though findings are inconsistent as in another study where women reported more concern about litter and had greater personal motivation and competence to reduce it (Hartley, Pahl, Veiga, et al., 2018). Littering amount per day at beaches was higher in a region frequented by people with lower income and literacy degree (I. R. Santos et al., 2005).

People from less littered regions showed more engagement in waste reduction strategies (Kiessling et al., 2017), although elsewhere concern and willingness to act were higher the more litter people noticed (Hartley, Pahl, Veiga, et al., 2018). Another study found no correlation between the perception of and action against littering (Rayon-Viña et al., 2018).

Social norms were found to be an important predictor for the act of littering, and awareness of the anti-social nature of littering was strongly related (Shimazu, 2018). Interestingly, environmental awareness was less predictive for reported littering behavior (Shimazu, 2018). Tourists were found to be primarily responsible for littering – again implying the relevance of social norms as tourists might have different norms than locals (I. R. Santos et al., 2005). However, this finding may also be explained by the fact that tourists feel less responsible for their travel destination than locals as they stay for shorter time and take less consequences, or because being on holiday may activate certain behavior patterns.

In summary, dealing with plastic is highly influenced by social factors (e.g., social desirability and norms), context factors, convenience, and habits. As far as the handling of plastic waste is concerned, there are mainly studies on recycling and littering. Recycling behavior can be well predicted by the constructs of the theory of planned behavior, with social norms being least important. In turn, social factors are particularly significant for littering. The studies reviewed imply to consider cultural differences when studying plastic-related behavior. These differences can arise because distinct external conditions prevail in different countries, but they may also be explained by varying norms, among others.

Solutions to tackle the plastic problem

In view of the huge challenges elicited by plastic consumption, solutions to tackle the plastic problem are needed. First, we introduce a variety of regulatory and economic policy instruments aimed at reducing plastic use which either already exist or are considered for implementation in countries around the world. Second, we will review "softer" and more psychological intervention strategies which are currently tested.

REGULATORY AND ECONOMIC POLICY INSTRUMENTS TO REDUCE PLASTIC USE

There are two main types of policy instruments aimed at reducing plastic use. While some countries have imposed full or partial bans on plastic bags or other plastic items, other countries prefer economic policy instruments such as fees, levies, or taxes that are paid either by the retail industry or the consumers (Ritch, Brennan, & MacLeod, 2009; Saidan, Ansour, & Saidan, 2017; Syberg et al., 2018; Wagner, 2017). The implementation of these instruments varies between and within countries with respect to policy details (e.g., the size and thickness of plastic bags). Here, we provide a brief overview of the two types of policy instruments and discuss some related psychological and political aspects. It is still unclear which instruments are most environmentally effective and politically acceptable (Ritch et al., 2009). In addition, note that another policy strategy, namely the so-called 'Extended Producer Responsibility', aims to return the responsibility for products after their use back to the producers, for example by taking back, reusing, or recycling products (optionally by a third party; see Hanisch, 2000; McKerlie, Knight, & Thorpe, 2006). However, as we focus on consumers in this review it is not elaborated here.

BANS

Bans of some kind are a widely adopted policy action and they are, by their nature, an effective way to reduce plastic use. Nevertheless, it is important to consider some potential unintended consequences, such as the use of alternative bags (e.g., of paper). The latter may be as harmful

for the environment as plastic bags, but may be judged by consumers as more environmentally friendly (Synthia & Kabir, 2015; and see above in section 4.1.2.1). This effect can be counter-vailed by also imposing fees or taxes on alternative bags, which was done successfully in many US local governments (Wagner, 2017). Another problem associated with bans is that they may evoke strong consumer resistance. This, in turn, may reduce the political acceptability of this policy instrument. However, research from Australia indicates that those consumers who strongly relied on plastic bags before a ban became supportive of the policy after its introduction, which may be due to visibility of their positive environmental effects (Sharp et al., 2010). A study from Brazil also showed high approval ratings after the ban was introduced, with over 86% of the participants considering the new law important or very important (Santos, Sousa, Sampaio, & Fagundes, 2013).

PLASTIC CHARGES AND OTHER TYPES OF ECONOMOC INCENTIVES

The seemingly most widespread policy instrument to reduce plastic use is the introduction of a charge (alternatively referred to as "tax" or "fee", depending on context). Several studies have examined the effectiveness of a charge in changing behavior as well as its acceptance by customers and industry. With respect to effectiveness, studies from various high- and low-income countries indicated that disposable plastic bag use dropped by 40% to 90% after implementing a charge (e.g., Convery, McDonnell, & Ferreira, 2007; Dikgang, Leiman, & Visser, 2012; Dikgang & Visser, 2012; He, 2012; Poortinga, Whitmarsh, & Suffolk, 2013; Thomas, Poortinga, & Sautkina, 2016). For example, Wales introduced a 0.07€ charge for "single-use carrier bags" in 2011. The distribution of such bags fell by over 80%, while the number of people "always" bringing their own shopping bag increased by over 20% (Poortinga et al., 2013; Thomas et al., 2016). Noteworthy, such changes were not observed in other UK countries where no charge was introduced during that time. Moreover, the results from Thomas and colleagues (2016) suggest that the plastic charge had additional environmental effects, namely insofar as the use

of one's own bag seemed to have increased the adoption of other, unrelated types of pro-environmental behaviors and attitudes (see also Truelove, Carrico, Weber, Raimi, & Vandenbergh, 2014, for a theoretical review on spillover research).

Some authors, however, suggested that the impact of a plastic charge might be overestimated, because unobserved factors such as changes in social norms are often not accounted for when comparing simple differences before and after the implementation of a charge (Rivers, Shenstone-Harris, & Young, 2017). In other words, it may not just be the monetary incentive that drives the behavioral changes, but also anti-plastic norms which inspire the introduction of the policy, but arguably may also be a consequence of it. This relates to research investigating the underlying motives of behavioral change resulting from a plastic charge. For example, a study from Portugal showed that for most of the participants indeed the main reason for not using plastic bags was to avoid the payment, but other reasons associated with convenience and environmental concern were mentioned as well (Martinho, Balaia, & Pires, 2017). Another issue related to the policy effectiveness is the long-term dynamics. That is, in some countries such as South Africa it was observed that demand for plastic bags went down as a consequence of introducing a charge, but after approximately a year increased again, though never completely to initial levels (Dikgang et al., 2012; Dikgang & Visser, 2012; Hasson, Leiman, & Visser, 2007). While this particular case can partially be explained by the fact that the initial charge levels were decreased, these observations certainly suggest the need for more long-term research to assess the instrument effects.

Finally, plastic charges are relatively accepted by consumers as well as the retail industry. For example, the Irish plastic bag levy is very well perceived by retailers because of financial savings, whereas almost all consumers perceived positive environmental benefits and no negative effects in terms of convenience (Convery et al., 2007; see also Zen et al., 2013). Nevertheless, research from Argentina indicates somewhat lower levels of acceptance by consumers, which may be due to differences in environmental concern or in terms of how the government has implemented and communicated the policy (Jakovcevic et al., 2014).

Another type of economic incentive is provided by deposit-refund systems, which compensate consumers monetarily for returning plastic products. For example, research from the US and Australia shows that coastal debris is approximately 40% lower in states that have such a refund system compared to others without it (Schuyler, Hardesty, Lawson, Opie, & Wilcox, 2018). Relatedly, we present additional findings on recycling schemes below.

To conclude, regulatory and economic public policies are effective in reducing plastic use. While bans are evidently most effective, they may not be politically feasible in every context. Plastic charges are a promising alternative, though more research is needed to investigate their long-term effects.

PSYCHOLOGICAL INTERVENTIONS

Beyond regulatory and economic interventions less coercive ones, such as educational approaches or improvement of infrastructure, are aimed at increasing awareness and to encourage behavior change. Guided by the three R's of waste management (recycle, reuse, and reduce; Thompson, Moore, vom Saal, & Swan, 2009), we now provide an overview of psychological interventions that aim at tackling the plastic problem.

RECYCLE

In the 1980's, many studies examined recycling and littering behavior as well as the influence of personal and situational factors on them (for reviews, see Schultz, Oskamp, & Mainieri, 1995; Huffman, Grossnickle, Cope, & Huffman, 1995). Later meta-analyses have focused on recycling in different settings such as at the workplace (Oke, 2015) or at home (Varotto & Spagnolli, 2017). However, most studies did not explicitly focus on plastic. Yet, a generalization over materials might be problematic when predicting recycling behavior (Schultz et al., 1995). In the following, only studies that investigated plastic explicitly are reviewed.

Accessibility of recycling schemes. Most of the studies investigated interventions at the point of action. The implementation of recycling stations in university settings encouraged recycling behavior (McCoy, Oliver, Borden, & Cohn, 2018; O'Connor, Lerman, Fritz, & Hodde, 2010; Ofstad et al., 2017). While lower distances to recycling bins enhanced recycling, a mere increase of bin quantity did not (O'Connor et al., 2010). Recycling amount of household plastic waste was higher when people had to bring it to public places, compared to when it was collected at the sidewalk, although more people participated in the latter (McDonald & Ball, 1998). In other studies, the recycling rate for household collection was higher than for "bring" schemes (Struk, 2017; Viscusi, Huber, & Bell, 2012). Additionally, incentives increased the overall recycling rate of plastic (Struk, 2017). Similarly, deposit systems for plastic bottles increased the attractiveness of "bring" schemes (Viscusi et al., 2012). Although, higher density of drop-off sites for "bring" schemes had only small effects (Struk, 2017), recycling rates decreased markedly when they were more than five miles away (Viscusi et al., 2012). In a Japanese study, people had a higher willingness to pay for less packaged shampoo when a unit-based pricing system of waste collection existed in their municipality. However, the general willingness to pay was quite low. When unit-based pricing was combined with plastic separation, willingness to pay decreased suggesting that recycling can lessen plastic reduction behavior (Yamaguchi & Takeuchi, 2016).

Appearance of recycling stations. People in Greece associate certain colors of public bins with different waste materials; while yellow was preferred for used plastic water bottles in particular, orange, yellow, or purple was chosen for plastic or packaging in general (Keramitsoglou & Tsagarakis, 2018). However, only changing the color of the bin had no effects on recycling rate as a US study indictaed (O'Connor et al., 2010). Moreover, covered bins with special drop slots and lids were preferred (Keramitsoglou & Tsagarakis, 2018). Other studies showed that signs prompting recycling increased correct recycling even when proximity to the bin decreased, and hence highlight the role of messages on the bins, especially in combination with the implementation of recycling schemes (Fritz et al., 2017; Miller, Meindl, & Caradine, 2016).

Furthermore, positive messages such as “thank you” or those referring to the environment encouraged people to continue recycling (Keramitsoglou & Tsagarakis, 2018).

Informational campaigns. Recycling behavior was strengthened when information campaigns were added to the implementation of recycling schemes (Cheung et al., 2018; Ofstad et al., 2017; Pearson et al., 2014). Information campaigns using posters, TV screens, flyers, websites, or broader environmental campaigns increased awareness, knowledge, and self-reported disposal behavior (Cheung et al., 2018; Ofstad et al., 2017; Pearson et al., 2014). In contrast, informational treatments using text or video did not increase recycling behavior but rather changed using preferences from plastic packaging to paper and boxboard (Klaiman et al., 2016). Nevertheless, a lack of instructions might be a barrier to recycle plastic (Vogt & Nunes, 2014). While pushy requests (e.g., “You must recycle plastic container”) were persuasive for recipients who already valued recycling as important, suggestive appeals (e.g., “It’s worth recycling plastic containers”) were more effective to initiate recycling intention for those who find recycling less important (Kronrod, Grinstein, & Wathieu, 2012). When participants were asked to plan and visualize when, where, and how to recycle their used plastic cups and old paper, this type of implementation intention increased recycling rates and thus decreased the number of cups in the dustbins by roughly 75% (Holland, Aarts, & Langendam, 2006). An awareness campaign including knowledge transfer and vocational training was also proposed to increase recycling in refugee camps in Jordan (Saidan, Drais, & Al-Manaseer, 2017).

Rebound effects. In an online experiment, participants were asked to do their typical grocery shopping in an online supermarket. After shopping they got fictitious feedback independent of their real shopping behavior. When people were told that they were considered as "green shoppers" (in comparison to a bogus peer group), participants recycled less of disposed material they got for a creativity task before (Longoni, Gollwitzer, & Oettingen, 2014). The decreased motivation to gain a green identity in this group indicates a self-licensing effect, signifying people who feel save in their goal achievement (e.g., being a green consumer) makes peo-

ple to worry less about other unsustainable behavior (Longoni et al., 2014). Similarly, US students were experimentally triggered to either recycle a water bottle, to throw it in the trash, or neither. Those who identified as Democrats and recycled their bottle were less willing to support a green fund compared to the control condition (Truelove, Yeung, Carrico, Gillis, & Raimi, 2016). This effect was mediated by environmental identity, indicating that for Democrats (who already show a high recycling baseline) recycling might be too easy to increase environmental identity. Thus, promoting recycling in certain groups could lead to a decrease in pro-environmental behavior in general (Truelove et al., 2016).

Conclusion. Implementing recycling schemes are necessary to increase recycling. However, it needs to be well planned, especially with a view on local conditions (i.e., proximity of bins, combination with incentives and information) and rebound effects of recycling policy. An elaborate but powerful approach is implementation intention to tackle habit change for a concrete behavior.

REUSE

One main characteristic of plastic is its durability. In a somewhat paradoxical contrast, it is mostly used in a disposable manner. Increasing the reuse of plastic products might therefore provide a solution to the wastage of this durable material. For example, in interviews, respondents stated to use plastic bottles "for a purpose other than that for which it was initially designed" (Caner & Pascall, 2010, p. 418) when a screw-type closure is used and bottles could be easily cleaned and refilled. However, only a few studies, which we review in this section, evaluated interventions related to reuse in order to avoid plastic waste. Most of them focus on beverage containers or plastic bags.

Provision of alternatives. US students who received a reusable water bottle and plastic cutlery for their matriculation used less disposable bottles and supported the bottle ban at the university (Santos & Van der Linden, 2016). Similarly, information about the reduction of plastic bottles before implementing a water refill system helped to increase the willingness to pay,

environmental awareness, and responsibility attribution in Japanese students (Uehara & Ynacay-Nye, 2018). In the UK, different interventions on reusable coffee cups were evaluated and the study authors concluded that providing a reusable cup increased its use, even in the long run (Poortinga & Whitaker, 2018). Furthermore, a charge on disposable cups – but not a discount – increased the use of the reusable cup. The single intervention had only small effects but they increased when combining interventions, in particular when message framing is added (Poortinga & Whitaker, 2018).

Rewards and framing. The interventions using a ban or taxes leading to the reuse of plastic bags were already mentioned above. Another program successfully encouraged consumers – even in the long run – to use reusable instead of plastic bags via monetary rewards and peer pressure (Jiang, 2016). Advertisements in a US supermarket encouraging consumers to bring reusable bags were either formulated as a gain "Bring reusable bags and avoid a fee" or as a loss "Bring reusable bags or pay the tax". While both ads worked, the first was less effective for people with low self-transcendence values (i.e., higher egoistic needs and low environmental awareness; Muralidharan & Sheehan, 2016, 2017). Vones, Allan, Lambert, and Vettese (2018) presented another option to build awareness for the reuse of plastic (without evaluating the project) by doing a beach-clean-up with a subsequent 3-D-printing workshop reusing the collected waste.

Conclusion. Providing alternatives such as reusable coffee cups or refillable bottles are promising approaches to reduce plastic waste. However, they are quite expensive and thus charges or bans may be more attractive for stakeholders. Moreover, alternatives have only selective effects with regard to a concrete product questioning the broader scope. Regulations of prices yielded to more reuse – not only due to the money benefit but also because of a subsequent shift in norms. Similar to recycling, a combination of available options and information campaigns seem to be promising.

REDUCE

While both recycling and reuse practices lower the plastic waste in the environment, they cannot alleviate resource use in general. Thus, reducing plastic use and production are critical. Both consumers and salespersons play essential roles for demand and supply. Recently, so called "zero waste" grocery stores emerged, and both advantages and disadvantages thereof are discussed in the literature (Beitzen-Heineke et al., 2017). However, most of the studies focusing on plastic reduction behavior refer to education on marine litter and address children, educators, and public.

Educating school children. School education programs increased both knowledge about causes and impacts of marine litter and environmental behavior intention in children (Hartley et al., 2015; Owens, 2018; So et al., 2016; Veiga et al., 2016). Active learning elements such as gaming simulations with role plays in a simulated city (Yeung, So, Cheng, Cheung, & Chow, 2017), inquiry learning strategies including independent learning with experiments (Hartley et al., 2015; Yeung et al., 2017), collecting of marine debris and report writing for a state legislator (Owens, 2018), and video contests about marine litter in different European countries (Hartley, Pahl, Holland, et al., 2018; Veiga et al., 2016) were used to change knowledge and behavior. Gaming simulation further induced attitude change via cognitive dissonance (i.e., psychological discomfort due to inconsistency between one's beliefs and behaviors; Yeung et al., 2017). Inquiry learning strategies focusing on the classification of plastics failed to increase waste-related behavior (i.e., reduce, reuse, and recycle) but led to an increase in knowledge about plastic types (So et al., 2016). Inquiry learning strategies including experiments, artworks, and demonstrations on marine litter revealed some overarching effects, as school children's self-reported behavior on littering and buying plastic packaging was reduced while the motivation to encourage others to do so increased (Hartley et al., 2015).

Training of stakeholders. Some programs did not address school children directly but aimed at teaching educators. After working with an online tool that included learning about marine litter and pedagogical skills, knowledge and perceived skills of educators increased and

they expressed high intentions to integrate marine litter education in future classes (Hartley, Pahl, Holland, et al., 2018; see Cheung et al., 2018, for a similar study). Moreover, art presentation in an educational context was discussed to initiate useful conversations with children about mass consumption and pollution (O'Gorman, 2017).

Educating the public. To raise awareness for plastic pollution, several countries have implemented campaigns. For example, activities developed by the MARLISCO initiative (e.g., public exhibitions, stakeholder meetings, and education tools) increased the feeling of being part of the solution as well as societal awareness and engagement related to marine litter (Veiga et al., 2016). An online campaign for adolescents that included tailored information (e.g., small action steps) increased knowledge, attitude, or behavior intention depending on the respective participants' stage of change (Chib, Chiew, Kumar, Choon, & Ale, 2009). When different councils in Australia were compared, those with educational campaigns on why and how to dispose waste correctly had less waste on their coastlines (Willis, Maureaud, Wilcox, & Hardesty, 2018). Furthermore, Greek informational campaigns aimed to reduce plastic bags raised the willingness to pay for protection of coastal environments but had no effect on the willingness to take action (Latinopoulos, Mentis, & Bithas, 2018).

Participation in plastic-reduction activities. Citizen science projects in which people are asked to participate in beach clean-ups increased the awareness of marine littering (Syberg et al., 2018; Yeo et al., 2015). Knowledge and positive attitudes were underlying factors for the willingness to participate in "plastic-free"-campaigns in Malaysia (Afroz et al., 2017). When fishermen encouraged others not to litter and participated also in beach clean-ups they developed a sense of ownership for "their" beaches along with a feeling of responsibility (Brennan & Portman, 2017). Involving school students in plastic-free practices, in which they helped to organize activities as co-researchers, led to an improvement in their awareness and behavior of littering (Mapotse & Mashiloane, 2017).

Interventions at the point of consumption. Looking at the product presentation, a non-overpacked product tagged with "No excess packaging" increased the purchase of these products. When this tagged product was additionally combined with a premium brand the purchase rate was highest (Elgaaïed-Gambier, 2016). A voice prompt by the salesperson during the purchase situation (i.e., customers were asked whether they wanted a free plastic bag instead of automatically handing them one) lead to a 5% decrease in plastic bag consumption (Ohtomo & Ohnuma, 2014). To motivate shop owners in Indonesia to sell reusable instead of plastic bags, information activating authority endorsements (i.e., head of the village supports the idea of distributing reusable bags) was more effective than information activating social norms or monetary incentives (Spranz, Schlüter, & Vollan, 2018). Such social influence of role models is also important for recipients indicated by the finding that the intention to reduce plastic waste was increased when recipients have read a media report with an actor behaving ecologically, whereas the actor's social proximity was relevant when recipients had low environmental consciousness (Arlt, Kuhlmann, & Wolling, 2012). Furthermore, making one's intention public helps to reduce plastic consumption via social pressure. Participants who signed a commitment to refuse free plastic bags were more likely to reduce their use afterward (Rubens, Gosling, Bonaiuto, Brisbois, & Moch, 2015). Reese and Junge (2017) used a game in which people could mark a plastic consumption pattern on a card after its realization (e.g., using a bag for purchase or making a purchase without plastic packaging) and then give it to another person of choice. When the task was perceived as moderately difficult, participants' collective efficacy (i.e., their feeling that acting together helps reach a goal) was highest and most predictive for behavioral intentions.

Conclusion. Participation in clean-up activities and educational approaches was effective to raise awareness and partly also to change behavior intention. Focusing on school children and their educators is promising to create awareness for environmental challenges at an early age. Overall, inquiry learning strategies and gaming approaches encouraging people to get active themselves seem most promising. The role of social norms became apparent as far

as the concrete purchase situation is concerned. Making one's purpose public via commitment or introducing role models were successful approaches to reduce plastic consumption. Nevertheless, more research is needed to identify factors for a general transformation in purchase or reduction behavior.

Discussion

Summary

The current review gave a comprehensive overview of the available social-scientific literature addressing plastic with a focus on risk awareness, consumer preferences, plastic use and disposal behavior, and behavior-oriented intervention strategies. By reviewing 187 articles from all over the world, this review provides a summary of the existing knowledge for researchers and stakeholders worldwide. Further, it identifies promising behavior-based solutions for the plastic problem.

The literature search revealed that interest in the plastic problem has markedly increased in social science in the last few years (Figure 3). These studies were from different countries worldwide. Although large-scaled surveys were relatively rare and focused mostly on countries in Europe or the US (Gelcich et al., 2014; Hartley, Pahl, Veiga, et al., 2018; Herbes et al., 2018), single studies were from all over the world and lead to a relatively weak bias for industrialized nations compared to other areas of research in which this bias is stronger. As plastic pollution is most often perceived as a threat for marine ecosystems (see Lotze et al., 2018, for a worldwide comparison), our review also indicates that most studies originate from countries with a coastline (Figure 2). The visibility of the problem in marine areas might have led to a stronger interest in this field. In total, across the 187 studies reviewed samples from 57 countries were investigated (Figure 2). Similarly, the first authors of the reviewed studies had an affiliation in 49 different countries (see S1 for an overview of all reviewed studies, the location of data collection, and the country where the first author was based at the time of publication). Although this diversity of study samples is important and much appreciated,

drawing general conclusions is – so far – difficult due to the yet limited number of studies per country and their associated culture(s), laws, infrastructure, and further situational factors.

Overall, the studies reviewed were from different (sub-)disciplines, including marketing, consumer studies, psychology, educational science, and environmental science, presenting a diversity of perspectives on the present topic. The articles covered various methodological approaches making comparisons and general conclusions difficult. Many studies, especially those focusing on awareness, perception, and attitudes, were of a qualitative nature. Moreover, most studies on behavior either focused on intention or self-reported behavior rather than actual behavior – although there are well-known gaps between attitudes, intentions, and behavior (see Kollmuss & Agyeman, 2002).

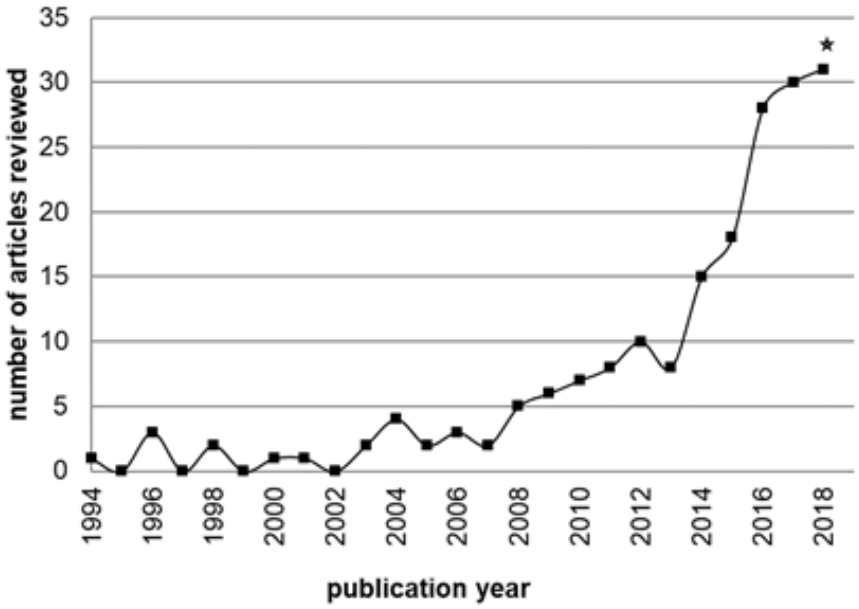

Figure 3 Number of articles reviewed by year of publication

* Note that only articles published before September 27, 2018 were considered in this review.

The studies identified high problem awareness of plastic pollution. In addition, people perceive certain health hazards related to plastic consumption. Although plastic is perceived as rather environmentally unfriendly, it is frequently used and appreciated for its practical functions and availability. Thus, plastic consumption is generally high, but this also seems to

vary between contexts and cultures. Similarly, this might be the case for reusing plastic as, for example, people with lower income tend to reuse plastic more often (Pandey et al., 2017). The reviewed studies showed that knowledge about alternatives to plastics and their characteristics is relatively low. Behaviors related to the use of plastic seem to be most affected by habits and (social) norms. Both political (e.g., bans, charges) and psychological (e.g., inquiry learning strategies, implementation intention) intervention strategies aim to change these by focusing on habits, availability, costs, situational factors, and awareness.

Implications for behavior-based solutions

Although problem awareness is high, behavior change does not follow automatically, mainly because of the following obstacles: 1) perceived practicability and convenience in the consumption context, 2) lack of knowledge on how to implement alternatives or lack of opportunities, 3) strong habits, and 4) shift of responsibility. Therefore, behavior-based solutions need to approach these issues. This may be done in an interdisciplinary manner. For example, by designing (by engineers), evaluating (by material, environmental, and social scientists) and promoting (by media) alternative materials that do have the appreciated properties of plastic but are more environmentally friendly (e.g., see Haider et al., 2018, for a good example considering some of these aspects). Consumers have not only insufficient knowledge about alternative materials but also about what an environmentally friendly material is, as indicated by the divergence of consumer perception and life cycle analyses (see chapter 4.1.2.1). Since consumers focus mainly on post-consumption (e.g., recyclability), more information about environmental impacts in the whole life cycle of a product may increase the knowledge about environmentally friendly materials and guide the consumer to better alternatives. However, since awareness and knowledge are not the only relevant factors influencing behavior, an increase in these does not necessarily imply a change in behavior. Despite the attitudes of the consumers, situational factors such as an appropriate infrastructure for alternatives need to be considered. Moreover, social and personal factors as well as habits play a crucial role, as suggested

by the studies on plastic-related behavior. To initiate a habit change, 'windows of opportunity' (Schäfer, Jaeger-Erben, & Bamberg, 2012) – periods where people are open for new behaviors as external conditions change (e.g., relocation) – may be preferably used. As windows of opportunity are not always available, a change in situational factors such as the provision of alternatives should also be used to initiate new behavior. Individuals that start a new behavior, might lead others to follow, can hence change norms, and set a spiral of action in motion. Thus, reaching a critical mass of acting people is helpful.

For all behavior-based solutions, it is important to consider structural, situational, and cultural factors. Although, the available literature is insufficient to make a final conclusion, awareness of the situation in a specific region (e.g., whether there is infrastructure for recycling) and what problems are most pressing (e.g., health hazards and thus importance of hygienic packaging) helps to identify the change of behavior that is most promising (cf., Steg & Vlek, 2009). Moreover, depending on particular circumstances and/or cultural background, demands of situational factors and infrastructure need to be considered (e.g., waste management in refugee camps vs. residential complexes; cf., O'Connor et al., 2010; Saidan, Drais, et al., 2017).

The reviewed literature shows that plastic consumption and avoidance is generally similar to other environmental behaviors as 1) it affects several aspects in life (as does mobility, for instance), 2) there is a conflict between problem awareness and behavior, and 3) it is predicted by situational factors as well as personal factors such as sociodemographics, habits, control beliefs, moral, and social norms. Therefore, models explaining pro-environmental behavior, such as the so-called SIMPEA which addresses social identity processes that affect appraisal and response to collective environmental challenges (Fritsche, Barth, Jugert, Masson, & Reese, 2017), might be helpful to further understand and study plastic-related behavior. Additionally, knowledge from available behavior-based solutions on other environmental behaviors can be used to create interventions – and vice versa. For example, the success of plastic

bag bans, fees, and taxes may motivate bans of other environment-damaging products. However, so far, the field lacks studies evaluating the long-term effects of such political interventions. What makes plastic-related behavior special is its diversity (consumption of alternatives, avoidance, reuse, recycling). Thus, a close look at specific behavioral antecedents as well as examining the impact of political measures as bans or change in infrastructure becomes therefore necessary in intervention context.

Citizen science and organized clean-ups appear to be promising approaches to raise awareness and responsibility, motivate reuse, and change behavior since, for example, people residing near clean beaches engage more in waste-reduction approaches (Kiessling et al., 2017). Further, organized clean-ups might be successful due to two other factors: creating a new habit by doing it once with instructions and strengthening the social norm by doing it with others. Since humans are social beings, social norms play a major role in (environmental) behavior. As it was pointed out throughout the review, norms predict different forms of plastic-related behavior although they were not as strong as in classical studies using the theory of planned behavior. Moreover, successful intervention studies with role models and voice prompts by salespersons highlight the social factor. Therefore, interventions that change norms are promising. When combined with adjusted situational factors and information they might have even bigger effects. Overall, intervention strategies should be combined since, so far, no strategy alone is sufficient to reduce the immense use of plastic. Moreover, the interventions need to be well-planned to reduce unwanted effects (e.g., licensing effects, perceived green-washing, or rebound-effects) and to meet the needs of the target group and therefore gain their acceptance.

Furthermore, different actors are needed to approach the plastic problem from various directions. While educators, media directors, and organizers of activities, such as beach clean-ups, are in positions to raise awareness, increase knowledge, and train alternative behavior patterns, stakeholders, politicians, and salespersons are capable to adjust general circum-

stances and situational factors to change consumption and waste behavior. For example, promoting a 'circular economy' or implementing an 'Extended Producer Responsibility' might be fruitful to make producers accountable and thus should be pursued by politics and public. Despite recently introduced laws on the national level that contribute to tackling the plastic problem (e.g., prohibition of plastic microbeads in cosmetics, U.S. Government Publishing Office, 2015), present developments (e.g., China's recent decision to stop accepting plastic from other countries) underline the pressing need for global, integrated solutions.

Implications for future research

The current review and conclusions have some limitations which, on the one hand, are due to the nature of plastic and behavior related to it, and on the other hand due to characteristics of the available literature. Plastic-related behavior is diverse and thus difficult to delineate. Although we reviewed a large amount of studies, only few focused on a particular behavior (e.g., avoiding plastic) and thus conclusions on these are limited. In contrast, recycling behavior is very well studied but plastic was explicitly considered only sparsely. This diversity, non-specificity, and the limited amount of studies might lead to different predictors of behavior and a low comparability of findings. Therefore, future studies should further investigate plastic-specific behavior and focus on real instead of reported or intended behavior. Furthermore, methods measuring (plastic) avoidance behavior should be developed. Moreover, research should endeavor to study breaking habits, since this is needed to change plastic-related behavior in the long-term.

In general, most studies investigating perception and consumption focused on plastic as packaging material or bags, while littering and recycling studies often did not classify waste origin or type. Interestingly, we found only a few studies investigating attitudes or behaviors related to microplastics, although this issue is hotly debated in both science and media. So far, the social-scientific literature largely ignored plastic types other than packaging or bags. We

therefore recommend that future studies focus also on microplastics and other origins of plastic waste (e.g., from fishing utensils, electronic devices, or agriculture).

Noteworthy, some studies were interdisciplinary, combining for example psychology and environmental science. However, the field lacks studies in the areas of media and communication science although plastic became more and more abundant in the media and thus scientific work on the effects of such media presence is much needed. Since plastic-related perception and behavior and the research of these is so diverse, this review is rather descriptive, and may not sufficiently cover the entire literature relevant. Furthermore, the quality of the studies reviewed varied strongly and was generally rather low compared to the standard of current psychological research. Therefore and because of the limitations above, conclusions should be taken with caution and future studies are needed to confirm the findings.

Conclusion

The plastic problem is a major challenge of our times and needs interdisciplinary and global solutions. This review provides a first overview of the social-scientific literature and can serve as a basis for both researchers and stakeholders to develop further investigations and implement behavior-based solutions. The current work shows that the research field is growing, very diverse, originating from different countries and disciplines, and using a wide range of methods. Because of the limitations mentioned above, general conclusions are difficult. Nevertheless, the reviewed literature suggests that, although problem awareness is high, the perceived advantages of plastic, consumer habits, and situational factors make it difficult for people to act accordingly. Bans and increased costs of plastic products as well as a combination of psychological interventions seem to be promising measures to reduce plastic consumption and waste. All actors from science, policy, industry, trade, and the general public have to work together to avoid a shift of responsibility. More research is needed to improve current interventions and to create additional powerful, immediate, and global solutions to limit the amount of plastic waste in the environment.

Acknowledgments

The authors would like to thank Katherine Muñoz for her valuable input to the natural scientific problem description. We thank Manfred Schmitt, Gerhard Reese, and Zacharias Steinmetz for helpful comments on a previous version of the manuscript, as well as Michaela Maier, Jutta Milde, Gabriele Schaumann, and Kristen Werling for fruitful discussions. Furthermore, we like to thank Sophie Dickel for her support in reference management. The authors have no competing interests to declare.

Funding

This work was supported by the European Research Council [grant number 741087].

Author statement

Lea Marie Heidbreder: Conceptualization, Methodology, Investigation, Writing Original Draft, Visualization. Isabella Bablok: Conceptualization, Methodology, Investigation, Writing Original Draft, Visualization. Stefan Drews: Investigation, Writing Original Draft. Claudia Menzel: Conceptualization, Methodology, Investigation, Writing Original Draft, Visualization.

References

*Adane, L., & Muleta, D. (2011). Survey on the usage of plastic bags, their disposal and adverse impacts on environment: A case study in Jimma City, Southwestern Ethiopia. *Journal of Toxicology and Environmental Health Sciences*, *3*(8), 234–248.

*Aday, M. S., & Yener, U. (2014). Understanding the buying behaviour of young consumers regarding packaging attributes and labels. *International Journal of Consumer Studies*, *38*(4), 385–393. https://doi.org/10.1111/ijcs.12105

*Afroz, R., Rahman, A., Masud, M. M., & Akhtar, R. (2017). The knowledge, awareness, attitude and motivational analysis of plastic waste and household perspective in Malaysia. *Environmental Science and Pollution Research*, *24*(3), 2304–2315. https://doi.org/10.1007/s11356-016-7942-0

*Ahmad, M. S., Bazmi, A. A., Bhutto, A. W., Shahzadi, K., & Bukhari, N. (2016). Students' Responses to Improve Environmental Sustainability Through Recycling: Quantitatively Improving Qualitative Model. *Applied Research in Quality of Life*, *11*(1), 253–270. https://doi.org/10.1007/s11482-014-9366-7

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

*Ali, J., & Kapoor, S. (2008). Consumers' perception on fruits and vegetables packaging in India. In *18th Annual World Symposium of the International Food and Agribusiness Management Association (IAMA) on Meeting Food System Challenges through Innovation and Entrepreneurship* (pp. 1–12). Monterey, California.

*Anderson, A. G., Grose, J., Pahl, S., Thompson, R. C., & Wyles, K. J. (2016). Microplastics in personal care products: Exploring perceptions of environmentalists, beauticians and students. *Marine Pollution Bulletin*, *113*(1–2), 454–460. https://doi.org/10.1016/j.marpolbul.2016.10.048

*Arı, E., & Yılmaz, V. (2017). Consumer attitudes on the use of plastic and cloth bags. *Environment, Development and Sustainability*, *19*(4), 1219–1234. https://doi.org/10.1007/s10668-016-9791-x

*Arlt, D., Kuhlmann, C., & Wolling, J. (2012). Ecological role models? The effect of the depiction of ecological activities in the media on the behavioral intentions of the recipients. *Studies in Communication and Media*, *1*(3–4), 411–442. https://doi.org/10.5771/2192-4007-2012-3-411

*Avallone, I. V., Giraldi, J. D. M. E., & de Oliveira, S. V. W. B. (2012). Conscious consumption: A study on plastic bags' consumers in Brazil. *International Journal of Psychological Studies*, *4*(1), 122–134. https://doi.org/10.5539/ijps.v4n1p122

*Ballance, A., Ryan, P. G., & Turpie, J. K. (2000). How much is a clean beach worth? The impact of litter on beach users in the Cape Peninsula, South Africa. *South African Journal of Science*, *96*, 210–213.

*Barnes, M., Chan-Halbrendt, C., Zhang, Q., & Abejon, N. (2011). Consumer preference and willingness to pay for non-plastic food containers in Honolulu, USA. *Journal of Environmental Protection*, *2*(9), 1264–1273.

*Barnett, A. J., Wiber, M. G., Rooney, M. P., & Curtis Maillet, D. G. (2016). The role of public participation GIS (PPGIS) and fishermen's perceptions of risk in marine debris mitigation in the Bay of Fundy, Canada. *Ocean and Coastal Management*, *133*, 85–94. https://doi.org/10.1016/j.ocecoaman.2016.09.002

*Bartolotta, J. F., & Hardy, S. D. (2018). Barriers and benefits to desired behaviors for single use plastic items in northeast Ohio's Lake Erie basin. *Marine Pollution Bulletin*, *127*, 576–585. https://doi.org/10.1016/j.marpolbul.2017.12.037

*Bech-Larsen, T. (1996). Danish Consumers' Attitudes to the Functional and Environmental Characteristics of Food Packaging. *Journal of Consumer Policy*, *19*, 339–363.

*Beeharry, Y. D., Bekaroo, G., Bokhoree, C., Phillips, M. R., & Jory, N. (2017). Sustaining anti-littering behavior within coastal and marine environments: Through the macro-micro level lenses. *Marine Pollution Bulletin*, *119*(2), 87–99. https://doi.org/10.1016/j.marpolbul.2017.04.029

*Beitzen-Heineke, E. F., Balta-Ozkan, N., & Reefke, H. (2017). The prospects of zero-packaging grocery stores to improve the social and environmental impacts of the food supply chain. *Journal of Cleaner Production*, *140*, 1528–1541. https://doi.org/10.1016/j.jclepro.2016.09.227

Bläsing, M., & Amelung, W. (2018). Plastics in soil: Analytical methods and possible sources. *Science of The Total Environment*, *612*, 422–435.

*Blesin, J.-M., Jaspersen, M., & Möhring, W. (2017). Boosting Plastics' Image? Communicative Challenges of Innovative Bioplastics. *Journal of Historic Polymeric Materials, Plastics Heritage and History*, *3*, 1–5.

*Braun, Y. A., & Traore, A. S. (2015). Plastic bags, pollution, and identity: Women and the gendering of globalization and environmental responsibility in Mali. *Gender & Society*, *29*(6), 863–887. https://doi.org/10.1177/0891243215602101

*Brennan, R. E., & Portman, M. E. (2017). Situating Arab-Israeli artisanal fishermen's perceptions of marine litter in a socio-institutional and socio-cultural context. *Marine Pollution Bulletin*, *115*(1–2), 240–251. https://doi.org/10.1016/j.marpolbul.2016.12.001

*Campbell, M. L., Slavin, C., Grage, A., & Kinslow, A. (2016). Human health impacts from litter on beaches and associated perceptions: A case study of "clean" Tasmanian beaches. *Ocean and Coastal Management*, *126*, 22–30. https://doi.org/10.1016/j.ocecoaman.2016.04.002

*Caner, C., & Pascall, M. A. (2010). Consumer complaints and accidents related to food packaging. *Packaging Technology and Science*, *23*(7), 413–422. https://doi.org/10.1002/pts.908

*Carpenter, E., & Wolverton, S. (2017). Plastic litter in streams: The behavioral archaeology of a pervasive environmental problem. *Applied Geography*, *84*, 93–101. https://doi.org/10.1016/j.apgeog.2017.04.010

*Carrigan, M., Moraes, C., & Leek, S. (2011). Fostering responsible communities: A community social marketing approach to sustainable living. *Journal of Business Ethics*, *100*(3), 515–534. https://doi.org/10.1007/s10551-010-0694-8

*Chan, K. (1998). Mass communication and pro-environmental behaviour: waste recycling in Hong Kong. *Journal of Environmental Management*, *52*(4), 317–325. https://doi.org/10.1006/jema.1998.0189

*Chan, R. Y. K., Wong, Y. H., & Leung, T. K. P. (2008). Applying ethical concepts to the study of ``green'' consumer behavior: An analysis of chinese consumers' intentions to bring their own shopping bags. *Journal of Business Ethics*, *79*(4), 469–481. https://doi.org/10.1007/s10551-007-9410-8

*Chang, M. (2015). Reducing microplastics from facial exfoliating cleansers in wastewater through treatment versus consumer product decisions. *Marine Pollution Bulletin*, *101*(1), 330–333. https://doi.org/10.1016/j.marpolbul.2015.10.074

*Chang, S.-H., & Chou, C.-H. (2018). Consumer intention toward bringing your own shopping bags in Taiwan: An application of ethics perspective and theory of planned behavior. *Sustainability (Switzerland)*, *10*(6), 1–14. https://doi.org/10.3390/su10061815

*Cherrier, H. (2006). Consumer identity and moral obligations in non-plastic bag consumption: a dialectical perspective. *International Journal of Consumer Studies*, *30*(5), 515–523.

*Cheung, T. Y., Fok, L., Cheang, C. C., Yeung, C. H., So, W.-M. W., & Chow, C. F. (2018). University halls plastics recycling: a blended intervention study. *International Journal of Sustainability in Higher Education*, *19*(6), 1038–1052. https://doi.org/10.1108/IJSHE-10-2017-0175

*Chib, A., Chiew, H. J., Kumar, C., Choon, L. G., & Ale, K. (2009). [minus]plastic: influencing pro-environmental attitudes among Singaporean youth. *Environmental Education Research*, *15*(6), 679–696. https://doi.org/10.1080/13504620903296001

*Clapp, J., & Swanston, L. (2009). Doing away with plastic shopping bags: International patterns of norm emergence and policy implementation. *Environmental Politics*, *18*(3), 315–332. https://doi.org/10.1080/09644010902823717

*Convery, F., McDonnell, S., & Ferreira, S. (2007). The most popular tax in Europe? Lessons from the Irish plastic bags levy. *Environmental and Resource Economics*, *38*(1), 1–11. https://doi.org/10.1007/s10640-006-9059-2

*Corraini, N. R., de Souza de Lima, A., Bonetti, J., & Rangel-Buitrago, N. (2018). Troubles in the paradise: Litter and its scenic impact on the North Santa Catarina island beaches, Brazil. *Marine Pollution Bulletin*, *131*, 572–579. https://doi.org/10.1016/j.marpolbul.2018.04.061

*Dikgang, J., Leiman, A., & Visser, M. (2012). Analysis of the plastic-bag levy in South Africa. *Resources, Conservation & Recycling*, *66*, 59–65. https://doi.org/10.1016/j.resconrec.2012.06.009

*Dikgang, J., & Visser, M. (2012). Behavioural response to plastic bag legislation in Botswana. *South African Journal of Economics*, *80*(1), 123–133.

*Drašković, N. (2010). Packaging convenience: Consumer packaging feature or marketig tool? *International Journal of Management Cases*, *12*(2), 267–274. https://doi.org/10.5848/APBJ.2010.00061

*Drašković, N., & Cerovečki, I. G. (2014). Moderating variables of consumer perception of packaging material. In *7th Annual EuroMed Conference of the EuroMed Academy of Business* (pp. 609–620).

*Draskovic, N., Temperley, J., & Pavicic, J. (2009). Comparative perception(s) of consumer goods packaging: Croatian consumers perspective(s). *International Journal of Management Cases*, *11*(2), 154–163. https://doi.org/10.5848/APBJ.2009.00028

*Eldesouky, A., & Mesías, F. (2014). An insight into the influence of packaging and presentation format on consumer purchasing attitudes towards cheese: A qualitative study. *Spanish Journal of Agricultural Research*, *12*(2), 305–312. https://doi.org/10.5424/sjar/2014122-5520

*Eldesouky, A., Mesías, F. J., Elghannam, A., Gaspar, P., & Escribano, M. (2016). Are packaging and presentation format key attributes for cheese consumers? *International Dairy Journal*, *61*, 245–249. https://doi.org/10.1016/j.idairyj.2016.06.011

*Eldesouky, A., Pulido, A. F., & Mesías, F. J. (2015). The Role of Packaging and Presentation Format in Consumers' Preferences for Food: An Application of Projective Techniques. *Journal of Sensory Studies*, *30*(5), 360–369. https://doi.org/10.1111/joss.12162

*Elgaaïed-Gambier, L. (2016). Who Buys Overpackaged Grocery Products and Why? Understanding Consumers' Reactions to Overpackaging in the Food Sector. *Journal of Business Ethics*, *135*(4), 683–698. https://doi.org/10.1007/s10551-014-2491-2

Eriksen, M., Lebreton, L. C. M., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., … Reisser, J. (2014). Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea. *PLoS ONE*, *9*(12), 1–15. https://doi.org/10.1371/journal.pone.0111913

*Fernqvist, F., Olsson, A., & Spendrup, S. (2015). What's in it for me? Food packaging and consumer responses, a focus group study. *British Food Journal*, *117*(3), 1122–1135. https://doi.org/10.1108/BFJ-08-2013-0224

*Ferreira, M. C., & Scaraboto, D. (2016). "My plastic dreams": Towards an extended understanding of materiality and the shaping of consumer identities. *Journal of Business Research*, *69*(1), 191–207.

Fritsche, I., Barth, M., Jugert, P., Masson, T., & Reese, G. (2017). A social identity model of pro-environmental action (SIMPEA). https://doi.org/http :/ /dx.doi.org/ 10.1037/rev0000090

*Fritz, J. N., Dupuis, D. L., Wu, W. L., Neal, A. E., Rettig, L. A., & Lastrapes, R. E. (2017). Evaluating increased effort for item disposal to improve recycling at a university. *Journal of Applied Behavior Analysis*, *50*(4), 825–829. https://doi.org/10.1002/jaba.405

Galloway, T. S., & Lewis, C. N. (2016). Marine microplastics spell big problems for future generations. *PNAS*, *113*(9), 2331–2333. https://doi.org/10.1073/pnas.1600715113

Gelcich, S., Buckley, P., Pinnegar, J. K., Chilvers, J., Lorenzoni, I., Terry, G., & Guerrero, M. (2014). Public awareness, concerns, and priorities about anthropogenic impacts on marine environments. *PNAS*, *111*(42), 15042–15047. https://doi.org/10.1073/pnas.1417344111

Gelici-Zeko, M. M., Lutters, D., ten Klooster, R., & Weijzen, P. L. G. (2013). Studying the Influence of Packaging Design on Consumer Perceptions (of Dairy Products) Using Categorizing and Perceptual Mapping. *Packaging Technology and Science*, *26*(4), 215–228. https://doi.org/10.1002/pts.1977

*Gómez, M., Martín-Consuegra, D., & Molina, A. (2015). The importance of packaging in purchase and usage behaviour. *International Journal of Consumer Studies*, *39*(3), 203–211. https://doi.org/10.1111/ijcs.12168

Haider, T. P., Völker, C., Kramm, J., Landfester, K., & Wurm, F. R. (2018). Plastics of the future? The impact of biodegradable polymers on the environment and on society. *Angewandte Chemie International Edition*, *58*(1), 50–62.

*Hammami, M. B. A., Mohammed, E. Q., Hashem, A. M., Al-Khafaji, M. A., Alqahtani, F., Alzaabi, S., & Dash, N. (2017). Survey on awareness and attitudes of secondary school students regarding plastic pollution: implications for environmental education and public health in Sharjah city, UAE.

Environmental Science and Pollution Research, *24*(25), 20626–20633. https://doi.org/10.1007/s11356-017-9625-x

Hanisch, C. (2000). Is Extended Producer Responsibility Effective? *Environmental Science & Technology*, *34*(7), 170–175.

*Hartley, B. L., Pahl, S., Holland, M., Alampei, I., Veiga, J. M., & Thompson, R. C. (2018). Turning the tide on trash: Empowering European educators and school students to tackle marine litter. *Marine Policy*, *96*, 227–234. https://doi.org/10.1016/j.marpol.2018.02.002

*Hartley, B. L., Pahl, S., Veiga, J., Vlachogianni, T., Vasconcelos, L., Maes, T., … Thompson, R. C. (2018). Exploring public views on marine litter in Europe: Perceived causes, consequences and pathways to change. *Marine Pollution Bulletin*, *133*, 945–955. https://doi.org/https://doi.org/10.1016/j.marpolbul.2018.05.061

*Hartley, B. L., Thompson, R. C., & Pahl, S. (2015). Marine litter education boosts children's understanding and self-reported actions. *Marine Pollution Bulletin*, *90*, 209–217. https://doi.org/10.1016/j.marpolbul.2014.10.049

*Hasson, R., Leiman, A., & Visser, M. (2007). The economics of plastic bag legislation in South Africa. *South African Journal of Economics*, *75*(1), 66–83. https://doi.org/10.1111/j.1813-6982.2007.00101.x

*He, H. (2012). Effects of environmental policy on consumption: Lessons from the Chinese plastic bag regulation. *Environment and Development Economics*, *17*(4), 407–431. https://doi.org/10.1017/S1355770X1200006X

*Herbes, C., Beuthner, C., & Ramme, I. (2018). Consumer attitudes towards biobased packaging - A cross-cultural comparative study. *Journal of Cleaner Production*, *194*, 203–218. https://doi.org/10.1016/j.jclepro.2018.05.106

Hertwich, E. G. (2005). Consumption and the Rebound Effect: An Industrial Ecology Perspective. *Journal of Industrial Ecology*, *9*(1–2), 85–98. https://doi.org/10.1162/1088198054084635

Hodson, M. E., Duffus-Hodson, C. A., Clark, A., Prendergast-Miller, M. T., & Thorpe, K. L. (2017). Plastic Bag Derived-Microplastics as a Vector for Metal Exposure in Terrestrial Invertebrates. *Environmental Science and Technology*, *51*(8), 4714–4721. https://doi.org/10.1021/acs.est.7b00635

*Hohmann, R., Wattana, C., Sracheam, P., Siriapornsakul, S., Ruckthum, V., & Clapp, R. (2016). An exploration of the factors concerned with reducing the use of plastic carrier bags in Bangkok, Thailand. *ABAC ODI Journal : Vision. Action. Outcome.*, *3*(2), 162–181.

*Holland, R. W., Aarts, H., & Langendam, D. (2006). Breaking and creating habits on the working floor: A field-experiment on the power of implementation intentions. *Journal of Experimental Social Psychology*, *42*(6), 776–783. https://doi.org/10.1016/j.jesp.2005.11.006

*Hollywood, L., Wells, L., Armstrong, G., & Farley, H. (2013). Thinking outside the carton: attitudes towards milk packaging. *British Food Journal*, *115*(6), 899–912. https://doi.org/10.1108/BFJ-Jul-2010-0127

Horton, A. A., Walton, A., Spurgeon, D. J., Lahive, E., & Svendsen, C. (2017). Microplastics in freshwater and terrestrial environments: Evaluating the current understanding to identify the knowledge gaps and future research priorities. *Science of the Total Environment*, *586*, 127–141. https://doi.org/10.1016/j.scitotenv.2017.01.190

Huffman, K. T., Grossnickle, W. F., Cope, J. G., & Huffman, K. P. (1995). Litter Reduction: A Review and Integration of the Literature. *Environment and Behavior*, *27*(2), 153–183.

*Isa, S. M., & Yao, P. X. (2013). Investigating the preference for green packaging in consumer product choices: A choice-based conjoint approach. *Business Management Dynamics*, *3*(2), 84–96.

*Jakovcevic, A., Steg, L., Mazzeo, N., Caballero, R., Franco, P., Putrino, N., & Favara, J. (2014). Charges for plastic bags: Motivational and behavioral effects. *Journal of Environmental Psychology*, *40*, 372–380. https://doi.org/10.1016/j.jenvp.2014.09.004

*Jeżewska-Zychowicz, M., & Jeznach, M. (2015). Consumers' Behaviours Related To Packaging And Their Attitudes Towards Environment. *Journal of Agribusiness and Rural Development*, *3*(37), 447–457. Retrieved from https://ideas.repec.org/a/ags/pojard/253597.html

*Jiang, J. (2016). Peer Pressure in Voluntary Environmental Programs: A Case of the Bag Reward Program. *Journal of Industry, Competition and Trade*, *16*(2), 155–190.

*Jones, J., Jackson, J. I., Bates, M., & Tudor, T. (2016). Factors influencing corporate pro-environmental behaviour – a case study from the UK construction sector. *Int. J. Environment and Sustainable Development*, *15*(1), 1–15. https://doi.org/10.1504/IJESD.2016.073314

*Joseph, N., Kumar, A., Majgi, S. M., Kumar, G. S., & Prahalad, R. B. Y. (2016). Usage of Plastic Bags and Health Hazards : A Study to Assess Awareness Level and Perception about Legislation Among a Small Population of Mangalore City. *Journal of Clinical and Diagnostic Research*, *10*(4), 1–4. https://doi.org/10.7860/JCDR/2016/16245.7529

Jungbluth, N., Tietje, O., & Scholz, R. W. (2000). Food purchases: Impacts from the consumers' point of view investigated with a modular LCA. *The International Journal of Life Cycle Assessment*, *5*(3), 134. https://doi.org/10.1007/BF02978609

*Kainz, U., Zapilko, M., Decker, T., & Menrad, K. (2013). Consumer-relevant information about bioplastics. In J. Geldermann & M. Schumann (Eds.), *First International Conference on Resource Efficiency in Interorganizational Networks* (pp. 391–402). Universitätsverlag Göttingen.

*Karmarkar, U. R., & Bollinger, B. (2015). BYOB: How bringing your own shopping bags leads to treating yourself and the environment. *Journal of Marketing*, *79*, 1–15.

*Keramitsoglou, K. M., & Tsagarakis, K. P. (2018). Public Participation in Designing the Recycling Bins to Encourage Recycling. *Sustainability (Switzerland)*, *10*(4), 16–18. https://doi.org/10.3390/su10041240

*Kiessling, T., Salas, S., Mutafoglu, K., & Thiel, M. (2017). Who cares about dirty beaches? Evaluating environmental awareness and action on coastal litter in Chile. *Ocean and Coastal Management*, *137*, 82–95. https://doi.org/10.1016/j.ocecoaman.2016.11.029

*Klaiman, K., Ortega, D. L., & Garnache, C. (2016). Consumer Preferences and Demand for Packaging Material and Recyclability Kimberly. *Resources, Conservation and Recycling*, *115*, 1–25.

*Klaiman, K., Ortega, D. L., & Garnache, C. (2017). Perceived barriers to food packaging recycling: Evidence from a choice experiment of US consumers. *Food Control*, *73*, 291–299. https://doi.org/10.1016/j.foodcont.2016.08.017

*Klöckner, C. A., & Oppedal, I. O. (2011). General Versus Domain Specific Recycling Behaviour - applying a multilevel comprehensive action determination model to recycling in Norwegian student homes. *Resources, Conservation and Recycling*, *55*(4), 463–471. https://doi.org/10.1016/j.resconrec.2010.12.009

*Knussen, C., Yule, F., MacKenzie, J., & Wells, M. (2004). An analysis of intentions to recycle household waste: The roles of past behaviour, perceived habit, and perceived lack of facilities. *Journal of Environmental Psychology*, *24*, 237–246. https://doi.org/10.1016/j.jenvp.2003.12.001

*Koenig-Lewis, N., Palmer, A., Dermody, J., & Urbye, A. (2014). Consumers' evaluations of ecological packaging – Rational and emotional approaches. *Journal of Environmental Psychology*, *37*, 94–105. Retrieved from https://core.ac.uk/display/29204991

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why Do People Behave Environmentally and What are the Barriers to Pro-Environmental Behaviour. *Environmental Education Research*, *8*(3), 239–260. https://doi.org/10.1080/1350462022014540

*Koutsimanis, G., Getter, K., Behe, B., Harte, J., & Almenar, E. (2012). Influences of packaging attributes on consumer purchase decisions for fresh produce. *Appetite*, *59*(2), 270–280. https://doi.org/10.1016/j.appet.2012.05.012

*Kronrod, A., Grinstein, A., & Wathieu, L. (2012). Go Green! Should Environmental Messages Be So Assertive? *Journal of Marketing*, *76*(1), 95–102. https://doi.org/10.1509/jm.10.0416

*Kurisu, K. H., & Bortoleto, A. P. (2011). Comparison of waste prevention behaviors among three Japanese megacity regions in the context of local measures and socio-demographics. *Waste Management*, *31*(7), 1441–1449. https://doi.org/10.1016/j.wasman.2011.03.008

*Lal, R. C., Yambrach, F., & McProud, L. (2015). Consumer Perceptions Towards Package Designs: A Cross Cultural Study. *Journal of Applied Packaging Research*, *7*(2), 61–94. https://doi.org/10.14448/japr.04.0004

*Lam, S. P., & Chen, J. K. (2006). What makes customers bring their bags or buy bags from the shop? A survey of customers at a Taiwan hypermarket. *Environment and Behavior*, *38*(3), 318–332. https://doi.org/10.1177/0013916505278327

*Latiff, Z. A. A., Mokhtar, S. I., Soon, S. W., & Ayob, M. A. (2018). Study on the Customer Perception of the Tropical Fruit Vinegar in Kelantan and Kuala Lumpur. *Journal of Food Products Marketing*, *24*(3), 263–279. https://doi.org/10.1080/10454446.2017.1266557

*Latinopoulos, D., Mentis, C., & Bithas, K. (2018). The impact of a public information campaign on preferences for marine environmental protection. The case of plastic waste. *Marine Pollution Bulletin*, *131*, 151–162. https://doi.org/10.1016/j.marpolbul.2018.04.002

*Lea, E., & Worsley, A. (2008). Australian consumers' food-related environmental beliefs and behaviours. *Appetite*, *50*(2), 207–214. https://doi.org/10.1016/j.appet.2005.07.012

*Lefebvre, A., Bassereau, J. F., Pensé-lheritier, A. M., Rivère, C., Harris, N., & Duchamp, R. (2010). Recruitment and training of a sensory expert panel to measure the touch of beverage packages: Issue and methods employed. *Food Quality and Preference*, *21*(1), 156–164. https://doi.org/10.1016/j.foodqual.2009.08.020

Li, W. C., Tse, H. F., & Fok, L. (2016). Plastic waste in the marine environment: A review of sources, occurrence and effects. *Science of the Total Environment*, *566–567*, 333–349. https://doi.org/10.1016/j.scitotenv.2016.05.084

*Li, Y., Muthu, S. S., Hu, J., Pik-Yin, M., Ding, X., Wang, L., & Chen, W. (2010). Eco-Impact of Shopping Bags: Consumer Attitude and Governmental Policies. *Journal of Sustainable Development*, *3*(2), 71–83. https://doi.org/10.5539/jsd.v3n2p71

*Lindh, H., Olsson, A., & Williams, H. (2016). Consumer Perceptions of Food Packaging: Contributing to or Counteracting Environmentally Sustainable Development? *Packaging Technology and Science*, *29*(1), 3–23. https://doi.org/10.1002/pts.2184

Lindh, H., Williams, H., Olsson, A., & Wikström, F. (2016). Elucidating the Indirect Contributions of Packaging to Sustainable Development: A Terminology of Packaging Functions and Features. *Packaging Technology and Science*, *29*(4–5), 225–246. https://doi.org/10.1002/pts

Liu, E. K., He, W. Q., & Yan, C. R. (2014). "White revolution" to "white pollution" - Agricultural plastic film mulch in China. *Environmental Research Letters*, *9*(9), 13–16. https://doi.org/10.1088/1748-9326/9/9/091001

Löhr, A., Savelli, H., Beunen, R., Kalz, M., Ragas, A., & Van Belleghem, F. (2017). Solutions for global marine litter pollution. *Current Opinion in Environmental Sustainability*, *28*, 90–99. https://doi.org/10.1016/j.cosust.2017.08.009

*Loizidou, X. I., Loizides, M. I., & Orthodoxou, D. L. (2018). Persistent marine litter: small plastics and cigarette butts remain on beaches after organized beach cleanups. *Environmental Monitoring and Assessment*, *190*(414), 1–10.

*Longoni, C., Gollwitzer, P. M., & Oettingen, G. (2014). A green paradox: Validating green choices has ironic effects on behavior, cognition, and perception. *Journal of Experimental Social Psychology*, *50*(1), 158–165. https://doi.org/10.1016/j.jesp.2013.09.010

*Lotze, H. K., Guest, H., O'Leary, J., Tuda, A., & Wallace, D. (2018). Public perceptions of marine threats and protection from around the world. *Ocean and Coastal Management*, *152*, 14–22. https://doi.org/10.1016/j.ocecoaman.2017.11.004

*Madara, D. S., Namango, S. S., & Wetaka, C. (2016). Consumer-Perception on Polyethylene-Shopping-Bags. *Journal of Environment and Earth Science*, *6*(11), 12–36.

*Madigele, P. K., Mogomotsi, G. E. J., & Kolobe, M. (2017). Consumer willingness to pay for plastic bags levy and willingness to accept eco-friendly alternatives in Botswana. *Chinese Journal of Population Resources and Environment*, *15*(3), 255–261. https://doi.org/10.1080/10042857.2017.1369243

*Magnier, L., & Crié, D. (2015). Communicating packaging eco-friendliness: An exploration of consumers' perceptions of eco-designed packaging. *International Journal of Retail and Distribution Management*, *43*(4/5), 350–366. https://doi.org/10.1108/IJRDM-04-2014-0048

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

44, 53–62. https://doi.org/10.1016/j.jenvp.2015.09.005

*Magnier, L., & Schoormans, J. (2017). How Do Packaging Material, Colour and Environmental Claim Influence Package, Brand and Product Evaluations? *Packaging Technology and Science*, *30*(11), 735–751. https://doi.org/10.1002/pts.2318

*Mapotse, T. A., & Mashiloane, T. K. (2017). Nurturing learners' awareness of littering through environmental campaigns: An action research approach. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(10), 6909–6921. https://doi.org/10.12973/ejmste/76658

Marsh, K., & Bugusu, B. (2007). Food packaging - Roles, materials, and environmental issues: Scientific status summary. *Journal of Food Science*, *72*(3). https://doi.org/10.1111/j.1750-3841.2007.00301.x

*Martinho, G., Balaia, N., & Pires, A. (2017). The Portuguese plastic carrier bag tax : The effects on consumers ' behavior. *Waste Management*, *61*, 3–12. https://doi.org/10.1016/j.wasman.2017.01.023

*McCoy, K., Oliver, J. J., Borden, D. S., & Cohn, S. I. (2018). Nudging waste diversion at Western State Colorado University: application of behavioral insights. *International Journal of Sustainability in Higher Education*, *19*(3), 608–621. https://doi.org/10.1108/IJSHE-05-2017-0063

*McDonald, S., & Ball, R. (1998). Public participation in plastics recycling schemes. *Resources, Conservation and Recycling*, *22*(3–4), 123–141. https://doi.org/10.1016/S0921-3449(97)00044-X

*McKay, D., & Perez, P. L. (2018). Plastic masculinity: How everyday objects in plastic suggest men could be otherwise. *Journal of Material Culture*, *23*(2), 169–186. https://doi.org/10.1177/1359183517742424

McKerlie, K., Knight, N., & Thorpe, B. (2006). Advancing extended producer responsibility in Canada. *Journal of Cleaner Production*, *14*(6–7), 616–628.

*Meng, T., Klepacka, A. M., Florkowski, W. J., & Braman, K. (2015). What drives an environmental horticultural firm to start recycling plastics? Results of a Georgia survey. *Resources, Conservation and Recycling*, *102*, 1–8. https://doi.org/10.1016/j.resconrec.2015.04.011

*Miller, N. D., Meindl, J. N., & Caradine, M. (2016). The Effects of Bin Proximity and Visual Prompts on Recycling in A University Building. *Behavior and Social Issues*, *25*, 4–10. https://doi.org/10.5210/bsi.v.25i0.6141

*Mohamed, N. A. (2015). Promoting of Environment Friendly Packaging Utilizing in the Egyptian Market "Study on Grocery Bags by Carrefour Egypt." *Civil and Environmental Research*, *7*(4), 54–61.

*Muizniece-Brasava, S., Dukalska, L., & Kantike, I. (2011). Consumer's knowledge and attitude to traditional and environmentally friendly food packaging materials in market of Latvia. In *In The 6th Baltic Conference on Food Science and Technology "FoodBalt - 2011"* (pp. 187–192).

*Muralidharan, S., & Sheehan, K. (2016). "Tax" and "fee" message frames as inhibitors of plastic bag usage among shoppers: A social marketing application of the theory of planned behavior. *Social Marketing Quarterly*, *22*(3), 200–217. https://doi.org/10.1177/1524500416631522

*Muralidharan, S., & Sheehan, K. (2017). "Tax" and "Fee" Frames in Green Advertisements: The Influence of Self-Transcendence in Reusable Bag Usage. *Journal of Promotion Management*, *23*(6), 851–871. https://doi.org/10.1080/10496491.2017.1323260

*Musa, H. M., Hayes, C., Bradley, M. J., Clayson, A., & Gillibrand, G. (2013). Measures Aimed at Reducing Plastic Carrier Bag Use: A Consumer Behaviour Focused Study. *Natural Environment*, *1*(1), 17. https://doi.org/10.12966/ne.06.02.2013

*Negussie, B., & Mustefa, J. (2017). Community's perception of utilization and disposal of plastic bags in Eastern Ethiopia. *Pollution*, *3*(1), 147–156. https://doi.org/10.7508/pj.2017.01.013

*Nittala, R. (2014). Green consumer behavior of the educated segment in India. *Journal of International Consumer Marketing*, *26*(2), 138–152. https://doi.org/10.1080/08961530.2014.878205

*Nørgaard Olesen, S., & Giacalone, D. (2018). The influence of packaging on consumers' quality perception of carrots. *Journal of Sensory Studies*, *33*(1), 1–8. https://doi.org/10.1111/joss.12310

*O'Connor, R. T., Lerman, D. C., Fritz, J. N., & Hodde, H. B. (2010). Effects of Number and Location of Bins on Plastic Recycling At a University. *Journal of Applied Behavior Analysis*, *43*(4), 711–715.

https://doi.org/10.1901/jaba.2010.43-711

*O'Gorman, L. (2017). Sustainability, the Arts and Big Numbers: The Challenge of Researching Children's Responses to Chris Jordan's Images. *International Journal of Early Childhood*, *49*(3), 321–332. https://doi.org/10.1007/s13158-017-0199-z

*Ofstad, S. P., Tobolova, M., Nayum, A., & Klöckner, C. A. (2017). Understanding the mechanisms behind changing people's recycling behavior at work by applying a comprehensive action determination model. *Sustainability (Switzerland)*, *9*(2). https://doi.org/10.3390/su9020204

*Ohtomo, S., & Ohnuma, S. (2014). Psychological interventional approach for reduce resource consumption: Reducing plastic bag usage at supermarkets. *Resources, Conservation and Recycling*, *84*(November), 57–65. https://doi.org/10.1016/j.resconrec.2013.12.014

Oke, A. (2015). Workplace waste recycling behaviour: A meta-analytical review. *Sustainability (Switzerland)*, *7*(6), 7175–7194. https://doi.org/10.3390/su7067175

*Omari, R., & Frempong, G. (2016). Food safety concerns of fast food consumers in urban Ghana. *Appetite*, *98*, 49–54. https://doi.org/10.1016/j.appet.2015.12.007

*Omari, R., Frempong, G. K., & Arthur, W. (2018). Public perceptions and worry about food safety hazards and risks in Ghana. *Food Control*, *93*, 76–82. https://doi.org/10.1016/j.foodcont.2018.05.026

*Orzan, G., Cruceru, A. F., Bălăceanu, C. T., & Chivu, R.-G. (2018). Consumers' Behavior Concerning Sustainable Packaging : An Exploratory Study on Romanian Consumers. *Sustainability (Switzerland)*, *10*, 1–11. https://doi.org/10.3390/su10061787

*Østergaard, S., & Hanssen, O. J. (2018). Wasting of Fresh-Packed Bread by Consumers — Influence of Shopping Behavior, Storing, Handling, and Consumer Preferences. *Sustainability (Switzerland)*, *10*(7), 1–16. https://doi.org/10.3390/su10072251

*Otsyina, H. R., Nguhiu-Mwangi, J., Mogoa, E. G. M., Mbuthia, P. G., & Ogara, W. O. (2018). Knowledge, attitude, and practices on usage, disposal, and effect of plastic bags on sheep and goats. *Tropical Animal Health and Production*, *50*(5), 997–1003. https://doi.org/10.1007/s11250-018-1523-9

*Owens, K. A. (2018). Using experiential marine debris education to make an impact: Collecting debris, informing policy makers, and influencing students. *Marine Pollution Bulletin*, *127*, 804–810. https://doi.org/10.1016/j.marpolbul.2017.10.004

*Pakpour, A. H., Zeidi, I. M., Emamjomeh, M. M., Asefzadeh, S., & Pearson, H. (2014). Household waste behaviours among a community sample in Iran : An application of the theory of planned behaviour. *Waste Management*, *34*, 980–986. https://doi.org/10.1016/j.wasman.2013.10.028

*Pandey, R. U., Surjan, A., & Kapshe, M. (2017). Exploring linkages between sustainable consumption and prevailing green practices in reuse and recycling of household waste: Case of Bhopal city in India. *Journal of Cleaner Production*, *173*, 49–59. https://doi.org/10.1016/j.jclepro.2017.03.227

Pasqualino, J., Meneses, M., & Castells, F. (2011). The carbon footprint and energy consumption of beverage packaging selection and disposal. *Journal of Food Engineering*, *103*(4), 357–365. https://doi.org/10.1016/j.jfoodeng.2010.11.005

*Pearson, E., Mellish, S., Sanders, B., & Litchfield, C. (2014). Marine wildlife entanglement: Assessing knowledge, attitudes, and relevant behaviour in the Australian community. *Marine Pollution Bulletin*, *89*(1–2), 136–148. https://doi.org/10.1016/j.marpolbul.2014.10.014

Peng, J., Wang, J., & Cai, L. (2017). Current understanding of microplastics in the environment: Occurrence, fate, risks, and what we should do. *Integrated Environmental Assessment and Management*, *13*(3), 476–482. https://doi.org/10.1002/ieam.1912

*Peters-Texeira, A., & Badrie, N. (2005). Consumers' perception of food packaging in Trinidad, West Indies and its related impact on food choices. *International Journal of Consumer Studies*, *29*(6), 508–514. https://doi.org/10.1111/j.1470-6431.2005.00419.x

*Phillips, C. (2016). Alternative food distribution and plastic devices: Performances, valuations, and experimentations. *Journal of Rural Studies*, *44*, 208–216. https://doi.org/10.1016/j.jrurstud.2016.02.006

*Piqueras-Fiszman, B., & Spence, C. (2011). Do the material properties of cutlery affect the perception of the food you eat? An exploratory study. *Journal of Sensory Studies*, *26*(5), 358–362. https://doi.org/10.1111/j.1745-459X.2011.00351.x

PlasticsEurope. (2017). *Plastics - the facts 2017: An analysis of European plastics production, demand and waste data*. Retrieved from https://www.plasticseurope.org/application/files/5715/1717/4180/Plastics_the_facts_2017_FINAL_for_website_one_page.pdf

PlasticsEurope. (2018). *Plastics - the facts 2018: An analysis of European plastics production, demand and waste data*. Retrieved from https://www.plasticseurope.org/download_file/force/2387/319

*Poortinga, W., & Whitaker, L. (2018). Promoting the use of reusable coffee cups through environmental messaging, the provision of alternatives and financial incentives. *Sustainability (Switzerland)*, *10*(3), 1–10. https://doi.org/10.3390/su10030873

*Poortinga, W., Whitmarsh, L., & Suffolk, C. (2013). The introduction of a single-use carrier bag charge in Wales : Attitude change and behavioural spillover effects. *Journal of Environmental Psychology*, *36*, 240–247. https://doi.org/10.1016/j.jenvp.2013.09.001

*Prendergast, G., Wai Ng, S., & Lee Leung, L. (2001). Consumer perceptions of shopping bags. *Marketing Intelligence and Planning*, *19*(7), 475–481. https://doi.org/10.1108/EUM0000000006217

*Rangel-Buitrago, N., Williams, A., & Anfuso, G. (2018). Killing the goose with the golden eggs: Litter effects on scenic quality of the Caribbean coast of Colombia. *Marine Pollution Bulletin*, *127*, 22–38. https://doi.org/10.1016/j.marpolbul.2017.11.023

*Rayon-Viña, F., Miralles, L., Gómez-Agenjo, M., Dopico, E., & Garcia-Vazquez, E. (2018). Marine litter in south Bay of Biscay: Local differences in beach littering are associated with citizen perception and awareness. *Marine Pollution Bulletin*, *131*, 727–735. https://doi.org/10.1016/j.marpolbul.2018.04.066

*Reese, G., & Junge, E. A. (2017). Keep on Rockin' in a (plastic-)free world: Collective efficacy and pro-environmental intentions as a function of task difficulty. *Sustainability (Switzerland)*, *9*(2), 1–13. https://doi.org/10.3390/su9020200

*Richardson, J., Grose, J., Nelmes, P., Parra, G., & Linares, M. (2016). Tweet if you want to be sustainable: a thematic analysis of a Twitter chat to discuss sustainability in nurse education. *Journal of Advanced Nursing*, *72*(5), 1086–1096. https://doi.org/10.1111/jan.12900

Rist, S., Almroth, B. C., Hartmann, N. B., & Karlsson, T. M. (2018). A critical perspective on early communications concerning human health aspects of microplastics. *Science of the Total Environment*, *626*, 720–726. https://doi.org/10.1016/j.scitotenv.2018.01.092

*Ritch, E., Brennan, C., & MacLeod, C. (2009). Plastic bag politics : modifying consumer behaviour for sustainable development. *International Journal of Consumer Studies*, *33*, 168–174. https://doi.org/10.1111/j.1470-6431.2009.00749.x

*Rivers, N., Shenstone-Harris, S., & Young, N. (2017). Using nudges to reduce waste? The case of Toronto's plastic bag levy. *Journal of Environmental Management*, *188*, 153–162. https://doi.org/10.1016/j.jenvman.2016.12.009

Rochman, C. M., Browne, M. A., Underwood, A. J., van Franeker, J. A., Thompson, R. C., & Amaral-Zettler, L. A. (2016). The ecological impacts of marine debris: unraveling the demonstrated evidence from what is perceived. *Ecology*, *97*(2), 302–312.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Iii, F. S. C., Lambin, E., … Liverman, D. (2009). Planetary Boundaries : Exploring the Safe Operating Space for Humanity. *Ecology and Society*, *14*(2).

*Rokka, J., & Uusitalo, L. (2008). Preference for green packaging in consumer product choices – Do consumers care? *International Journal of Consumer Studies*, *32*(5), 516–525. https://doi.org/10.1111/j.1470-6431.2008.00710.x

*Romero, C. B. A., Laroche, M., Aurup, G. M., & Ferraz, S. B. (2018). Ethnicity and acculturation of environmental attitudes and behaviors: A cross-cultural study with Brazilians in Canada. *Journal of Business Research*, *82*, 300–309. https://doi.org/10.1016/j.jbusres.2017.09.009

*Rothstein, H. (2003). Neglected risk regulation: The institutional attenuation phenomenon. *Health, Risk & Society*, *5*(1), 85–103. https://doi.org/10.1080/1369857031000066023

Royer, S.-J., Ferrón, S., Wilson, S. T., & Karl, D. M. (2018). Production of methane and ethylene from plastic in the environment. *PLoS ONE*, *13*(8), 1–13. https://doi.org/10.1371/journal.pone.0200574

*Rubens, L., Gosling, P., Bonaiuto, M., Brisbois, X., & Moch, A. (2015). Being a Hypocrite or Committed

While I Am Shopping? A Comparison of the Impact of Two Interventions on Environmentally Friendly Behavior. *Environment and Behavior*, *47*(1), 3–16. https://doi.org/10.1177/0013916513482838

Rujnić-Sokele, M., & Pilipović, A. (2017). Challenges and opportunities of biodegradable plastics: A mini review. *Waste Management & Research*, *35*(2), 132–140. https://doi.org/10.1177/0734242X16683272

*Ryan, P. G., & Jewitt, D. (1996). The "free" shopping bag debate: Costs and attitudes. *South African Journal of Science*, *92*, 163–164.

*Saidan, M. N., Ansour, L. M., & Saidan, H. (2017). Management of Plastic Bags Waste: An Assessment of Scenarios in Jordan. *Journal of Chemical Technology and Metallurgy*, *52*(1), 148–154.

*Saidan, M. N., Drais, A. A., & Al-Manaseer, E. (2017). Solid waste composition analysis and recycling evaluation: Zaatari Syrian Refugees Camp, Jordan. *Waste Management*, *61*, 58–66.

*Santos, I. R., Friedrich, A. C., Wallner-Kersanach, M., & Fillmann, G. (2005). Influence of socio-economic characteristics of beach users on litter generation. *Ocean and Coastal Management*, *48*, 742–752. https://doi.org/10.1016/j.ocecoaman.2005.08.006

*Santos, J. M., & Van Der Linden, S. (2016). Changing Norms by Changing Behavior: The Princeton Drink Local Program. *Environmental Practice*, *18*(2), 116–122. https://doi.org/10.1017/S1466046616000144

*Santos, S. C., Sousa, C. V. e, Sampaio, D. de O., & Fagundes, A. F. A. (2013). The impact of using compostable carrier bags on consumer behaviour in the City of Belo Horizonte, Brazil. *Ambiente and Sociedade*, *16*(4), 1–20. https://doi.org/10.1590/S1414-753X2013000400002

Schäfer, M., Jaeger-Erben, M., & Bamberg, S. (2012). Life Events as Windows of Opportunity for Changing Towards Sustainable Consumption Patterns? *Journal of Consumer Policy*, *35*(1), 65–84. https://doi.org/10.1007/s10603-011-9181-6

*Scherer, C., Emberger-Klein, A., & Menrad, K. (2017). Biogenic product alternatives for children: Consumer preferences for a set of sand toys made of bio-based plastic. *Sustainable Production and Consumption*, *10*, 1–14. https://doi.org/10.1016/j.spc.2016.11.001

*Schifferstein, H. N. J. (2009). The drinking experience: Cup or content? *Food Quality and Preference*, *20*(3), 268–276. https://doi.org/10.1016/j.foodqual.2008.11.003

Schultz, P. W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, *15*(2), 105–121. https://doi.org/10.1016/0272-4944(95)90019-5

*Schuyler, Q., Hardesty, B. D., Lawson, T., Opie, K., & Wilcox, C. (2018). Economic incentives reduce plastic inputs to the ocean. *Marine Policy*, *96*, 250–255.

Seltenrich, N. (2015). New Link in the Food Chain? Marine Plastic Pollution and Seafood Safety. *Environmental Health Perspective*, *123*(2), A34–A41. https://doi.org/10.1289/ehp.123-A34

*Shao, Y., Cai, H., & Chen, G. (2014). Rethinking plastic bag pollution problems in China. *Environmental Science: An Indian Journal*, *9*(6), 215–222.

*Sharp, A., Høj, S., & Wheeler, M. (2010). Proscription and its impact on anti-consumption behaviour and attitudes: The case of plastic bags. *Journal of Consumer Behaviour*, *9*(6), 470–484. https://doi.org/10.1002/cb.335

*Shimazu, H. (2018). Littering Behavior Analysis Based on Survey and Questionnaire About Littering in the Nagase River. *International Journal of GEOMATE*, *14*(41), 95–101. https://doi.org/10.21660/2018.41.59010

Sigler, M. (2014). The effects of plastic pollution on aquatic wildlife: Current situations and future solutions. *Water, Air, and Soil Pollution*, *225*, 2184. https://doi.org/10.1007/s11270-014-2184-6

*Silayoi, P., & Speece, M. (2004). Packaging and purchase decisions: An exploratory study on the impact of involvement level and time pressure. *British Food Journal*, *106*(8), 607–628.

*Silvenius, F., Grönman, K., Katajajuuri, J.-M., Soukka, R., Koivupuro, H.-K., & Virtanen, Y. (2014). The Role of Household Food Waste in Comparing Environmental Impacts of Packaging Alternatives. *Packaging Technology and Science*, *27*(4), 277–292. https://doi.org/10.1002/pts

Smith, M., Love, D. C., Rochman, C. M., & Neff, R. A. (2018). Microplastics in Seafood and the Implications

for Human Health. *Current Environmental Health Report*, *5*(3), 375–386.

*So, W. M. W., Cheng, N. Y. I., Chow, C. F., & Zhan, Y. (2016). Learning about the types of plastic wastes: effectiveness of inquiry learning strategies. *Education 3-13*, *44*(3), 311–324. https://doi.org/10.1080/03004279.2014.976239

*Spence, C., & Wan, X. (2015). Beverage perception and consumption: The influence of the container on the perception of the contents. *Food Quality and Preference*, *39*, 131–140. https://doi.org/10.1016/j.foodqual.2014.07.007

Spierling, S., Knüpffer, E., Behnsen, H., Mudersbach, M., Krieg, H., Springer, S., … Endres, H.-J. (2018). Bio-based plastics - A review of environmental, social and economic impact assessments. *Journal of Cleaner Production*, *185*, 476–491. https://doi.org/10.1016/j.jclepro.2018.03.014

*Spranz, R., Schlüter, A., & Vollan, B. (2018). Morals, money or the master: The adoption of eco-friendly reusable bags. *Marine Policy*, *96*, 270–277. https://doi.org/10.1016/j.marpol.2018.01.029

*Steenis, N. D., van Herpen, E., van der Lans, I. A., Ligthart, T. N., & van Trijp, H. C. M. (2017). Consumer response to packaging design: The role of packaging materials and graphics in sustainability perceptions and product evaluations. *Journal of Cleaner Production*, *162*, 286–298.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Steinmetz, Z., Wollmann, C., Schaefer, M., Buchmann, C., David, J., Tröger, J., … Schaumann, G. E. (2016). Plastic mulching in agriculture. Trading short-term agronomic benefits for long-term soil degradation? *Science of The Total Environment*, *550*, 690–705. https://doi.org/10.1016/j.scitotenv.2016.01.153

*Struk, M. (2017). Distance and incentives matter: The separation of recyclable municipal waste. *Resources, Conservation and Recycling*, *122*, 155–162. https://doi.org/10.1016/j.resconrec.2017.01.023

*Sun, Y., Wang, S., Li, J., Zhao, D., & Fan, J. (2017). Understanding consumers' intention to use plastic bags: Using an extended theory of planned behaviour model. *Natural Hazards*, *89*(3), 1327–1342. https://doi.org/10.1007/s11069-017-3022-0

*Syberg, K., Hansen, S. F., Christensen, T. B., & Khan, F. R. (2018). Risk Perception of Plastic Pollution: Importance of Stakeholder Involvement and Citizen Science. In M. Wagner & S. Lambert (Eds.), *Handbook of Environmental Chemistry* (Vol. 58, pp. 203–221). Springer, Cham. https://doi.org/10.1007/978-3-319-61615-5

*Synthia, I. J., & Kabir, S. (2015). An Investigation of Consumer Attitudes Towards New Varieties of Shopping Bags: Exploring Eco-Awareness and the Possibility of Behavior Change. *The Journal of Developing Areas*, *49*(5), 183–196. https://doi.org/10.1353/jda.2015.0062

*Thomas, G. O., Poortinga, W., & Sautkina, E. (2016). The Welsh Single-Use Carrier Bag Charge and behavioural spillover. *Journal of Environmental Psychology*, *47*(2880), 126–135. https://doi.org/10.1016/j.jenvp.2016.05.008

Thompson, R. C., Moore, C. J., vom Saal, F. S., & Swan, S. H. (2009). Plastics, the environment and human health: Current consensus and future trends. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 2153–2166. https://doi.org/10.1098/rstb.2009.0053

Thompson, R. C., Swan, S. H., Moore, C. J., & Vom Saal, F. S. (2009). Our plastic age. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 1973–1976. https://doi.org/10.1098/rstb.2009.0054

*Tih, S., & Zainol, Z. (2012). Minimizing Waste and Encouraging Green Practices. *Jurnal Ekonomi Malaysia*, *46*(1), 157–164.

*Tonglet, M., Phillips, P. S., & Bates, M. P. (2004). Determining the drivers for householder pro-environmental behaviour : waste minimisation compared to recycling. *Resources, Conservation and Recycling*, *42*, 27–48. https://doi.org/10.1016/j.resconrec.2004.02.001

*Tonglet, M., Phillips, P. S., & Read, A. D. (2004). Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: A case study from Brixworth, UK. *Resources, Conservation and Recycling*, *41*(3), 191–214. https://doi.org/10.1016/j.resconrec.2003.11.001

Truelove, H. B., Carrico, A. R., Weber, E. U., Raimi, K. T., & Vandenbergh, M. P. (2014). Positive and negative spillover of pro-environmental behavior : An integrative review and theoretical framework. *Global Environmental Change*, *29*, 127–138. https://doi.org/10.1016/j.gloenvcha.2014.09.004

*Truelove, H. B., Yeung, K. L., Carrico, A. R., Gillis, A. J., & Raimi, K. T. (2016). From plastic bottle recycling to policy support: An experimental test of pro-environmental spillover. *Journal of Environmental Psychology*, *46*, 55–66. https://doi.org/10.1016/j.jenvp.2016.03.004

*Tu, Y., Yang, Z., & Ma, C. (2015). Touching tastes: The haptic perception transfer of liquid food packaging materials. *Food Quality and Preference*, *39*, 124–130. https://doi.org/10.1016/j.foodqual.2014.07.001

*Tudor, D. T., & Williams, A. T. (2003). Public Perception and Opinion of Visible Beach Aesthetic Pollution: The Utilisation of Photography. *Journal of Coastal Research*, *19*(4), 1104–1115.

U.S. Government Publishing Office. (2015). *Microbead-Free Waters Act, Public Law 114-114 §.*

*Uehara, T., & Ynacay-Nye, A. (2018). How water bottle refill stations contribute to campus sustainability: A case study in Japan. *Sustainability (Switzerland)*, *10*(9), 1–19. https://doi.org/10.3390/su10093074

*van Dam, Y. K. (1996). Environmental assessment of packaging: The consumer point of view. *Environmental Management*, *20*(5), 607–614. https://doi.org/10.1007/BF01204134

*van Dam, Y. K., & van Trijp, H. C. M. (1994). Consumer perceptions of, and preferences for, beverage containers. *Food Quality and Preference*, *5*(4), 253–261. https://doi.org/10.1016/0950-3293(94)90050-7

*Van der Merwe, D., Viljoen, S., De Beer, H., Bosman, M., & Kempen, E. (2013). Consumers' experiences of cold chain food packaging : A qualitative study among women in South Africa. *International Journal of Consumer Studies*, *37*(6), 650–657. https://doi.org/10.1111/ijcs.12052

*van Herpen, E., Immink, V., & van den Puttelaar, J. (2016). Organics unpacked: The influence of packaging on the choice for organic fruits and vegetables. *Food Quality and Preference*, *53*, 90–96. https://doi.org/10.1016/j.foodqual.2016.05.011

*Varotto, A., & Spagnolli, A. (2017). Psychological strategies to promote household recycling. A systematic review with meta-analysis of validated field interventions. *Journal of Environmental Psychology*, *51*, 168–188. https://doi.org/10.1016/j.jenvp.2017.03.011

*Veiga, J. M., Vlachogianni, T., Pahl, S., Thompson, R. C., Kopke, K., Doyle, T. K., … Alampei, I. (2016). Enhancing public awareness and promoting co-responsibility for marine litter in Europe: The challenge of MARLISCO. *Marine Pollution Bulletin*, *102*(2), 309–315. https://doi.org/10.1016/j.marpolbul.2016.01.031

*Venter, K., van der Merwe, D., de Beer, H., Kempen, E., & Bosman, M. (2011). Consumers' perceptions of food packaging: an exploratory investigation in Potchefstroom, South Africa. *International Journal of Consumer Studies*, *35*(3), 273–281. https://doi.org/10.1111/j.1470-6431.2010.00936.x

*Viscusi, W. K., Huber, J., & Bell, J. (2012). Alternative policies to increase recycling of plastic water bottles in the united states. *Review of Environmental Economics and Policy*, *6*(2), 190–211. https://doi.org/10.1093/reep/res006

*Vogt, J., & Nunes, K. R. A. (2014). Recycling behaviour in healthcare: Waste handling at work. *Ergonomics*. Taylor & Francis. https://doi.org/10.1080/00140139.2014.887786

*Vones, K., Allan, D., Lambert, I., & Vettese, S. (2018). 3D-printing 'Ocean plastic'–Fostering childrens' engagement with sustainability. *Materials Today Communications*, *16*, 56–59. https://doi.org/10.1016/j.mtcomm.2018.04.001

*Wagner, T. P. (2017). Reducing single-use plastic shopping bags in the USA. *Waste Management*, *70*, 3–12. https://doi.org/10.1016/j.wasman.2017.09.003

*White, K. M., Smith, J. R., Terry, D. J., Greenslade, J. H., & McKimmie, B. M. (2009). Social influence in the theory of planned behaviour : The role of descriptive, injunctive, and ingroup norms. *British Journal of Social Psychology*, *48*(1), 135–158.

*Widaningrum, D. L. (2014). The Importance of Take-Out Food Packaging Attributes: Conjoint Analysis and Quality Function Deployment Approach. In *EPJ Web of Conferences* (Vol. 68, p. 36). EDP

Sciences.

Wikström, F., Williams, H., Verghese, K., & Clune, S. (2014). The influence of packaging attributes on consumer behaviour in food-packaging life cycle assessment studies - a neglected topic. *Journal of Cleaner Production*, *73*, 100–108. https://doi.org/10.1016/j.jclepro.2013.10.042

*Willis, K., Maureaud, C., Wilcox, C., & Hardesty, B. D. (2018). How successful are waste abatement campaigns and government policies at reducing plastic waste into the marine environment? *Marine Policy*, *96*, 243–249. https://doi.org/10.1016/j.marpol.2017.11.037

*Williams, A. T., Rangel-Buitrago, N. G., Anfuso, G., Cervantes, O., & Botero, C. M. (2016). Litter impacts on scenery and tourism on the Colombian north Caribbean coast. *Tourism Management*, *55*, 209–224. https://doi.org/10.1016/j.tourman.2016.02.008

*Williams, H., Wikström, F., Otterbring, T., Löfgren, M., & Gustafsson, A. (2012). Reasons for Household Food Waste With Special Attention to Packaging. *Journal of Cleaner Production*, *24*, 141–148. https://doi.org/10.1016/j.jclepro.2011.11.044

Wohlin, C. (2014). Guidelines for snowballing in systematic literature studies and a replication in software engineering. In *Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering - EASE '14*. London, United Kingdom: ACM. https://doi.org/10.1145/2601248.2601268

*Wyles, K. J., Pahl, S., Thomas, K., & Thompson, R. C. (2016). Factors That Can Undermine the Psychological Benefits of Coastal Environments: Exploring the Effect of Tidal State, Presence, and Type of Litter. *Environment and Behavior*, *48*(9), 1095–1126. https://doi.org/10.1177/0013916515592177

*Yamaguchi, K., & Takeuchi, K. (2016). Consumer preferences for reduced packaging under economic instruments and recycling policy. *Waste Management*, *48*, 540–547. https://doi.org/10.1016/j.wasman.2015.11.015

Yeo, B. G., Takada, H., Taylor, H., Ito, M., Hosoda, J., Allinson, M., … McGrath, J. (2015). POPs monitoring in Australia and New Zealand using plastic resin pellets, and International Pellet Watch as a tool for education and raising public awareness on plastic debris and POPs. *Marine Pollution Bulletin*, *101*(1), 137–145. https://doi.org/10.1016/j.marpolbul.2015.11.006

*Yeow, P., Dean, A., & Tucker, D. (2014). Bags for Life: The Embedding of Ethical Consumerism. *Journal of Business Ethics*, *125*(1), 87–99. https://doi.org/10.1007/s10551-013-1900-2

*Yeung, S.-K., So, W.-M. W., Cheng, N.-Y. I., Cheung, T.-Y., & Chow, C.-F. (2017). Comparing pedagogies for plastic waste management at university level. *International Journal of Sustainability in Higher Education*, *18*(7), 1039–1059. https://doi.org/10.1108/14676371311312905

*Young, S. (2008). Packaging and the Environment: A Cross-Cultural Perspective. *Design Management Review*, *19*(4), 42–48. https://doi.org/10.1111/j.1948-7169.2008.tb00140.x

*Yue, C., Hall, C. R., Behe, B. K., Campbell, B. L., Dennis, J. H., & Lopez, R. G. (2010). Are consumers willing to pay more for biodegradable containers than for plastic ones? Evidence from hypothetical conjoint analysis and nonhypothetical experimental auctions. *Journal of Agricultural and Applied Economics*, *42*(4), 757.

*Zen, I. S., Ahamad, R., & Omar, W. (2013). No plastic bag campaign day in Malaysia and the policy implication. *Environment, Development and Sustainability*, *15*(5), 1259–1269. https://doi.org/10.1007/s10668-013-9437-1

*article met review criteria

4 MANUSCRIPT 2 – WHY DO PEOPLE ENGAGE IN A PLASTIC-FREE WORLD? EXPLORING ANTECEDENTS OF ANTI-PLASTIC ACTIVITIES

Heidbreder, L.M., Troeger, J. & Schmitt, M. (under review). Why do people engage in a plastic-free world? Exploring antecedents of anti-plastic activities.

Date of submission: 07th of September, 2020

Abstract

In the last few years, plastic has become an issue of current interest as tremendous ecological effects from plastic littering became visible. Taking the role of consumers into account, activities comprising purchase decisions and political engagement are expected to impact plastic pollution prevention. However, facets of anti-plastic activities and their origins are currently not yet well understood. This study examines antecedents of three anti-plastic activity intentions referring to purchase, activism, and policy support. Based on current models of pro-environmental behaviour[3], an online-survey (N = 648) was implemented. Structural equation modelling revealed personal norms as a relevant predictor of all three activity intentions. While sufficiency orientation and collective efficacy only predicted political activity intentions, perceived behaviour control was the strongest predictor for purchase intention. As a behavioural measurement, participants could either choose a conventional or plastic-free shopping voucher or donate the amount of money to an NGO addressing plastic pollution. The last two options were aggregated to one category of plastic-free incentives. People with high activism intention and sufficiency orientation were more likely to choose the plastic-free incentive instead of the conventional shopping voucher. Implications for research and consumer-oriented interventions that increase anti-plastic activities are discussed.

Keywords: plastic, structural equation model, consumption, policy support, activism, sufficiency orientation

[3] This manuscript is written in British English

Introduction

Plastic pollution is a major global crisis: Worldwide, 359 million tons of plastic are produced every year (PlasticsEurope, 2019). It is estimated that 79% of the plastic waste generated has ended up in landfills or the natural environment (Geyer, Jambeck, & Law, 2017). Marine and terrestrial ecosystems are contaminated with plastic particles (Horton, Walton, Spurgeon, Lahive, & Svendsen, 2017; Jambeck et al., 2015). Animals get sick and die of plastic ingestion (Li, Tse, & Fok, 2016; Sigler, 2014) and plastic residuals have already been detected in human bodies (Galloway, 2015).

In the last years, the topic of plastic was on top of the agenda in the media and the European Commission proposed a directive to target single-use plastic products most often found on European beaches (European Commission, 2018). The current concern and critics mainly focus on single-use plastics with a short life and fast, subsequent disposal. Thereby, 40% of the European plastic demand can be traced to packaging made for direct disposal (PlasticsEurope, 2019). Every year, 17 million tons of plastic packaging waste is collected in Europe (PlasticsEurope, 2019). Starting at the beginning of the waste chain, promoting a reduction and substitution of single-use plastics is an important step to tackle the plastic problem. Thus, the role of consumers is decisive to decrease plastic waste. General awareness of the plastic problem is already quite high: The Federal Environment Agency reported that the general public in Germany rated plastic waste in the ocean as the biggest environmental problem, even above climate change (UBA, 2017).

While many studies have focused on recycling behaviour, only a few examined reduction-oriented behaviour in the field of purchase decisions (Heidbreder, Bablok, Drews, & Menzel, 2019). Furthermore, people can engender change through political behaviour (Stern, 2000). Therefore, it is important to take several types of consumer responses into account and examine them in parallel. Studies that integrate several behavioural strategies addressing plastic pollution in both private and public sphere are lacking. To fill this gap, this work presents

and evaluates an integrated model contributing to a comprehensive understanding of various anti-plastic activities and their both shared as well as unique antecedents.

A comprehensive model of anti-plastic activities

According to Stern (2000) individuals can either adopt a sustainable lifestyle or/and support other (e.g., policy or business) to act in a sense of sustainable behaviour. In his taxonomy he distinguishes private sphere behaviour (e.g., buying organic food or recycling household waste) and public sphere activities such as environmental activism (e.g., active involvement in demonstrations), civic engagement (e.g., joining an organization, signing a petition), and policy support (e.g., willingness to pay taxes for environmental goals). In our study we apply this differentiation and seek to identify shared as well as unique predictors in the field of anti- plastic usage and activities.

To capture important drivers of pro-environmental action, several factors from different theories have proven to be valid. First, the theory of planned behaviour provides meaningful insights and important predictors (TPB; Ajzen, 1991) and has been widely applied to the context of sustainable behaviour (Si et al., 2019). It takes a rational choice approach to explain when and why people engage in pro-environmental behaviour. The theory assumes intention as direct predictor for behaviour. Attitude (in terms of cost-benefit-considerations regarding the behaviour), perceived behaviour control (belief of being capable to perform the behaviour) and social norms (perceived social pressure to perform the behaviour) indirectly influence behaviour via intentions (Armitage & Conner, 2001). Furthermore, perceived behaviour control is assumed to have a direct impact on behaviour. Based on these theoretical considerations we assume:

> H1a: Each of the TPB variables (attitude, perceived behaviour control, social norms) has a unique direct regression effect on (a) private sphere and (b) public sphere behavioural intentions.

H1b: Private and public sphere intentions as well as perceived behaviour control have a unique direct regression effect on behaviour.

Behaviour is not only driven by self-interest. In several studies, effects of the TPB were augmented by personal norms (feeling of a moral obligation to act) as another predictor of intention (Bamberg, Hunecke, & Blöbaum, 2007; Klöckner, 2013; Rivis, Sheeran, & Armitage, 2009), suggesting that pro-environmental behaviour does not only result from rational but also from moral choices. According to a meta-analysis, TPB variables supplemented by personal norms explained 52% of the variance in pro-environmental behavioural intention (Bamberg & Möser, 2007). In the context of plastic usage, TPB variables in combination with personal norms were predictive for recycling behaviour (Ofstad, Tobolova, Nayum, & Klöckner, 2017; Pakpour, Zeidi, Emamjomeh, Asefzadeh, & Pearson, 2014; Tonglet, Phillips, & Bates, 2004). In the case of packing choices, personal norms were influential and a stronger predictor than TPB variables (Thøgersen, 1999). Based on the repeated finding that personal norms uniquely affect various kinds of pro-environmental behaviour, Klöckner, (2013) proposed an integrative approach including personal norms, attitude, perceived behaviour control and social norms as direct predictors of intention. According to Stern (2000), personal norms shape pro-environmental behaviour in both private and public spheres (Stern, 2000). Following the original norm activation model (NAM, Schwartz, 1977), personal norms directly influence behaviour. Therefore, we assume:

H2a: Personal norms have a unique direct regression effect on (a) private sphere and (b) public sphere behavioural intentions.

H2b: Personal norms have a unique direct regression effect on behaviour.

Biodiversity loss through marine littering and its consequences is a global challenge. Thus, the question arises if one single person can really make a difference. At this point collective efficacy becomes relevant. It refers to the belief that, as a group member, one has an influence towards a certain goal (e.g., reducing waste as students by using re-usable coffee-cups) (Hamann & Reese, 2020). Since individual behaviour sometimes appears as a “drop in the ocean”, collective

efficacy in terms of the expectation to attain a goal by means of collective action has further predictive power regarding pro-environmental behaviour (Chen, 2015; Homburg & Stolberg, 2006; Jugert et al., 2016), and thus influences plastic reduction (Reese & Junge, 2017). Collective efficacy predicts pro-environmental behaviour and intentions in the private and public sphere (see Hamann & Reese, 2020). Thus, we hypothesize:

H3a: Collective efficacy has a unique direct regression effect on (a) private sphere and (b) public sphere behavioural intentions.

H3b: Collective efficacy has a unique direct regression effect on behaviour.

Sufficiency is discussed as a sustainability strategy that aims to combat climate change by strictly reducing overall levels of resource consumption. Sufficiency questions the general demand of resources and seeks to strictly lower it (Samadi et al., 2017; Toulouse et al., 2019). In contrast to efficiency, sufficiency goes beyond technical approaches to solve the climate crisis. It includes individual and collective shifts in resource handling by using planetary boundaries as one core guiding principle (Rockström et al., 2009) and limiting absolute consumption levels to a necessary level. In brief, sufficiency captures the idea of the less the better. Instead of focusing on wants (e.g., the desire to go on vacation), the underlying need (e.g., recovery) of individuals and society is predominant. Often, it is strived for satisfaction of these needs without material goods (Gorge, Herbert, Özçağlar-Toulouse, & Robert, 2015). Downshifting consumption implies a reflection how to live a good and satisfying life by respecting natural planetary boundaries and important justice principles (i.e. intra- and intergenerational justice concerns, see for instance Schäpke & Rauschmayer, 2014). In line, sufficiency orientation was recently conceptualized as attitudinal stance to refrain from resource intensive consumption (Verfuerth, Henn, & Becker, 2019). It is correlated with significantly lower individual CO2-emissions and discussed to successfully bridge the intention behaviour gap (Reese, Drews, & Tröger, 2019; Verfuerth, Henn, & Becker, 2019).

In the context of plastic consumption and handling, we argue that sufficiency orientation would play a significant role. Consuming less by strictly not using or buying products made

of or wrapped in plastic should be an immediate consequence of pursuing an attitude of rejecting overconsumption and adhering the rule of the less the better. We argue that this would be translated in appropriate private sphere intentions also in the field of anti-plastic activities. Furthermore, living sufficiency-oriented within (infra-)structures that deeply enrooted (over) consumption as default structures in order to maintain the current economic system, would be a very hard job for a single individual. Thus, it is highly probable that an individual sufficiency orientation goes hand in hand with a vote for stricter political measures that would make sufficiency-oriented decisions easier. Therefore, we argue that people who express a high sufficiency orientation also support public sphere behaviour.

H4a: Sufficiency orientation has a unique direct regression effect on (a) private sphere and (b) public sphere behaviour intentions.

H4b: Sufficiency orientation has a unique direct regression effect on behaviour.

The present research

Based on the integrative approach by Klöckner (2013) we combine TPB variables and personal norms as predictors of intentions. We added two further predictors to Klöckner's model. First, impacts of engagement in anti-plastic can be displayed mainly on a collective level. Therefore, we integrate collective efficacy as an additional predictor in our comprehensive model. Second, in current models a consequent attitude against overconsumption is missing that depict an opposite pole to efficacy beliefs within the field of pro-environmental behaviour. To include such a predictor, we propose the construct of sufficiency orientation representing people's mindset to reduce consumption. Thus, our model assumes that anti-plastic activity intentions in private sphere and public sphere are predicted by people's perceived behaviour control, attitude, social and personal norms, collective efficacy and sufficiency orientation. We further assume that behaviour is directly predicted by intentions, perceived behaviour control, personal norms, collective efficacy and sufficiency orientation.

This study pursues three goals: First, we aim to increase knowledge in the field of consumption-related plastic reduction by testing a comprehensive model on several anti-plastic activities. We focus on plastic packaging because the majority of plastic use in Europe can be traced back to packaging (PlasticsEurope, 2019). Second, environmental impact cannot be limited to individual consumption decisions only. In line with Stern's approach, we considered several dimensions of anti-plastic activities as outcome variables. By testing the comprehensive model in both, the private and public sphere, we can identify unique and shared predictors of various anti-plastic activities and reveal spillover effects as reflected in correlations between activities originating from shared sources of variance. Third and following the interdisciplinary debate on transformation and sustainability, we integrate sufficiency orientation into the model and explore its potentials in one particular field of reduction-oriented behaviour. Psychological research on sufficiency orientation is still in its infancy but a deeper understanding is highly necessary to make sufficiency policies more attractive and feasible (Gossen, Ziesemer, & Schrader, 2019; Spangenberg, & Lorek, 2019). Thus, integrating sufficiency as attitudinal stance within a comprehensive model seems useful to both tie in with this important actual societal debate on ecological transformation. And also, to test if common models that are discussed within classical environmental psychology can be complemented meaningfully and gain explanatory power.

Methods

Procedure and participants

N = 648 German participants completed an online-survey during summer 2017. Participants were recruited via mailing-lists of German universities and social media. We offered shopping vouchers as incentives for participation. The survey was implemented on SosciSurvey (Leiner, 2016). Mean time to complete the survey was 15 minutes (M = 14.42, SD = 5.14; median = 13.87). Participants' ages ranged from 18 to 76 years (M = 30.34, SD = 10.56). The sample was predominantly female with 77% women, 22% men and 2% that did not indicate their gender.

Educational level was above the German national average (Destatis, 2018): 35% stated to hold a high school diploma (32% on national level) and 56% had a university degree (18% on national level).

Measures

According to our comprehensive model, several psychological variables assumed as important predictors of plastic-related activities were included in the questionnaire. If not otherwise stated, answers were recorded on Likert scales ranging from 0 (do not agree at all) to 4 (agree completely). The questionnaire can be found in the appendix.

Attitude. To measure people's attitude towards plastic packaging and its usage, participants answered the question "In my opinion, using plastic packaging is…", and indicated their personal opinion on four statements in completion of this sentence, such as, "practical" or "cheap". Higher numbers recorded a positive attitude towards plastic packaging use.

Perceived behaviour control. Participants indicated their control beliefs towards the avoidance of plastic packaging in response to four items (e.g., "For me, it is easy to use no plastic packaging").

Social norms. Four items captured descriptive norms (e.g., "Most people whose opinion I value try to use less plastic packaging") as well as injunctive norms (e.g., "Most people who are important to me expect me to avoid plastic packaging"). Confirmatory factor analysis revealed that the items have one factor in common, hence, descriptive and injunctive norms were aggregated into one variable of social norms.

Personal norms. To measure personal norms, three items were adopted from previous work (e.g., Bamberg, Hunecke, & Blöbaum, 2007; Harland, Staats, & Wilke, 1999), for instance, "I feel morally obliged to use less plastic packaging".

Collective efficacy. Four items measured collective efficacy (Homburg & Stolberg, 2006; Jugert et al., 2016), for instance, "I think that we as consumers can solve together the plastic packaging problem".

Sufficiency orientation. To measure people's readiness to downshift from high-impact consumption to low-impact consumption, a sufficiency orientation scale was implemented (Verfuerth et al., 2019). People answered six statements, for instance, "It's unnecessary to have such a high range of products in supermarkets" and "Usually, high consumption increases environmental pollution".

Intentions. Nine items measured intentions to engage in anti-plastic activities in both private and public sphere. Confirmatory factor analysis revealed a three-factor-solution, with three items capturing purchase intention, two items measuring activism intention and three items assessing policy support intention. One item indicating the willingness to pay for plastic-free products was excluded due to a low factor loading (see Table 1 for results of the factor models).

Behaviour. As reward for participation, participants selected between two types of voucher, a conventional online shopping voucher versus one for an online shop selling plastic-free products only. As a third option, participants could donate the monetary value of the voucher to an NGO lobbying for raising awareness of the plastic waste problem. People's choices served as a behavioural measurement in form of a binary variable aggregating the last two options to an ecological category (conventional vs. plastic-free option).

Table 2 presents convergent and discriminant validity results as well as reliability of the five predictors in the model based on confirmatory factor analysis. The Maximum Shared Variance (MSV) and the Average Shared Variance (ASV) were found to be lower than the Average Variance Extracted (AVE) for all the predictors, indicating discriminant validity of the predictors. Average Variance Extracted (AVE) of each construct was higher than its correlation with other constructs, indicating convergent validity (see Alumran, Hou, Sun, Yousef, & Hurst, 2014).

Table 1 Parameter estimates and fit indices for the two-factor and three-factor models of anti-plastic activities

Two-factor		Three-factor	
λ11	.66	λ11	.65
λ21	.75(.11)	λ21	.74(.11)
λ31	.69(.11)	λ31	.70(.11)
λ42	.68	λ42	.77
λ52	.69(.08)	λ52	.75(.07)
λ62	.65(.05)	λ63	.80
λ72	.73(.06)	λ73	.70(.05)
λ82	.69(.06)	λ83	.67(.05)
λ92	.50(.06)		
θ_δ11	.58(.04)	θ_δ11	.58(.04)
θ_δ22	.44(.07)	θ_δ22	.45(.07)
θ_δ33	.53(.08)	θ_δ33	.51(.08)
θ_δ44	.54(.05)	θ_δ44	.40(.06)
θ_δ55	.53(.06)	θ_δ55	.45(.07)
θ_δ66	.58(.03)	θ_δ66	.36(.04)
θ_δ77	.47(.04)	θ_δ77	.51(.04)
θ_δ88	.53(.03)	θ_δ88	.55(.03)
θ_δ99	.76(.05)		
ϕ21	.62(.04)	ϕ21	.64(.04)
		ϕ31	.50(.04)
		ϕ23	.78(.06)
χ2(df)	152.35(26), *p*<.001	χ2(df)	38.24(17), *p*=.002
RMSEA	.09	RMSEA	.04
TLI	0.90	TLI	.98
CFI	0.93	CFI	.99
SRMR	.051	SRMR	.028

Note. Standard errors of parameters in parentheses; error variances, covariances and factor loadings are standardized; *N* = 648.

Table 2 Convergent and discriminant validity assessment and reliability of the predictors

Scales	AVE	MSV	ASV	REL
Perceived behavior control	0.487	0.228	0.156	0.783
Attitudes	0.489	0.198	0.104	0.781
Social norms	0.448	0.062	0.041	0.755
Personal norms	0.707	0.362	0.187	0.874
Collective efficacy	0.554	0.249	0.134	0.831
Sufficiency orientation	0.516	0.362	0.160	0.832

Note. AVE Average Variance Extracted; MSV Maximum Shared Variance; ASV Average Shared Variance; REL Reliability.

Results

All analyses were conducted with R (version 3.5.2). We used the packages psych (Revelle, 2018) for descriptive analyses and correlations as well as lavaan (Rosseel, 2012) and sem (Fox et al., 2017) for structural equation modelling.

Dimensions of anti-plastic activity intentions

According to Stern's basic classification, we conducted a confirmatory analysis with two factors differentiating private sphere intention (three items) and public sphere intention (six items). The model revealed no good fit: $X^2(26) = 152.35$ ($p < .001$), CFI = .931, RMSEA = .087 [.074; .100], SRMR = .051. We excluded one item (willingness to pay more for plastic-free products) due to a low factor loading (< .50). However, the fit was hardly improved: $X^2(19) = 115.04$ ($p < .001$), CFI = .942, RMSEA = .088 [.073; .104], SRMR = .046. Therefore, we proposed a three-factor solution according to Stern's differentiation within the public sphere between activism und non-activist behaviour (see Table 1) with a good model fit: $X^2(17) = 38.24$ ($p = .002$), CFI = .987, RMSEA = .044 [.025; .063], SRMR = .028. Importantly, the three-factor model fit the data significantly better than did the two-factor model ($X^2(2) = 76.8$, $p < .001$). The results indicate a strong correlation between the factors, particularly between the two factors of public sphere. This is plausible due to the content-related proximity of the three constructs. As the confidence interval around the value, $.67 \leq \phi 23 \leq .89$, does not include 1.00, we assume distinct constructs. Convergent and discriminant validity results and reliability based on confirmatory factor analysis for the three anti-plastic activity intentions are presented in Table 3. The small difference between AVE and ASE reflect the high correlation between the three factors. Content-wise and due to the better fit, we decided to maintain the three-factor solution.

The first factor included three items reflecting the willingness to buy food without packaging and was labelled as "purchase intention". The second factor captured "activism intentions" and comprised two items stating the willingness to actively engage in organizational structures against plastic usage or to participate in a demonstration. The third factor capturing

"policy support intentions" included three items expressing support for policy regulations, respective voting and signing a petition.

Descriptive analyses

Bivariate correlations of all variables based on latent constructs of confirmatory factor analysis and socio-demographics are provided in Table 4. When aggregating the items of intentions to mean values, policy support intention (M = 3.18, SD = 0.83) reached higher approval rates than purchase intention (M = 2.55, SD = 0.99) and activism intention (M = 2.14, SD = 1.14). Considering socio-demographics, age did not significantly correlate with policy support or activism intention, but weakly with purchase intention indicating that elderly people were more willing to purchase products with less plastic packaging (r = .16). Women were also more likely to purchase products with less packaging (r = .33), to show more activism (r = .19) and more policy support (r = .23).

Testing the comprehensive model

To test our comprehensive model, we specified a structural equation model (SEM) according to our hypotheses, tested the model, and estimated its parameters (see Bagozzi & Yi, 2012). As multivariate normality was not given and ordinal data was included as a dependent variable, we used the robust WLSMV estimator. The three intentions were included as latent endogenous (dependent) variables in the model and as latent exogenous (independent) variables for behaviour. TPB variables (attitude, social norms, perceived behaviour control), personal norms, collective efficacy and sufficiency orientation were included as latent exogenous (independent) variables in the model, age and gender were included as control variables. The voucher choice at the end of the survey was taken as a behavioural measurement. People could decide to take a conventional shopping voucher (n = 155) or a shopping voucher for a plastic-free shop (n = 204) or to donate the money to an NGO addressing plastic pollution (n = 168). We combined the last two in one category as a plastic-free option and used the binary variable

as an ordered endogenous (dependent) variable in the model (see Figure 4). As 121 participants did not choose any of these options, the SEM was calculated with n = 527 participants.

The SEM revealed a good model fit ($X^2(545) = 912.20$ ($p < .001$), CFI = .978, RMSEA = .036 [.032; .040], SRMR = .036). The predictors explained 78% of the variance of purchase intention, 45% of the variance of activism intention and 55% of the variance of policy support intention. 52% of the variance of behaviour was explained. Personal norms strongly predicted all three intentions. Attitude towards plastic usage had a negative influence on purchase intention and activism intention. Perceived behaviour control had a strong positive influence on purchase intention and a negative influence on policy support intention. Social norms were no significant predictor at all, while collective efficacy and sufficiency orientation were predictors of activism intention and policy support intention. Gender predicted all three intentions. And age had a positive impact on purchase intention. Activism intention, age and sufficiency orientation predicted behaviour.

Table 3 Convergent and discriminant validity assessment and reliability of anti-plastic activity intentions

Scales	AVE	MSV	ASV	REL
Purchase intention	0.487	0.407	0.330	0.732
Activism intention	0.575	0.601	0.504	0.728
Policy support intention	0.527	0.601	0.427	0.764

Note. AVE Average Variance Extracted; MSV Maximum Shared Variance; ASV Average Shared Variance; REL Reliability.

Table 4 Correlations among the latent variables, behaviour and socio-demographics in CFA model

	1 - BEH	2 - PU	3 - ACT	4 - PS	5 - Age	6 - GD	7 - ATT	8 - SN	9 - PBC	10 - PN	11 - CE	12 - SO
1	-	[.32;.49]	[.44;.59]	[.41;.57]	[.08;.25]	[.12;.28]	[-.36;-.18]	[.05;.24]	[.16;.34]	[.36;.51]	[.14;.32]	[.37;.52]
2	.41***	-	[.56;.72]	[.43;.60]	[.08;.25]	[.25;.41]	[-.67;-.52]	[.12;.32]	[.68;.81]	[.63;75]	[.33;.50]	[.43;.58]
3	.51***	.64***	-	[.72;.85]	[-.07;.11]	[.11;.28]	[-.49;-.31]	[.23;.42]	[.31;.49]	[.51;.66]	[.37;.54]	[.41;.57]
4	.49***	.51***	.79***	-	[-.02;.15]	[.15;.32]	[-.41;-.23]	[.13;.32]	[.17;.36]	[.60;.72]	[.38;.45]	[.56;.69]
5	.17***	.16***	.02	.07	-	[-.18;-.03]	[-.25;-.08]	[.04;.21]	[.04;.21]	[.07;.23]	[-.14;.03]	[.08,.25]
6	.20***	.33***	.19***	.23***	-.10**	-	[-.30,-.14]	[-.10;.08]	[.08;.25]	[.23;.38]	[.08;.25]	[.07;.23]
7	-.27***	-.60***	-.40***	-.32***	-.17***	-.22***	-	[-.22;-.03]	[-.53;-.37]	[-.48;-.32]	[-.31;-.13]	[-.40;-.23]
8	.15**	.22***	.33***	.23***	.12**	-.01	-.12*	-	[.13;.32]	[.16;.34]	[.12;.30]	[.09;.27]
9	.25***	.74***	.40***	.27***	.12**	.17***	-.45***	.23***	-	[.40,.55]	[.32;.48]	[.29;.45]
10	.43***	.69***	.58***	.66***	.15***	.31***	-.40***	.25***	.48***	-	[.43;.57]	[.55;.67]
11	.23***	.41***	.45***	.46***	-.06	.17***	-.22***	.21***	.40***	.50***	-	[.32;.48]
12	.45***	.51***	.49***	.62***	.17***	.15***	-.31***	.18***	.37***	.61***	.40***	-

Note. Below diagonal: correlations, above diagonal: confidence intervals of the correlations; BEH = behaviour; PU = Purchase intention; ACT = Activism intention; PS = Policy support intention; GD = Gender; ATT = Attitude; SN = Social norms; PBC = Perceived behavioural control; PN = Personal norms; CO = Collective efficacy; SO = Sufficiency orientation; *p < .05, **p <. 01, ***p <. 001; N = 648; N_{GD} = 638

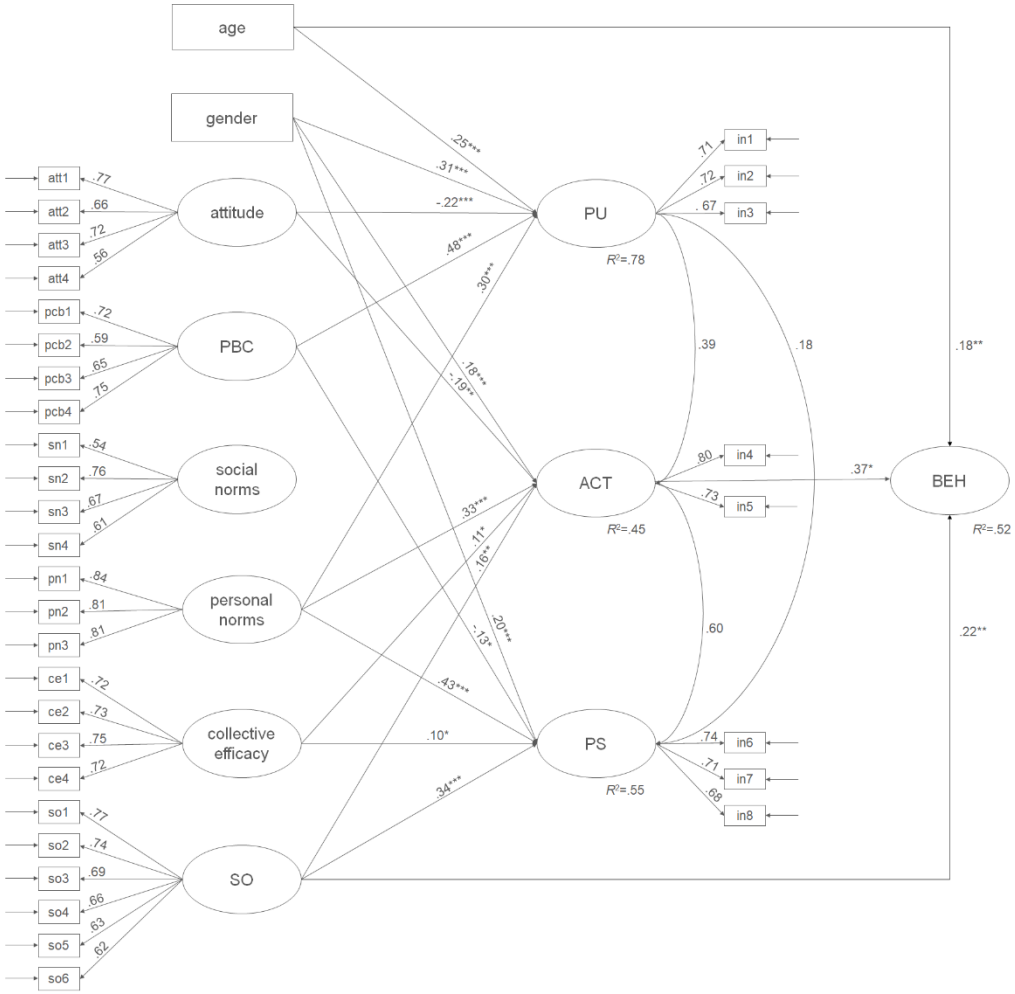

Figure 4 Structural equation model of anti-plastic activities (N = 527)

Note. *p < .05, **p <. 01, ***p <. 001

Discussion

Combined efforts in private as well as public sphere are needed to decrease single-usage of plastic products and limit plastic pollution. This paper focuses on different anti-plastic activities people can perform to reduce plastic wastage in the field of single-use plastics. We shed a light on purchase decisions, political engagement and policy support. As hypothesized, psychological variables from the TPB and NAM were predictive towards the willingness to perform anti-plastic activities (cp. Figure 4). We also detected significant explanatory power from the newly introduced sufficiency orientation scale on plastic-free voucher choice and donation.

Three dimensions of anti-plastic activity intentions

Based on confirmatory factor analyses, we distinguished three intentions of anti-plastic activities: purchase intention, activism intention and policy support intention. Purchase intention referred to the willingness to buy products without plastic packaging and corresponded with Stern's factor of private sphere behaviour. Activism intention and policy support intention corresponded with public sphere behaviour and correlated substantially but not perfectly with each other. In line with Stern (2000), confirmatory factor analysis revealed the two intentions within the public sphere, policy support intention and activism intention, to be partly distinct. In contrast to Stern's findings, signing a petition loaded on policy support instead of civic engagement. We argue that due to digitization it is nowadays much easier to sign an online petition as it was the case when Stern established his typology. Notwithstanding these differences, the necessity of looking closer at a specific target behaviour and its antecedents – which was already highlighted by Stern (2000) – was confirmed by the present study within the field of anti-plastic behaviour.

Interrelations between anti-plastic activity intentions

The correlational and cross-sectional design of the present study does not allow causal interpretations, for instance regarding potential spillover effects from one intention to another.

However, the substantial correlations found in the present study are consistent with spillover effects and can be compared to previous research. Previous studies revealed inconsistent results for spillover effects from private to public sphere behaviour (Truelove, Yeung, Carrico, Gillis, & Raimi, 2016). On the one hand, people with pro-environmental lifestyles were more willing to sign a petition (De Moor & Verhaegen, 2020) and sustainable consumption predicted policy support of wind power and political activism (Thøgersen & Noblet, 2012; Willis & Schor, 2012). This points out that a positive spillover effect between private and public sphere behaviour may exist. On the other hand, no or even negative effects were found regarding recycling behaviour and the support of a green fund (Truelove et al., 2016). Additionally, people who showed sustainable energy behaviour were less likely to support a tax increase on carbon emissions or policy investments in renewable energy (Noblet & McCoy, 2018; Werfel, 2017). No spillover from public to private sphere behaviour was found in case of the introduction of a fee for plastic bags (Poortinga, Whitmarsh, & Suffolk, 2013).

In the present study, private and public sphere intentions were positively correlated, indicating potential spillover effects within the domain of anti-plastic activities. Residuals of purchase intention and activism intention correlated on a medium level in our model (r = .39), thus, they shared variance that is not explained by our predictors. As spillover refers to the activation of an intention by another intention (Maki et al., 2019), the willingness to buy less plastic might lead to the willingness to get engaged in this field (and the other way around), independent of other predictors. As activism intention and policy support intention shared a strong common variance source over and above the predictors (r = .60), a spillover effect of these two intentions is also likely. It looks differently for purchase intention and policy support intention as the shared variance independent of the predictors was on a low level (r = .18). The negative impact of perceived behaviour control in plastic-free purchase on policy support intention leads to the assumption that for people who fail to purchase less plastic (e.g., because of lacking available infrastructures that set up adequate default structures for plastic free shopping), policy support constitutes an opportunity to request structural change. People with

lower perceived control were less likely to purchase plastic-free but were more likely to support policy measures that change the societal handling of plastics. Thus, a negative spillover from "failed" private sphere behaviour to public sphere behaviour is also feasible.

Predicting anti-plastic activity intentions

PURCHASE INTENTION

The predictors in the model explained 78% of the variance of purchase intention. Compared to other models that target pro-environmental behaviour, this is a comparatively well prediction (Bamberg & Möser, 2007). The first hypothesis assuming a unique direct regression effect of each TPB variable was partly confirmed (H1a). Perceived behaviour control of anti-plastic purchase was the strongest predictor, which is in line with results found for general pro-environmental behaviour (see for a meta-analysis, Bamberg & Möser, 2007). Moreover, people who had a positive attitude towards plastic packaging were less willing to refrain from consumption in this domain. Against our hypothesis, social norms were not predictive for purchase intention in our study. Although social norms had a small (Armitage & Conner, 2001) or only indirect impact through personal norms on intentions in former research (Bamberg & Möser, 2007), social norms often show positive impact in intervention studies. Communicating social norms was successful in reducing consumption of bottled water (van der Linden, 2015) or plastic bag usage (De Groot, Abrahamse, & Jones, 2013). In addition, they strongly influenced recycling and waste minimization in a cross-cultural study (Mintz, Henn, Park, & Kurman, 2019). Considering these studies, social norms might become more relevant for behaviour at the point of sale and be less relevant for the intention to purchase less plastic.

Beyond TPB variables, personal norms strongly predicted purchase intention (H2a). Thus, raising moral consciousness towards the problems of plastic would facilitate behaviour change. Collective efficacy (H3a) and sufficiency orientation (H4a) did not predict purchase intention. This underlines the rational choice approach that intention to reduce plastic pur-

chase is less affected by collective beliefs rather than individual decision-making. The low importance of sufficiency orientation might surprise at first glance as it has been predictive for food consumption in former studies (Verfuerth et al., 2019). However, sufficiency orientation is conceptualized as very general attitudinal stance on the relation between individual consumption, resource use and its climate impact, whereas items on purchase intention formulated very concrete behavioural options (e.g., to buy fresh products in glass instead of wrapped plastics). This difference in specificity levels between sufficiency orientation and purchase intentions may explain the insignificant effect of sufficiency orientation. Considering socio-demographics, gender and age were significant predictors. Females and elderly people seem to be more willing to purchase plastic-free products. This corresponds with research indicating that gender plays a significant role in many private sphere ecological behaviour (see for a review on gender and sustainable consumption Bloodhart & Swim, 2020).

ACTIVISM INTENTION

The psychological predictors explained 45% of the variance of activism intention. This was the lowest percentage of explained variance of all three intentions. This result is probably due to the degree of correspondence between the content of the predictors and the content of intentions. Specifically, the contents of the TPB variables overlapped more with the content of purchase intentions than with the content of the other two intentions. Accordingly, against our hypothesis (H1a), perceived behaviour control and social norms had no unique impact. However, people holding a positive attitude towards plastic packaging were less willing to perform activism. Personal norms (H2a) most strongly predicted activism intention. People who were morally convinced of the need to reduce plastic packaging showed a higher willingness to become active in terms of participating in demonstrations or engaging in a pro-environmental organization. Sufficiency orientation (H4a), played a secondary role regarding activism intention. Nevertheless, it seems to comprise motivational prerequisites that lead to engagement in

the public sphere. If people hold high collective-efficacy beliefs (H3a) to reduce plastic packaging, this also influenced their willingness to get active. This underlined collective action as an integral part of activism. Belonging to an environmental organization has been shown to be a good predictor for future activism (Fielding, McDonald, & Louis, 2008; McFarlane & Boxall, 2003). As our study shows, the feeling to have an impact within a group leads to higher activism intention including the willingness to get engaged in an organization. To increase impact, people team up with like-minded people striving for a collective goal. With regard to socio-demographics, females were more likely to show activism intention, but age revealed no impact.

POLICY SUPPORT INTENTION

Overall, the variables explained 55% of the variance of policy support intention. The strongest predictor was personal norms (H2a), followed by sufficiency orientation (H4a). Thus, the willingness to support policy regulations was driven by moral conviction and an inner belief of the need to change the current consumption system. Collective efficacy (H3a) was also a significant predictor but revealed the smallest predictive power towards policy support intention. With regard to TPB variables (H1a), perceived behaviour control negatively influenced policy support intention indicating that people who perceived low opportunities to buy plastic-free were more willing to support policy to take appropriate action. Attitude and social norms were no significant predictors. which again might be due to the limited content overlap between PBC and policy support intention. Gender, but not age, had a unique effect on policy support intention. As gender had the same effect on the other two intentions, we conclude that females are more willing to tackle the plastic problem than men – independent of the form of intention.

Prediction of behaviour

In our study, activism intention was an important predictor. Against our hypothesis (H1b), policy support intention and purchase intention were no significant predictors. Age and sufficiency orientation (H4b) had an additional impact. Overall, 52% of the variance in peoples' choice for an incentive was explained. We have to note that the choice between a conventional

shopping voucher and a plastic-free option does not directly correspond to the measured intentions. However, the result indicates content validity of the intentions. In particular, the effect of activism intention is meaningful because conventional shopping voucher are often targeted as a boycott objective. As boycott can be interpreted as a form of activism, it is plausible that activism intention reduced the probability to take a conventional shopping voucher instead of an ecological option. Therefore, it seems unsurprising that the impacts of purchase intention with a focus on concrete packaging choices and policy support intention addressing policy measures on have remained behind the impact of activism intention on this choice. The strong role of sufficiency orientation confirms the inherent motivation as a clear stance against overconsumption.

Contrary to our theoretical assumptions (H1b, H2b, H3b), perceived behavioural control, personal norms and collective efficacy were no direct predictors of behaviour. Though, this is in line with empirical evidence that personal norms and perceived behaviour control have only indirect impact on behaviour via intention, rather than predicting behaviour directly when intention is included in the model (e.g., Bamberg et al., 2007). Furthermore, the incentive choice was not directly linked to the content of perceived behaviour control that referred to plastic-free purchase. There was no barrier to choose one of the incentives options. Hence, perceived behaviour control was irrelevant.

Limitations

The sample in this study was quite large but not representative. The majority of participants were female and higher educated; thus, conclusions should be considered carefully when transferred to other target groups. In particular when considering research about the gender bias in the environmental domain (Bloodhart & Swim, 2020; Zelezny, Chua, & Aldrich, 2000) a more diverse group should be investigated. However, demographic variables revealed only small effects in the path model.

Participants were recruited in summer 2017. During this time, the topic of plastic was on top of the agenda in the German media. The general willingness to become active in this field was quite large and socially desirable. Thus, generalization to the future should consider the presence of this topic in the media and public debate. In addition, the results presented here do not allow for causal inferences as the parameters of our path models are only based on cross-sectional correlations. Moreover, our outcome variables were conceptualized and measured in line with Stern's behavioural categorization. However, the factorial structure of the items we employed did not fully match with Stern's model. We propose that our three-factor structure needs to be replicated by additional studies with more heterogenous samples. Future research should also explore directional influences between the factors in longitudinal designs.

Referring to the explained variance in this study, purchase intention was predicted best by the measured variables. This could partly be due to the difference in content symmetry between the intentions as criteria and the predictors. For example, the content of the perceived behaviour control items was more similar to the content of purchase intention than to the content of activism and policy support intention. Despite the possible inflation of effects due to content symmetry and the possible deflation of effects due to a lack of content symmetry, it seems noteworthy that sufficiency orientation, a broadly defined construct with the least overlap in content with intentions, had a rather strong effect on behavioral choice. Thus, content and specificity similarity alone cannot explain the effect pattern of our path model.

Apart from the specific formulation of the items, it is likely that some constructs of relevance in the field of plastic consumption are missing and should be included in future studies (e.g. self-identity, Fielding et al., 2008; Rees & Bamberg, 2014 or positive and negative emotions, Hamann & Reese, 2020; Rees & Bamberg, 2014; Rees, Klug, & Bamberg, 2015). Overall, one might discuss if a general shift of responsibility to tackle the plastic problem also decreased the explained variance. Assigning responsibility to other important stakeholders such as politicians, distributors or producers rather than one-self might be a barrier to show anti-plastic activities but was not addressed in this study explicitly.

Implications and future directions

The strongest predictor for purchase intention was perceived behaviour control indicating a lack of relevant opportunities to avoid single-use plastic, at least in the perception of people. In contrast to other pro-environmental behaviour, anti-plastic purchase is characterized by its variety of possible choices (e.g., using reusable packaging, reducing packaging by buying products in different packaging or without packaging, or refusing a product completely) which might result in a sense of uncertainty. Moreover, people often need to switch where to go shopping as conventional supermarkets offer only few plastic-free alternatives yet. This goes along with a higher effort of planning when, where and which amount one likes to buy. Tackling this structural barrier to increase behaviour control, more convenient alternatives to single-use plastic, suitable shopping concepts paired with information about these alternatives need to be offered and could be supported by local trade and business initiatives. Furthermore, interdisciplinary research should address the interrelations between topics of environmentally friendly production, product design, alternative marketing chains, life-cycle-assessment, marketing strategies and consumers' acceptance in application praxis.

A positive attitude towards plastic packaging served as barrier for purchase intention and activism intention. In general, two different ways to change attitude are discussed: persuasive information and social influence (Wood, 2000). However, only few studies address the impact of environmental communication in the context of plastic, like media communication about microplastic (Schallhorn, Kirchknopf, Kareta, & Schellbacher, 2019) or role models in the media reports about plastic pollution (Arlt, Kuhlmann, & Wolling, 2012). This lack should be closed in future research.

Personal norms were an important predictor for all three anti-plastic activity intentions. To activate personal norms, Schwartz (1977) argued that people need to be aware of a problem and to feel responsible to solve it. With regard to plastic, the distance in time and space that is inherent for consequences of individual behaviour in the environmental domain (van Lange, Joireman, & Milinski, 2018) should be considered. To raise awareness and feeling of

responsibility it is crucial to overcome this distance. Visual communication of plastic litter on consumer products might be an approach to make the link between people's consumption and its consequences more visible (Pahl, Wyles, & Thompson, 2017).

Collective efficacy beliefs had a small but significant influence to foster activism and policy support in the field of plastic consumption. Putting this knowledge into practice, campaigns could strengthen collective attitudes and collective efficacy of consumers and communicate the impact of a certain behaviour on a collective level (Fritsche, Barth, Jugert, Masson, & Reese, 2018).

As sufficiency orientation was a strong predictor for behaviour in the plastic domain, it could be a key in regard to a more comprehensive shift towards resource conservation. If people have the insight that overconsumption is part of a general problem of our societies' metabolism, they are likely to feel responsible for addressing politics and to act in accordance to that stance. Although people may be reluctant to use the term sufficiency in everyday practise (Reese et al., 2019) we want to outline its potential as a "mindset of enoughness" (Spangenberg & Lorek, 2019, p. 1071). The results of our study suggest that this mindset can contribute to resource reduction. The construct thus seems promising and should be included in future studies.

Conclusion

In face of biodiversity loss through littering and plastics in the environment, we should collectively take action. To solve the anthropogenic plastic problem, all societal actors need to promote a more conscious handling of plastic. This study addressed the role of the general public as consumers, activists and policy supporters within a representative democracy. The study highlights three dimensions of anti-plastic activity intentions, namely private purchase intentions as well as policy support intentions and activism intentions. Our study confirmed psychological factors grounded in rational choice and normative theories (TPB, NAM) and raised awareness on different predictors for different plastic-free activities in private and public

sphere. More research addressing plastic pollution coupled with interdisciplinary perspectives and solutions needs to be done in the future. While natural science perspectives work on detecting risks and finding material replacement for plastics, social sciences can quantify the human scale of plastic usage and shape the discourse on how to solve this current issue. Knowing relevant behavioural antecedents should help to establish better communication strategies and policy measurements to encourage behavioural change within the field of anti-plastic activities.

Declaration of Interest

None

Acknowledgments

The authors would like to thank Kristen Werling for English proof-reading. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Alumran, A., Hou, X. Y., Sun, J., Yousef, A. A., & Hurst, C. (2014). Assessing the construct validity and reliability of the parental perception on antibiotics (PAPA) scales. *BMC Public Health*, *14*(1), 1–9. https://doi.org/10.1186/1471-2458-14-73

Arlt, D., Kuhlmann, C., & Wolling, J. (2012). Ecological role models? The effect of the depiction of ecological activities in the media on the behavioral intentions of the recipients. *Studies in Communication and Media*, *1*(3–4), 411–442. https://doi.org/10.5771/2192-4007-2012-3-411

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, *40*(4), 471–499. https://doi.org/10.1348/014466601164939

Bagozzi, R. P., & Yi, Y. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the Academy of Marketing Science*, *40*(1), 8–34. https://doi.org/10.1007/s11747-011-0278-x

Bamberg, S., Hunecke, M., & Blöbaum, A. (2007). Social context, personal norms and the use of public transportation: Two field studies. *Journal of Environmental Psychology*, *27*(3), 190–203. https://doi.org/10.1016/j.jenvp.2007.04.001

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, *27*(1), 14–25. https://doi.org/10.1016/j.jenvp.2006.12.002

Bloodhart, B., & Swim, J. K. (2020). Sustainability and consumption: What has gender got to do with it? *Journal of Social Issues*. https://doi.org/10.1111/josi.12370

Chen, M. F. (2015). Self-efficacy or collective efficacy within the cognitive theory of stress model: Which more effectively explains people's self-reported proenvironmental behavior? *Journal of Environmental Psychology*, *42*, 66–75. https://doi.org/10.1016/j.jenvp.2015.02.002

De Groot, J. I. M., Abrahamse, W., & Jones, K. (2013). Persuasive normative messages: The influence of injunctive and personal norms on using free plastic bags. *Sustainability (Switzerland)*, *5*(5), 1829–1844. https://doi.org/10.3390/su5051829

De Moor, J., & Verhaegen, S. (2020). Gateway or getaway? Testing the link between lifestyle politics and other modes of political participation. *European Political Science Review*, *12*(1), 91–111. https://doi.org/10.1017/S1755773919000377

Destatis. (2018). *Bevölkerung nach Bildungsabschluss in Deutschland*. Retrieved from https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Bildungsstand/Tabellen/bildungsabschluss.html

European Commission. (2018). *Proposal for a Directive of the European Parliament and of the Council on the Reduction of the Impact of Certain Plastic Products on the Environment* (Vol. 0172). https://doi.org/COM(2018) 340 final 2018/0172 (COD)

Fielding, K. S., McDonald, R., & Louis, W. R. (2008). Theory of planned behaviour, identity and intentions to engage in environmental activism. *Journal of Environmental Psychology*, *28*(4), 318–326.

Fox, J., Nie, Z., Byrnes, J., Culbertson, M., DebRoy, S., Friendly, M., & Fox, M. J. (2017). Package 'sem.'

Fritsche, I., Barth, M., Jugert, P., Masson, T., & Reese, G. (2018). A social identity model of pro-environmental action (SIMPEA). *Psychological Review*, *125*(2), 245–269. https://doi.org/http://dx.doi.org/10.1037/rev0000090

Galloway, T. S. (2015). Micro-and nano-plastics and human health. In M. Bergmann, L. Gutow, & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 343–366). Cham: Springer.

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, *3*(7), 1–5. https://doi.org/10.1126/sciadv.1700782

Gorge, H., Herbert, M., Özçağlar-Toulouse, N., & Robert, I. (2015). What Do We Really Need? Questioning Consumption Through Sufficiency. *Journal of Macromarketing*, *35*(1), 11–22.

https://doi.org/10.1177/0276146714553935

Gossen, M., Ziesemer, F., & Schrader, U. (2019). Why and How Commercial Marketing Should Promote Sufficient Consumption: A Systematic Literature Review. *Journal of Macromarketing*, *39*(3), 252–269. https://doi.org/10.1177/0276146719866238

Hamann, K. R. S., & Reese, G. (2020). My influence on the world (of others) – goal efficacy beliefs and efficacy affect predict private, public, and activist pro-environmental intentions. *Journal of Social Issues*. https://doi.org/10.1111/josi.12369

Harland, P., Staats, H., & Wilke, H. A. M. (1999). Explaining Proenvironmental Intention and Behavior by Personal Norms and the Theory of Planned Behavior1. *Journal of Applied Social Psychology*, *29*(12), 2505–2528. https://doi.org/10.1111/j.1559-1816.1999.tb00123.x

Heidbreder, L. M., Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of the Total Environment*, *668*, 1077–1093. https://doi.org/10.1016/j.scitotenv.2019.02.437

Homburg, A., & Stolberg, A. (2006). Explaining pro-environmental behavior with a cognitive theory of stress. *Journal of Environmental Psychology*, *26*(1), 1–14. https://doi.org/10.1016/j.jenvp.2006.03.003

Horton, A. A., Walton, A., Spurgeon, D. J., Lahive, E., & Svendsen, C. (2017). Microplastics in freshwater and terrestrial environments: Evaluating the current understanding to identify the knowledge gaps and future research priorities. *Science of the Total Environment*, *586*, 127–141. https://doi.org/10.1016/j.scitotenv.2017.01.190

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., … Law, K. L. (2015). Plastic waste inputs from land into the ocean. *Marine Pollution*, *347*(6223), 768–771. https://doi.org/10.1126/science.1260352

Jugert, P., Greenaway, K. H., Barth, M., Büchner, R., Eisentraut, S., & Fritsche, I. (2016). Collective efficacy increases pro- environmental intentions through increasing self-efficacy. *Journal of Environmental Psychology*, *48*, 12–23. https://doi.org/10.1016/j.jenvp.2016.08.003

Klöckner, C. A. (2013). A comprehensive model of the psychology of environmental behaviour - A meta-analysis. *Global Environmental Change*, *23*(5), 1028–1038. https://doi.org/10.1016/j.gloenvcha.2013.05.014

Leiner, D. J. (2016). SoSci Survey (Version 2.6.00) [Computer Software]. Retrieved from https://www.soscisurvey.de

Li, W. C., Tse, H. F., & Fok, L. (2016). Plastic waste in the marine environment: A review of sources, occurrence and effects. *Science of the Total Environment*, *566*, 333–349. https://doi.org/10.1016/j.scitotenv.2016.05.084

Maki, A., Carrico, A. R., Raimi, K. T., Truelove, H. B., Araujo, B., & Yeung, K. L. (2019). Meta-analysis of pro-environmental behaviour spillover. *Nature Sustainability*, *2*(4), 307–315. https://doi.org/10.1038/s41893-019-0263-9

McFarlane, B. L., & Boxall, P. C. (2003). The role of social psychological and social structural variables in environmental activism: An example of the forest sector. *Journal of Environmental Psychology*, *23*(1), 79–87. https://doi.org/10.1016/S0272-4944(02)00080-4

Mintz, K. K., Henn, L., Park, J., & Kurman, J. (2019). What predicts household waste management behaviors? Culture and type of behavior as moderators. *Resources, Conservation and Recycling*, *145*, 11–18. https://doi.org/10.1016/j.resconrec.2019.01.045

Moser, S., & Kleinhückelkotten, S. (2017). Good Intents, but Low Impacts: Diverging Importance of Motivational and Socioeconomic Determinants Explaining Pro-Environmental Behavior, Energy Use, and Carbon Footprint. *Environment and Behavior*, *50*(6), 626–656. https://doi.org/10.1177/0013916517710685

Noblet, C. L., & McCoy, S. K. (2018). Does One Good Turn Deserve Another? Evidence of Domain-Specific Licensing in Energy Behavior. *Environment and Behavior*, *50*(8), 839–863. https://doi.org/10.1177/0013916517718022

Ofstad, S. P., Tobolova, M., Nayum, A., & Klöckner, C. A. (2017). Understanding the mechanisms behind changing people's recycling behavior at work by applying a comprehensive action determination

model. *Sustainability (Switzerland)*, *9*(2). https://doi.org/10.3390/su9020204

Pahl, S., Wyles, K. J., & Thompson, R. C. (2017). Channelling passion for the ocean towards plastic pollution. *Nature Human Behaviour*, *1*(10), 697–699. https://doi.org/10.1038/s41562-017-0204-4

Pakpour, A. H., Zeidi, I. M., Emamjomeh, M. M., Asefzadeh, S., & Pearson, H. (2014). Household waste behaviours among a community sample in Iran: An application of the theory of planned behaviour. *Waste Management*, *34*(6), 980–986. https://doi.org/10.1016/j.wasman.2013.10.028

PlasticsEurope. (2019). *Plastics - the Facts 2019*. Retrieved from https://www.plasticseurope.org/application/files/1115/7236/4388/FINAL_web_version_Plastics_the_facts2019_14102019.pdf

Poortinga, W., Whitmarsh, L., & Suffolk, C. (2013). The introduction of a single-use carrier bag charge in Wales : Attitude change and behavioural spillover effects. *Journal of Environmental Psychology*, *36*, 240–247. https://doi.org/10.1016/j.jenvp.2013.09.001

Rees, J. H., & Bamberg, S. (2014). Climate protection needs societal change: Determinants of intention to participate in collective climate action. *European Journal of Social Psychology*, *44*(5), 466–473. https://doi.org/10.1002/ejsp.2032

Rees, J. H., Klug, S., & Bamberg, S. (2015). Guilty conscience: motivating pro-environmental behavior by inducing negative moral emotions. *Climatic Change*, *130*(3), 439–452. https://doi.org/10.1007/s10584-014-1278-x

Reese, G., Drews, S., & Tröger, J. (2019). Warum haben wir Angst vor dem Weniger? Umweltpsychologie und Suffizienz im Fokus. In L. Voget-Kleschin, L. Bossert, & S. Meisch (Eds.), *Damit gutes Leben einfacher wird - Suffizienzpolitik für Naturbewahrung*. Weimar: Metropolis Verlag.

Reese, Gerhard, & Junge, E. A. (2017). Keep on Rockin' in a (plastic-)free world: Collective efficacy and pro-environmental intentions as a function of task difficulty. *Sustainability (Switzerland)*, *9*(2). https://doi.org/10.3390/su9020200

Revelle, W. (2018). psych: Procedures for Personality and Psychological Research. Retrieved from https://cran.r-project.org/package=psychVersion=1.8.12.

Rivis, A., Sheeran, P., & Armitage, C. J. (2009). Expanding the Affective and Normative Components of the Theory of Planned Behavior : A Meta-Analysis of Anticipated Affect and Moral Norms. *Journal of Applied Soc*, *39*(12), 2985–3019. https://doi.org/10.1111/j.1559-1816.2009.00558.x

Rockström, J., Steffen, W., Noone, K., Persson, Å., Iii, F. S. C., Lambin, E., … Liverman, D. (2009). Planetary Boundaries : Exploring the Safe Operating Space for Humanity. *Ecology and Society*, *14*(2).

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, *48*(2), 1–36. https://doi.org/http://www.jstatsoft.org/v48/i02/

Samadi, S., Gröne, M. C., Schneidewind, U., Luhmann, H. J., Venjakob, J., & Best, B. (2017). Sufficiency in energy scenario studies: Taking the potential benefits of lifestyle changes into account. *Technological Forecasting and Social Change*, *124*, 126–134.

Schallhorn, C., Kirchknopf, L., Kareta, N., & Schellbacher, C. (2019). Zur Wirkung von Umweltberichterstattung auf umweltfreundliche Verhaltensweisen: Ein Experiment am Beispiel der Mikroplastik. *Umweltpsychologie*, *23*(2), 151–169.

Schäpke, N., & Rauschmayer, F. (2014). Going beyond efficiency: including altruistic motives in behavioral models for sustainability transitions to address sufficiency. *Sustainability: Science, Practice, & Policy*, *10*(1), 29–44. https://doi.org/10.1080/15487733.2014.11908123

Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (pp. 221–279). San Diego: Academic Press.

Si, H., Shi, J. G., Tang, D., Wen, S., Miao, W., & Duan, K. (2019). Application of the theory of planned behavior in environmental science: a comprehensive bibliometric analysis. *International Journal of Environmental Research and Public Health*, *16*(15). https://doi.org/10.3390/ijerph16152788

Sigler, M. (2014). The effects of plastic pollution on aquatic wildlife: Current situations and future solutions. *Water, Air, and Soil Pollution*, *225*, 2184. https://doi.org/10.1007/s11270-014-2184-6

Spangenberg, J. H., & Lorek, S. (2019). Sufficiency and consumer behaviour: From theory to policy.

Energy Policy, *129*, 1070–1079. https://doi.org/10.1016/j.enpol.2019.03.013

Stern, P. C. (2000). Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, *56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175

Thøgersen, J. (1999). The Ethical Consumer. Moral Norms and Packaging Choice. *Journal of Consumer Policy*, *22*(4), 439–460. https://doi.org/10.1023/A:1006225711603

Thøgersen, J., & Noblet, C. (2012). Does green consumerism increase the acceptance of wind power? *Energy Policy*, *51*, 854–862. https://doi.org/10.1016/j.enpol.2012.09.044

Tonglet, M., Phillips, P. S., & Bates, M. P. (2004). Determining the drivers for householder pro-environmental behaviour: waste minimisation compared to recycling. *Resources, Conservation and Recycling*, *42*, 27–48. https://doi.org/10.1016/j.resconrec.2004.02.001

Toulouse, E., Sahakian, M., Lorek, S., Bohnenberger, K., Bierwirth, A., & Leuser, L. (2019). Energy sufficiency: how can research better help and inform policy-making? In *ECEEE summer study proceedings* (pp. 331–339).

Truelove, H. B., Yeung, K. L., Carrico, A. R., Gillis, A. J., & Raimi, K. T. (2016). From plastic bottle recycling to policy support: An experimental test of pro-environmental spillover. *Journal of Environmental Psychology*, *46*, 55–66. https://doi.org/10.1016/j.jenvp.2016.03.004

UBA. (2017). *Umweltbewusstsein in Deutschland 2016*. Retrieved from https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/umweltbewusstsein_deutschland_2016_bf.pdf

van der Linden, S. (2015). Exploring Beliefs About Bottled Water and Intentions to Reduce Consumption: The Dual-Effect of Social Norm Activation and Persuasive Information. *Environment and Behavior*, *47*(5), 526–550. https://doi.org/10.1177/0013916513515239

van Lange, P. A. M., Joireman, J., & Milinski, M. (2018). Climate Change: What Psychology Can Offer in Terms of Insights and Solutions. *Current Directions in Psychological Science*, 1–6. https://doi.org/10.1177/0963721417753945

Verfuerth, C., Henn, L., & Becker, S. (2019). Is it up to them? Individual leverages for sufficiency. *GAIA-Ecological Perspectives for Science and Society*, *28*(4), 374–380.

Werfel, S. H. (2017). Household behaviour crowds out support for climate change policy when sufficient progress is perceived. *Nature Climate Change*, *7*(7), 512–515. https://doi.org/10.1038/nclimate3316

Willis, M. M., & Schor, J. B. (2012). Does Changing a Light Bulb Lead to Changing the World? Political Action and the Conscious Consumer. *Annals of the American Academy of Political and Social Science*, *644*(1), 160–190. https://doi.org/10.1177/0002716212454831

Wood, W. (2000). Attitude Change: Persuasion and Social Influence. *Annual Review of Psychology*, *51*(1), 539–570. https://doi.org/10.1146/annurev.psych.51.1.539

Zelezny, L. C., Chua, P. P., & Aldrich, C. (2000). New ways of thinking about environmentalism: Elaborating on gender differences in environmentalism. *Journal of Social Issues*, *56*(3), 443–457. https://doi.org/10.1111/0022-4537.00177

Appendix

Questionnaire

ATTITUDE
5-point-Likert scale ranging from 0 (do not agree at all) to 4 (agree completely)
In my opinion, using plastic packaging is…

- …practical
- …cheap
- …hygienic
- …useful

PERCEIVED BEHAVIOURAL CONTROL
5-point-Likert scale ranging from 0 (do not agree at all) to 4 (agree completely)

- For me, it is easy to use no plastic packaging.
- It's up to me to avoid plastic packaging.
- I know how to avoid plastic packaging.
- I am able to find alternatives for plastic packaging.

SOCIAL NORMS
5-point-Likert scale ranging from 0 (do not agree at all) to 4 (agree completely)

- Most people whose opinion I value try to use less plastic packaging.
- Many people in my close environment deal with problems arose from plastic packaging.
- Important people in my close environment would support me if I tried to avoid plastic packaging.
- Most people who are important to me expect me to avoid plastic packaging.

PERSONAL NORMS
5-point-Likert scale ranging from 0 (do not agree at all) to 4 (agree completely)

- I feel morally obliged to use less plastic packaging.
- I should do everything within my power to reduce the amount of plastic packaging.
- Due to my values I should do everything to curb negative consequences of plastic packaging.

COLLECTIVE EFFICACY
5-point-Likert scale ranging from 0 (do not agree at all) to 4 (agree completely)

- I think that we as consumers can solve together the plastic packaging problem.
- I think that we as consumers can curb negative consequences of plastic packaging.
- I think that we as consumers can push together politics to reduce the number of plastic packaging.
- I think that we as consumers can push together economy to reduce the number of plastic packaging.

SUFFICIENCY ORIENTATION

5-point-Likert scale ranging from 0 (do not agree at all) to 4 (agree completely)

- I think it is unnecessary to have this affluence of different products in our supermarkets.
- All the products that are sold all the time are a big waste of resources to me.
- High consumption leads to unjust distribution of natural resources in the world.
- To reduce environmental pollution, it is necessary to reduce consumption.
- Usually, high consumption increases environmental pollution.
- Our current life style leads to a waste of valuable resources.

INTENTIONS

5-point-Likert scale ranging from 0 (do not agree at all) to 4 (agree completely)

- Thinking of my next purchase, I plan to buy fresh products (e.g., milk, yoghurt) wrapped in glass instead of plastics.
- Thinking of my next purchase, I plan to fill food into several containers I bring with me.
- Thinking of my next purchase, I plan to buy no fruits or vegetables wrapped in plastics.
- I'm willing to engage in an organization that strives against plastic packaging.
- I'm willing to participate in a demonstration aiming to call on policy and industry to curtail plastic packaging.
- I'm willing to vote for a party that campaigns for a ban of plastic packaging.
- I'm willing to support policy regulations that limit the use of plastic packaging.
- I'm willing to sign a petition for a prohibition of plastic packaging in supermarkets.
- I'm willing to pay more for food that is not wrapped into plastic. (excluded from later analyses)

5 MANUSCRIPT 3 – FASTING PLASTIC: AN INTERVENTION STUDY TO BREAK HABITS OF PLASTIC CONSUMPTION

Heidbreder, L.M. & Schmitt, M. (2020): Fasting plastic: an intervention study to break habits of plastic consumption. *PsyEcology. 11*(2), 1-23.
https://doi.org/10.1080/21711976.2020.1728652

Date of submission: 30th of October, 2018
Date of Acceptance: 7th of February 2020

Abstract:
Addressing the prevalent topic of plastic pollution, an intervention to break people's consumption patterns was implemented. It was investigated if Lent could work as a 'window of opportunity' of habit change, expecting people to be open to try new behavior in this period. An online survey was conducted before, during and after Lent. 140 persons in three different intervention groups, including an invitation to the plastic challenge (baseline), information about problems (group I) and information about action steps (group II) participated by the end. Mixed ANOVA revealed a reduction in plastic consumption during Lent (d = 0.69). This effect was maintained even after Lent. Informational approaches showed no further effect. Path analysis revealed insights in antecedents of fasting behaviour[4] and habit change. Intention, previous behaviour and moral norms were direct predictors of plastic reduction during Lent. In turn, people who reduced plastic consumption in this period continued it after Lent independent of other constructs. Implications of these results are discussed.

Keywords:
plastic use; habits; window of opportunity; theory of planned behaviour; norm activation model

[4] This manuscript is written in British English

Introduction

Our modern society is facing a number of environmental challenges due to an overuse of resources. Sometimes denoted as the 'Plastic Age' (Thompson, Swan, Moore, & Vom Saal, 2009), in the last decades an increase in plastic production and use could be observed, reaching over 350 million tons per year (PlasticsEurope, 2018). Plastic particles are found in aquatic and terrestrial environments (e.g. Jambeck et al., 2015), posing a risk to animals through ingestion and entanglement, and are even found in human bodies (Galloway, 2015; Li, Tse, & Fok, 2016). Despite its long-lasting character, one third of worldwide plastic production can be traced back to packaging made for direct disposal. Although there is a pressing need to start at the beginning of the waste chain, addressing a reduction of plastic consumption, a focus on recycling behaviour can be observed in the social sciences (Heidbreder, Bablok, Drews, & Menzel, 2019). At the same time, daily consumption is hard to imagine without plastic making the change of habits challenging. Thus, consumers' behaviour as a key factor in curbing pollution is in the very scope of this article.

Changing habits

Habits help to manage our daily lives. With habits we avoid complex considerations while making decisions or implementing actions. However, when we intend to change our behaviour, this advantage of habits can become a barrier to developing new behaviour patterns. Habits are automatic responses that people repeat in stable circumstances (e.g. Schäfer, Jaeger-Erben, & Bamberg, 2012). Therefore, one interesting target to tackle behaviour change is the modification of circumstances when moving to another city or having a child (Verplanken & Wood, 2006). In those phases habitual routines are disrupted and people are forced to reflect their actions and develop new behavioural patterns. These periods are often called 'windows of opportunity' (e.g. Schäfer et al., 2012). Because those periods are rare and difficult to provoke, more frequent periods in which people are open to change might be sought. In the Christian tradition, before Easter there is a period of 40 days called Lent. It has become common practice

during Lent to engage in a more conscious lifestyle (e.g. avoiding sweets). This study investigates whether Lent might be a 'window of opportunity' of longitudinal habit change in the domain of plastic consumption.

Explaining pro-environmental behavior

Several theories have been proposed to explain pro-environmental behaviour (see Steg, van den Berg, & De Groot, 2012 for an overview) such as the Theory of Planned Behaviour (TPB, Ajzen, 1991) assuming that deliberate behaviour is predicted by weighing its consequences and the values of these consequences.

Despite substantial support for the TPB (Armitage & Conner, 2001), there is concern about its completeness (Gifford, 2014). For instance, the TPB fails to consider that behaviour is affected not only by self-interest but also by moral concerns (Rivis, Sheeran, &Armitage, 2009). Therefore, the Norm Activation Model (NAM, Schwartz, 1977) is often used in addition to the TPB (e.g. Bamberg & Möser, 2007; Klöckner, 2013). Moreover, emotions can play a fundamental role in pro-environmental behaviour (Gatersleben, 2007).

Interventions to promote behaviour change

As TPB and NAM have been shown to explain pro-environmental behaviour, forming an intervention based on constructs of those theories seems reasonable. In meta-analyses, perceived behaviour control has a stronger impact compared to attitudes and subjective norms (Armitage & Conner, 2001). In addition to perceived behaviour control, moral norms have a strong influence on behaviour intention (Bamberg & Möser, 2007). In intervention contexts, two forms of knowledge are relevant: knowledge of problems and knowledge of action (Steg et al., 2012). Knowledge of problems reinforces moral norms and knowledge of action reinforces perceived behaviour control. Therefore, knowledge is necessary but not sufficient for behaviour change (Bamberg & Möser, 2007). Beyond knowledge, behaviour intentions play a

key role in predicting behaviour. Therefore, interventions have to reduce the gap between intention and behaviour (Gardner & Stern, 2002). This can be achieved with training implementation intentions encouraging people to reflect their intentions with regards to a concrete realization (e.g. Bamberg, 2002).

Hypotheses

The current study tested interventions aimed at changing purchase habits. Specifically, a decrease in plastic food packaging consumption during Lent and maintenance of this decrease after Lent was aspired to. Three different interventions were designed according to our previous theoretical considerations. The following hypotheses were preregistered at AsPredicted. Consumers' food plastic packaging will decrease during Lent (H1). Strengthening moral norms or perceived behaviour control via information has a stronger effect on plastic packaging reduction compared to a condition without such information (H2). Furthermore, a longitudinal structural equations path model including assumed predictors of plastic consumption was preregistered.

Method

Procedure and intervention

This study realized a longitudinal design over 10 weeks on the Platform SosciSurvey (Leiner, 2016). Participants answered an online survey before, during and two weeks after Lent. Furthermore, participants who agreed to be contacted again filled out a short follow-up survey after one year including measures of consumer behaviour only. The intervention was implemented before Lent. Participants were randomly assigned to one of three conditions: implementation intention only (control group), strengthening moral norms, strengthening perceived behavioural control.

All groups got an invitation to participate in a plastic challenge. Using the motto "Put your yellow bag on diet" (yellow bag is a rubbish bag for light packaging waste in Germany),

participants were challenged to reduce plastic packaging waste in the upcoming six weeks of Lent. Participants were informed about the dates of the study and the voluntary nature of the challenge. All participants were asked to plan first steps of how to avoid plastic packaging consumption during Lent as a short form of implementation intention to reduce the gap between intention and behaviour. Participants in the control group continued the questionnaire, whereas the two intervention groups got reflective questions and information to either strengthen moral norms (intervention group I) or perceived behaviour control (intervention group II). Participants were asked to answer three questions about negative environmental impacts, responsibilities and injustice of plastic waste (intervention group I) or about action steps to reduce plastic in daily life (intervention group II). Then, participants read short texts about these topics. Each text was complemented by three photos showing either a littered environment and consumers buying products packed in plastic (intervention group I) or plastic-free shopping facilities (intervention group II). A lottery was used as incentive to participate. In addition, psychology students could collect credits as trial subjects.

Participants

Participants were recruited via mailing lists of psychology students from two German universities and via social media groups for online surveys. One hundred and sixty-seven participants filled out the first survey. Of these, 144 (86%) completed the second survey and 140 (84%) the third. Participants in the final sample were 80% female and ranged in age from 18 to 63 with a mean age of M = 25.04 (SD = 7.68) and a high education level (44% stated to have a university degree). ANOVA revealed no significant difference for socio-demographic profiles between the three intervention groups. Concerning their fasting habits, 42% stated having never fasted before and 17% fast every year. Thirty-two per cent affirmed religion as the reason to fast. One year after the intervention, 55 (33%) participants completed the follow-up survey of consumer behaviour only.

Questionnaire

Independent variables were derived from the TPB and the NAM, supplemented with positive and negative emotions. All items were answered on a 5-point-scale ranging from 'fully disagree' to 'fully agree'. Items were based on construction advice of Ajzen (2006) and adapted from previous work (e.g. Bamberg & Schmidt, 2003; Harland, Staats, & Wilke, 1999) to the context of plastic consumption.

Attitude. Participants were provided three items to measure attitude towards plastic use (α_1 = .44; α_2 = .38) and three towards not using plastic (α_1 = .38; α_2 = .50), e.g. '(Not) Using plastic is hygienic'.

Subjective norms. Two descriptive (α_1 = .55; α_2 = .66) as well as two injunctive norms items (α_1 = .68; α_2 = .75) were formulated as follows 'Most people who are important to me try not to use plastic packaging' or 'Most people of my close environment expect me to avoid plastic packaging'.

Perceived behavior control. Participants answered three items of the following form to measure perceived behavior control (α_1 = .64; α_2 = .61) 'While making my purchase, I have no opportunity to avoid plastic packaging' (inversely coded).

Moral norms. Personal moral norms were obtained by three items, e.g. 'I feel a moral obligation to use less plastic packaging' (α_1 = .86; α_2 = .86).

Emotions. Four items to measure negative emotions towards plastic were formulated as follows 'When thinking about negative impacts of plastic, I feel angry' (α_1 = .86; α_2 = .89). In addition, participants answered two items to measure positive emotions 'When I do not use plastic, I am proud of me' (α_1 = .69; α_2 = .78).

Behaviour intentions. In the first wave the item of behaviour intention was formulated as follows: 'For the following six weeks of Lent, I plan to renounce plastic packaging when purchasing food products.' The behaviour intention item in the second wave was formulated as follows: 'After Lent, I plan to renounce plastic packaging when purchasing food products.'

Consumer behaviour. Consumer behaviour was operationalized as the self-reported proportion of food products bought with plastic packaging during the last two weeks. An index over six items (vegetables and fruits, refrigerated products, dry products, beverages, baked goods, snack food and candies) was formed with higher numbers indicating more plastic use. Additional questions concerning experience with the plastic challenge and its implementation were added.

Results

Statistical analyses were performed using R version 3.4.4 with packages 'psych' (Revelle, 2018), 'lavaan' (Rosseel, 2012), 'sem' (Fox et al., 2017) and 'reshape2' (Wickham, 2012).

Effectiveness of the interventions

ANOVA results revealed no significant difference between the three groups in moral norms (F[2, 164] = 0.888, p = .414) or perceived behaviour control (F[2, 164] = 0.389, p = .678).

Effectiveness of the plastic-challenge

The main dependent variable was self-reported plastic consumption over two weeks before, during and after Lent. Mixed-ANOVA revealed no treatment effect between the groups (F_{Group}[2, 137] = 0.541, p = .583) but an effect of time (F_{Time}[2, 274] = 48.79, p < .001). According to pair-wise t-tests participants differed between the first and second (t[139] = 8.4; p < .001; 0.57; 95%-CI [0.44; 0.71], d = 0.69) as well as the first and third (t[139] = 7.9; p < .001; 0.51; 95%-CI [0.38; 0.64], d = 0.61) but not between the second and third measurement occasion (t[139] = −1.1; p = .28; −0.06; 95%-CI [−0.18; 0.05], d = −0.07). Thus, participants consumed less plastic during and after than before Lent. No interaction between time and group was found (F[4, 274] = 1.09, p = .362).

Mean of plastic consumption in the groups and over time is shown in Figure 5. Moreover, 39% of participants stated having tried plastic-free behaviour for the very first time during Lent (e.g. visiting a zero-waste shop or using a reusable water bottle).

In the follow-up-survey one year after Lent, mean of plastic consumption (M = 3.09, SD = 0.88) was higher than during Lent (t[53] = −2.5; p = .015; −0.29; 95%- CI [−0.52; −0.06], d = −0.30) but still lower than before the intervention (t[53] = 3.7; p < .001; 0.43; 95%-CI [0.19; 0.66], d = 0.52). Because of the low sample, size power for a multiple regression analysis was too low and only mean values are reported here.

Prediction of plastic consumption

Means, standard deviations and correlations of all model variables are presented in Table 5. Figure 6 presents the path model for predicting intention to fast from plastic (t_0) and self-reported plastic consumption during Lent (t_1). Model fit was acceptable (CFI = 0.99; RMSEA = 0.09). Maximum likelihood parameter estimation was used. The strongest predictor of the intention to fast from plastic was perceived behavior control followed by subjective descriptive norms and negative emotions. Injunctive norms had a negative effect. As injunctive norms did not correlate with intention but strongly with descriptive norms, a suppressor effect can be assumed. Preceding behavior had no influence on intention, neither had attitudes, moral norms or positive emotions. Together, predictors explained 32% of variance in intention. Plastic consumption behaviour during Lent was predicted by behaviour before Lent, the intention to reduce plastic, and moral norms (R^2 = .45). Contrary to the assumption of the TPB, perceived behaviour control had no direct influence on behaviour.

The fit of the second model predicting plastic packaging consumption after Lent (see Figure 7) was also acceptable (CFI = 0.97; RMSEA = 0.08). Moral norms had the strongest effect on intention to avoid plastic after Lent, followed by perceived behavior control and positive emotions. The plastic use during Lent had an additional influence. Together, predictors explained 56% of the variance in behaviour intention.

Subjective norms, attitudes and negative emotions did not predict behaviour intention. Plastic consumption after Lent was predicted by plastic consumption before and during Lent (R^2 = .59). Intention to do so, perceived behaviour control and moral norms had no unique effects.

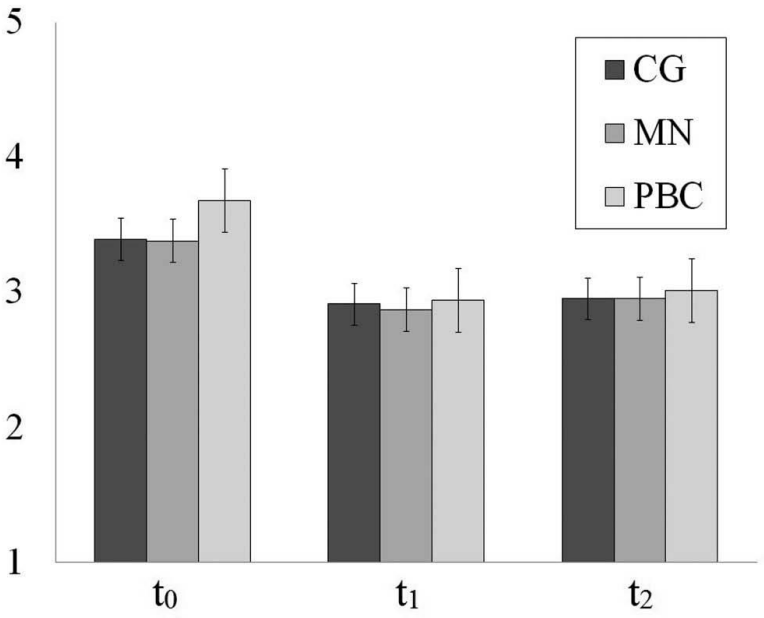

Figure 5 Mean of plastic consumption before (t_0), during (t_1) and after (t_2) Lent in three intervention conditions (N = 140)

Notes. CG = control group (implementation intention only), MN = intervention group I (moral norms), PBC = intervention group II (perceived behaviour control), error bars show the standard error

Table 5 Means, standard deviations and correlations of the model variables

		M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	pl_0	3.48	0.74	.61	***	***	***	-	*	*	***	***	-	-	-	-	***	**	***	***	***	-	-	-
2	pl_1	2.91	0.91	0.53	.74	***	***	***	**	***	**	***	***	**	**	***	**	**	***	**	**	***	***	**
3	pl_2	2.97	0.90	0.59	0.73	.77	***	***	***	***	*	***	***	**	*	***	***	***	***	***	***	***	**	**
4	in_0	3.66	0.85	-0.11	-0.46	-0.33		***	***	***	-	**	***	***	***	***	***	***	***	-	-	***	***	***
5	$att1_0$	2.53	0.63	0.15	0.30	0.27	-0.29	.44	***	***	-	-	***	***	**	***	***	***	**	-	**	***	*	**
6	$att2_0$	2.82	0.72	-0.15	-0.21	-0.30	0.28	-0.39	.38	***	-	-	***	***	***	***	***	***	**	**	***	***	***	***
7	pbc_0	3.36	0.75	-0.21	-0.30	-0.27	0.32	-0.26	0.25	.64	*	-	***	-	-	*	***	**	***	*	-	**	*	-
8	sni_0	2.17	0.88	-0.24	-0.23	-0.17	0.11	<0.01	0.09	0.16	.68	***	**	-	-	-	-	**	**	***	***	-	-	-
9	snd_0	2.46	0.83	-0.32	-0.31	-0.31	0.19	<0.01	0.11	0.05	0.58	.55	-	-	-	-	-	-	**	***	***	-	-	-
10	mn_0	3.99	0.82	-0.07	-0.34	-0.26	0.43	-0.29	0.36	0.31	0.22	0.11	.86	***	***	***	***	***	***	-	**	***	***	***
11	pe_0	3.97	0.90	<0.01	-0.17	-0.21	0.33	-0.27	0.37	0.07	0.11	0.04	0.49	.69	***	***	***	***	*	-	**	***	***	***
12	ne_0	3.98	0.82	0.03	-0.19	-0.15	0.40	-0.22	0.33	0.11	0.14	0.04	0.68	0.53	.86	***	**	***	*	-	**	***	***	***
13	in_1	3.45	0.97	-0.12	-0.45	-0.38	0.43	-0.29	0.28	0.16	0.09	0.06	0.52	0.40	0.50		***	***	***	-	**	***	***	***
14	$att1_1$	2.49	0.62	0.20	0.43	0.48	-0.29	0.51	-0.48	-0.24	-0.14	-0.11	-0.29	-0.32	-0.19	-0.30	.35	***	***	*	*	***	***	**
15	$att2_1$	2.84	0.78	-0.21	-0.23	-0.34	0.31	-0.34	0.64	0.18	0.18	0.14	0.37	0.34	0.34	0.34	-0.51	.50	***	***	***	***	***	***
16	pbc_1	3.43	0.72	-0.30	-0.48	-0.44	0.30	-0.23	0.22	0.53	0.21	0.18	0.24	0.16	0.16	0.45	-0.35	0.27	.61	***	**	***	***	-
17	sni_1	2.30	0.95	-0.38	-0.22	-0.26	0.12	-0.06	0.21	0.17	0.54	0.43	0.11	0.07	0.04	0.10	-0.15	0.25	0.34	.75	***	-	*	-
18	snd_1	2.57	0.87	-0.35	-0.19	-0.30	0.11	-0.20	0.25	0.08	0.42	0.43	0.20	0.20	0.18	0.21	-0.16	0.30	0.23	0.64	.66	**	**	**
19	mn_1	4.00	0.84	-0.03	-0.36	-0.29	0.35	-0.28	0.30	0.17	0.11	0.12	0.70	0.51	0.62	0.63	-0.25	0.28	0.30	0.11	0.18	.86	***	***
20	pe_1	4.07	0.91	0.08	-0.28	-0.21	0.45	-0.15	0.25	0.14	0.14	0.14	0.53	0.61	0.56	0.53	-0.25	0.34	0.28	0.16	0.21	0.60	.78	***
21	ne_1	3.96	0.85	-0.01	-0.20	-0.20	0.40	-0.20	0.28	0.10	0.11	0.02	0.59	0.46	0.75	0.43	-0.23	0.33	0.14	0.09	0.23	0.57	0.52	.89

Note. Correlations are presented below the diagonal (N = 140), probability-values are presented above the diagonal (*** p < .001, ** p < .05, p < .1, - n.s.), Cronbachs-α in the diagonal, $_0$ = measurement before Lent, $_1$ = measurement during Lent, $_2$ = measurement after Lent, pl = plastic use, in = intention, att1 = attitude of use, att2 = attitude of non-use, pbc = perceived behavior control, sni = subjective injunctive norms, snd = subjective descriptive norms, mn = moral norms, pe = positive emotions, ne = negative emotions

Discussion

Breaking habits is challenging but seems mandatory for societal solutions to environmental problems. The current study investigated whether Lent might be a 'window of opportunity' where people are open to try new behaviour patterns and take them on even after Lent. Factors promoting behaviour change were examined to understand the underlying processes. Results revealed the fasting period to be a good period to successfully implement behaviour change. People were willing to participate in the plastic challenge and reduced their plastic packaging consumption markedly. This reduction behaviour was maintained two weeks and even one year after Lent. Inviting people to take part in the challenge and to let them write down first steps to implement their behaviour was enough to encourage a majority to deal with the topic of plastic reduction during Lent. This is in line with other studies emphasizing the role of implementation intention for habit change (Bamberg, 2002).

However, informational intervention strategies including reflective questions and information about problems of plastic or action steps to reduce plastic consumption did not show a reinforcing effect on people's plastic reduction. In general, information campaigns alone show weak effects on behaviour change (Steg & Vlek, 2009). In particular, people with strong habits absorb less information about behaviour alternatives than people with weak habits (Verplanken, Aarts, & Van Knippenberg, 1997). Furthermore, plastic pollution is a topic with strong media presence. It is likely that the provided information was not new for this highly educated sample and thus, the intervention was too weak to change moral and control beliefs that have arisen over a long period.

Regarding mechanisms underlying behaviour change, this study provided interesting insights. Intention, the main predictor of behaviour according to the TPB (Ajzen, 1991), was only relevant for the initiation of new behaviour. It had no influence on the continuation of new behaviour after the challenge. This is in line with findings showing that intention shapes con-

scious behavioural choices but not habitual behaviour (Aarts & Custer, 2009). Previous behaviour was important in both cases. For the continuation, behaviour before Lent was less predictive than behaviour during Lent. Accordingly, encouraging people to change behaviour during Lent might break habitual behaviour and let intention play a more crucial role for implementing new behaviour which then can lead to new habits which replace the former ones. Previous studies showing a link between intention and behaviour mostly focused on the prediction of new behaviour (e.g. starting to use public transportation) without mentioning it explicitly. Thus, educational campaigns will be most effective if they address intentions at the right moment, namely in a phase of change.

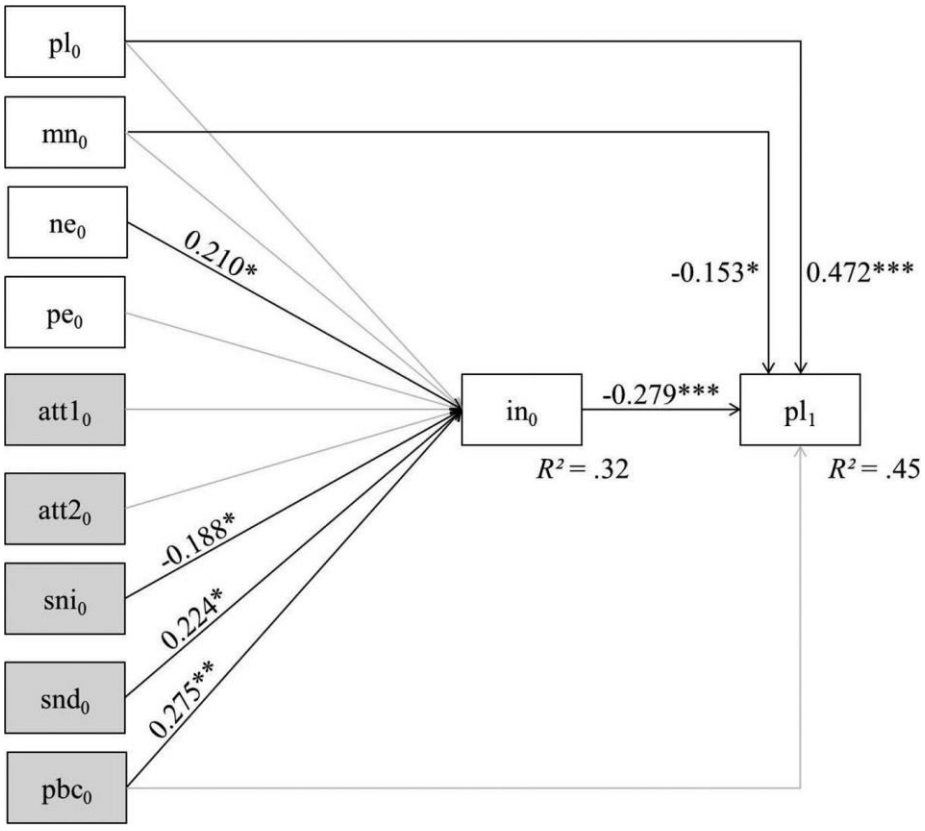

Figure 6 Results of a path analysis (N = 140) modelling plastic use during Lent and its antecedents

Notes. Model fit: X^2 = 6.06, (p = 0.416), df = 6, CFI = 0.99, RMSEA = 0.009 [0.001–0.110]; black arrows = significant standardized path-coefficients, grey arrows = non-significant path-coefficients, grey shaded boxes = variables of TPB, R^2 = explained variance, $_0$ = measurement before Lent, $_1$ = measurement during Lent, pl = plastic use, in = intention, att1 = attitude of use, att2 = attitude of non-use, pbc = perceived behaviour control, sni = subjective injunctive norms, snd = subjective descriptive norms, mn = moral norms, ne = negative emotions, pe = positive emotions, * p < .05, ** p < .01, *** p < .001

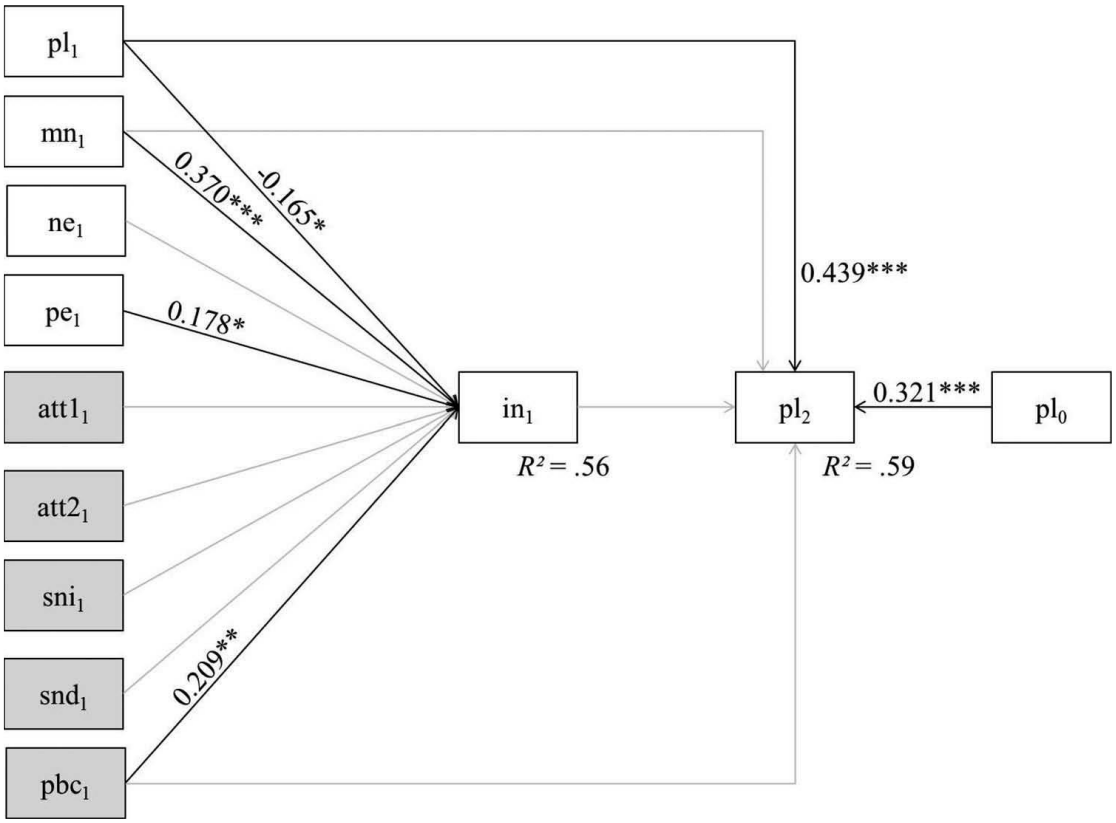

Figure 7 Results of a path analysis (N = 140) modelling plastic use after Lent and its antecedents

Note. Model fit: X^2 = 12.75, (p = 0.078), df = 7, CFI = 0.97, RMSEA = 0.077 [0.001–0.142]; black arrows = significant standardized path-coefficients, grey arrows = non-significant path-coefficients, grey shaded boxes = variables of TPB, R^2 = explained variance, $_0$ = measurement before Lent, $_1$ = measurement during Lent, $_2$ = measurement after Lent, pl = plastic use, in = intention, att1 = attitude of use, att2 = attitude of non-use, pbc = perceived behaviour control, sni = subjective injunctive norms, snd = subjective descriptive norms, mn = moral norms, ne = negative emotions, pe = positive emotions, * p < .05, ** p < .01, *** p < .001

In view of the high proportion of packaging in global plastic production, we focus on a quite specific behaviour in the form of plastic packaging consumption. One might argue that a broader focus (e.g. zero-waste or pro-environmental lifestyle) would better display a person's reasons to act and have bigger environmental impact (Arnold, Kibbe, Hartig, & Kaiser, 2018; Kaiser & Wilson, 2004). However, one main barrier to behavior change is a loss of possible actions, and thus a focus on concrete actions steps people could put into practice might be particularly fruitful for interventions. In line with this, perceived behaviour control was a good predictor of intention to start the plastic challenge and to continue it (Armitage & Conner,

2001; Bamberg & Möser, 2007), but in contrast to the TPB, it had no direct influence on behaviour. Moral norms as well as positive emotions were only predictive of intention to continue the plastic challenge after Lent, replacing negative emotions which were predictive of intention to start the challenge. People who associated positive emotions with the plastic challenge, were willing to continue the challenge after Lent. This result supports the crucial role of moral norms and positive emotions in encouraging pro-environmental behaviour (see also Dunn, Aknin, & Norton, 2008). Furthermore, moral norms had a direct influence on behaviour during Lent. People who felt a strong moral obligation to reduce plastic did so. People who had negative emotions about the consequences of plastic pollution and knew how to reduce plastic packaging in daily life showed a higher willingness to fast from plastic. This willingness was independent of previous behaviour demonstrating the potential to create a willingness of behaviour change in the right window. Lent seems to be such a window.

Acknowledgement

The authors would like to thank Gerhard Reese and Josephine Tröger for giving constructive feedback to the implementation of interventions. Thanks are also due to Isabella Bablok for fruitful discussions and helpful comments.

Disclosure Statement

No potential conflict of interest was reported by the authors

References

Aarts, H., & Custer, R. (2009). Habit, action, and consciousness. In W. P. Banks (Ed.), Encyclopedia of consciousness (pp. 315–328). Amsterdam: Academic Press. doi:10.1016/B978-012373873-8.00035-9

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

Ajzen, I. (2006). Constructing a theory of planned behavior questionnaire. In TPB questionaire cons truction. Retrieved from http://people.umass.edu/~aizen/pdf/tpb.measurement.pdf

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A metanalytic review. British Journal of Social Psychology, 40, 471–499.

Arnold, O., Kibbe, A., Hartig, T., & Kaiser, F. G. (2018). Capturing the environmental impact of individual lifestyles: Evidence of the criterion validity of the general ecological behavior scale. Environment and Behavior, 50, 350–372.

Bamberg, S. (2002). Effects of implementation intentions on the actual performance of new environmentally friendly behaviours - Results of two field experiments. Journal of Environmental Psychology, 22, 399–441.

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

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students' car use for univer sity routes with the models of Ajzen, Schwartz, and Triandis. Environment and Behavior, 35, 264–285. https://doi.org/10.1177/0013916502250134

Dunn, E. W., Aknin, L. B., & Norton, M. I. (2008). Spending money on others promotes happiness. Science, 319, 1687–1688.

Fox, J.,Nie, Z., Byrnes, J., Culbertson, M., DebRoy, S., Friendly, M., & Fox, M. J. (2017). Package 'sem'.

Galloway, T. S. (2015). Micro-and nano-plastics and human health. In M. Bergmann, L. Gutow, & M. Klages (Eds.), Marine anthropogenic litter (pp. 343–366). Cham: Springer.

Gardner, G. T., & Stern, P. C. (2002). Environmental problems and human behavior. Boston, MA: Pearson Custom Publishing. (Pearson Cu).

Gatersleben, B. (2007). Affective and symbolic aspects of car use. In T. Gärling & L. Steg (Eds.), Threats from car traffic to the quality of urban life: Problems, causes and solutions (pp. 219–233). Bingley: Emerald Group Publishing Limited.

Gifford, R. (2014). Environmental psychology matters. Annual Review of Psychology, 65, 541–579.

Harland, P., Staats, H., & Wilke, H. A. M. (1999). Explaining pro-environmental intention and behavior by personal norms and the theory of planned behavior. Journal of Applied Social Psychology, 29, 2505–2528.

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

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., … Law, K. L. (2015). Plastic waste inputs from land into the ocean. Marine Pollution, 347, 768–771. Kaiser,

F. G., & Wilson, M. (2004). Goal-directed conservation behavior: The specific composition of a general performance. Personality and Individual Differences, 36, 1531–1544.

Klöckner, C. A. (2013). A comprehensive model of the psychology of environmental behaviour - A meta -analysis. Global Environmental Change, 23, 1028–1038.

Leiner, D. J. (2016). SoSci survey (Version 2. 6.00) [Computer Software]. Retrieved from https://www.soscisurvey.de

Li, W. C., Tse, H. F., & Fok, L. (2016). Plastic waste in the marine environment: A review of sources, occ urrence and effects. Science of the Total Environment, 566, 333–349.

PlasticsEurope. (2018). Plastics - the facts 2018: An analysis of European plastics production, demand and waste data. Retrieved from https://www.plasticseurope.org/download_file/force/2387/319

Revelle, W. (2018). Psych: Procedures for personality and psychological research. Retrieved from https://cran.r-project.org/package=psychVersion=1.8.12

Rivis, A., Sheeran, P., & Armitage, C. J. (2009). Expanding the affective and normative components of the theory of planned behavior: A meta-analysis of anticipated affect and moral norms. Journal of Applied Sociology, 39, 2985–3019.

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. Journal of Statistical Software, 48, 1–36. Retrieved from http://www.jstatsoft.org/v48/i02/

Schäfer, M., Jaeger-Erben, M., & Bamberg, S. (2012). Life events as windows of opportunity for changing towards sustainable consumption patterns? Journal of Consumer Policy, 35, 65–84.

Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz (Ed.), Advances in experimental social psychology (pp. 221–279). San Diego: Academic Press.

Steg, L., van den Berg, A. E., & De Groot, J. I. (2012). Environmental psychology: An introduction. Chichester, West Sussex: John Wiley & Sons.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. Journal of Environmental Psychology, 29, 309–317.

Thompson, R. C., Swan, S. H., Moore, C. J., & Vom Saal, F. S. (2009). Our plastic age. Philosophical Transactions of the Royal Society B: Biological Sciences, 364, 1973–1976.

Verplanken, B., Aarts, H., & Van Knippenberg, A. (1997). Habit, information acquisition, and the process of making travel mode choices. European Journal of Social Psychology, 27, 539–560.

Verplanken, B., & Wood, W. (2006). Interventions to break and create consumer habits. Journal of Public Policy & Marketing, 25, 90–103.

Wickham, H. (2012). reshape2: Flexibly reshape data: A reboot of the reshape package. R Package Version, 1(2).

6 Manuscript 4 – Plastic Free July: An experimental study of limiting and promoting factors in encouraging a reduction of single-use plastic consumption

Heidbreder, L.M., Steinhorst, J. & Schmitt, M. (2020). Plastic Free July: An experimental study of limiting and promoting factors in encouraging a reduction of single-use plastic consumption. *Sustainability, 12*(11), 4698. https://doi.org/10.3390/su12114698

Date of submission: 14th of March, 2020
Date of Acceptance: 26th of May, 2020

Abstract

To tackle the plastic problem, the worldwide campaign 'Plastic Free July' aims at encouraging people to reduce single-use plastics during the month of July. To get people started with new behavior patterns, so-called 'windows of opportunity' – periods where people become open to new experiences – are expected to matter. Therefore, the current study evaluated if an arbitrary month that is framed as an opportunity for change can interrupt people in their daily routines and reduce plastic consumption. An online survey (n = 509) with repeated measures (n = 366) was conducted including one experimental and one control group. The experimental group was invited to reduce their single-use plastic consumption during July in line with the 'Plastic Free July' campaign. Results revealed that, in this action period, single-use plastic consumption was slightly but significantly lower in the experimental than in the control group, which did not receive any information about 'Plastic Free July'. The campaign seemed to be more effective for participants with low pro-environmental identity. Path analysis revealed that plastic consumption (prior to the intervention) was significantly predicted by perceived difficulty, habits, and pro-environmental identity. Policy support was predicted by problem awareness, pro-environmental identity, and perceived barriers. We conclude with recommendations for plastic-free purchase and policy support.

Keywords

single-use plastic; consumption; window of opportunity; pro-environmental identity; intervention

Introduction

In our affluent western society, we are facing an era of overconsumption (Woodhouse, 2001), which is defined as the 'excessive use of goods and services' (Brown & Cameron, 2000, p. 28). Consumers can experience almost endless autonomy in shopping facilities, since a wide range of products are available to them. However, this range of products comes at the cost of huge environmental challenges along the whole product chain, from an intensive use of resources in the production process to waste from products that are no longer used. These side effects of overconsumption have increased citizens' awareness about plastic pollution as a predominant concern in the current debate of global environmental issues. In the last decades, the yearly production rate of plastic has reached almost 360 million tons (PlasticsEurope, 2019). It is estimated that, of the plastic waste ever generated, only 9% has been recycled (Geyer, Jambeck, & Law, 2017), and 4.8 to 12.7 million tons end up in sea annually (Jambeck et al., 2015). Thus, plastic particles can now be found even in remote areas of the world as well as in human bodies (Cózar et al., 2014; Thompson, Moore, vom Saal, & Swan, 2009). In particular, many different wildlife species suffers as animals die of entanglement and ingestion (Galloway, Cole, & Lewis, 2017; Li, Tse, & Fok, 2016; Thompson et al., 2009). Economic costs are estimated at up to $33,000 per ton of marine plastic per year (Beaumont et al., 2019).

In the last century, plastic has performed a triumph in manifold areas, making it ubiquitous in our daily life. However, as plastic is especially valued for its robustness, its long living character turns out to be the difficulty when it ends up in the ecosystem and stays there as waste for a long time. The current concern mainly focusses on single-use plastics with a short useful life and a fast, subsequent disposal. Single-use plastic objects mainly constitute packaging material, which causes one third of the global plastic production (PlasticsEurope, 2019). Packaging provides several functions, such as protection of food quality or attraction of consumers (Risch, 2009). As a growing concern about plastic pollution in society is registered (Hartley et al., 2018), alternatives to plastic bags, packaging, or plastic bottles are under dis-

cussion. The European Union has adopted a directive on the use of single-use plastics (European Commission, 2018), and many nonprofit organizations have started campaigns to reduce the amount of plastics (Bates, 2010; Heidbreder, Bablok, Drews, & Menzel, 2019). However, campaigns for a broad audience aiming at encouraging people to change their plastic consumption are rare and mostly not evaluated (Bates, 2010)—a gap in literature that we seek to fill with the present research.

In the following section, we will describe the theoretical framework on which our research builds. We begin with delineating prominent theories of environmental behavior that have inspired our framework and mention the constructs we have selected as part of that framework. Subsequently, we elaborate on these constructs, explain in depth the reasons for their selection and combination, and translate these reasons into hypotheses that our research sought to test. Next, we explain the application of the integrative theoretical framework to plastic consumption and policy support, the two outcomes we investigated. Finally, we provide an overview of the study we performed for testing the hypotheses.

Integrative Theoretical Framework

The current socio-scientific research discusses a number of different drivers to encourage pro-environmental behavior (Schultz, 2014) and suggests that multiple factors determine behavior change (Steg & Vlek, 2009). These factors are embedded in different theories and research traditions. We selected those factors from these theories and research traditions for an integrative theoretical framework that were found to be particularly effective in previous studies addressing pro-environmental behavior.

Rational Choice Model

A prominent approach to explain behavior change is rooted in rational choice theories (Little, 1991), by which people are expected to weigh the costs and benefits of their behavior. This approach is represented by the theory of planned behavior (TPB) (Ajzen, 1991). In line with

this approach, our theoretical framework and study considered perceived difficulties and barriers as predictors of single plastic use. However, from a rational point of view, individuals do not always have greater benefit from showing pro-environmental behavior. Positive consequences of pro-environmental behavior are often delayed in time and space and might only take effect when it is collectively implemented. Nevertheless, people do act environmentally friendly. There is growing evidence that people do not only maximize rational criteria in their ecological behavior but also take moral considerations into account in their decision processes (Honkanen & Verplanken, 2004; Honkanen, Verplanken, & Olsen, 2006).

Moral Choice Model

Therefore, several researchers have proposed to expand the rational choice model with moral and normative factors (Klöckner, 2013), including the consideration of positive outcomes for others and the natural environment per se rather than oneself (Schwartz, 1977). In line with this reasoning, our theoretical framework and study considered problem awareness and pro-environmental identity as predictors of pro-environmental behavior.

Habit Model

Beyond rational and moral choices, people also act in a more unconscious manner following their habits (Bamberg & Schmidt, 2003). Habits are automatic behavior sequences that are often exercised without consciousness (Verplanken & Wood, 2006). In fact, one main barrier that hinders people to try new behavior and should therefore be addressed in campaigns is their habits (Verplanken, 2012). In the context of plastic use, habits were shown to be a key factor that influences plastic consumption (Heidbreder et al., 2019). Accordingly, our theoretical framework and study considered habits as predictors of pro-environmental behavior. To interrupt habits, periods of change in peoples' lives (e.g., moving to another city) were found to ease the establishment of new behavior (Bamberg, 2006). However, these phases are rare and may differ in their intensity. Less intense phases of change, such as Lent (Heidbreder & Schmitt,

2020), are understudied with regard to their potential of changing consumer behavior. Arbitrary periods, if appropriately framed as phases of change, might also work as a 'window of opportunity' where people change their consumption behavior. Accordingly, our theoretical framework and study considered such an arbitrary 'window of opportunity'.

Constructs of the Integrative Theoretical Framework and Expected Effects on Pro-Environmental Behavior

RATIONAL CHOICE CONSTRUCT: PERCEIVED DIFFICULTY

Perceived difficulty of a target behavior is an important predictor for behavioral change. External circumstances influence how easy or difficult it is for people to act environmentally friendly. Having a bus stop in front of one's door makes it easier to take public transportation, and having a zero-waste shop within manageable distance makes it easier to reduce plastic consumption. In his prominent theory of planned behavior, Ajzen (1991) introduced the construct of perceived behavior control, which was a strong predictor for intention and behavior in meta-analyses (Armitage & Conner, 2001; Bamberg & Möser, 2007). According to Ajzen's original studies, perceived behavior control includes two subdimensions: the controllability over the performance of a certain behavior (How much control do I have?) and the perceived difficulty (How difficult is it for me to show this behavior?). In many studies, these subdimensions are mixed. However, Chan and Fishbein (Chan & Fishbein, 1993) showed that one might perceive a behavior as difficult but still feel to be in control of showing it (and vice versa). In a study by Cheung, Chan, and Wong (Cheung, Chan, & Wong, 1999), for example, perceived difficulty significantly predicted recycling intention, whereas perceived controllability did not. Thus, in this study we concentrated on perceived difficulty only and proposed the following hypothesis:

H1a: Perceived difficulty is negatively related to pro-environmental behavior.

RATIONAL CHOICE CONSTRUCT: PERCEIVED BARRIERS

Perceived barriers are also an important variable that determines behavioral change. Although many people show a high willingness to act environmentally friendly, consumers in the western world have made slow progress in changing their behavior toward a more sustainable way (Thøgersen, 2005). Barriers that are objectively or subjectively beyond an individuals' control can prevent people from acting according to their normative standards, apart from psychological processes such as habits (Gifford, 2011). Perceived barriers and perceived difficulty are closely linked. Someone who perceives many barriers is more likely to evaluate his or her behavior as difficult. According to Schultz (Schultz, 2014), barriers can be either structural (e.g., lack of plastic-free alternatives) or personal (e.g., lack of individual resources such as money or time). Both can paralyze pro-environmental behavior (Thøgersen, 2005). Therefore, we propose:

H1b: Perceived barriers are negatively related to pro-environmental behavior.

MORAL CHOICE CONSTRUCT: PRO-ENVIRONMENTAL IDENTIY

It is more likely to show pro-environmental behavior if someone considers him- or herself as an environmentally friendly person, and thus has a strong pro-environmental identity. Considering positive outcomes for others (or the environment) rather than oneself seems to motivate people to act environmentally friendly. For example, moral considerations were a predictor to buy products with an ecological label (Bradu, Orquin, & Thøgersen, 2014). The crucial role of morality as a motivator for pro-environmental behavior was explained by people's aspiration to maintain a positive self-concept or identity (Ariely, Bracha, & Meier, 2009; Mazar, Amir, & Ariely, 2008). According to Rise, Sheeran, and Hukkelberg (2010), the self-concept or self-identity refers to individuals' perception of relevant attributes they possess. These attributes, in turn, reflect behaviors they prefer. People with strong pro-environmental identities try to be 'green rather than greedy' (Bolderdijk, Steg, Geller, Lehman, & Postmes, 2012, p.1) and seek

self-consistency by ensuring that their actions are in line with their elevated ecological standards (Dunning, 2007; Festinger, 1957; Thøgersen, 2006). Pro-environmental identity has been found to be predictive of pro-environmental behavior in different domains, such as sustainable consumption (Sparks & Shepherd, 1992; Whitmarsh & O'Neill, 2010), carbon-offset (Whitmarsh & O'Neill, 2010), environmental activism (Fielding, McDonald, & Louis, 2008), or recycling (Nigbur, Lyons, & Uzzell, 2010; Terry, Hogg, & White, 1999). According to this, we propose:

H1c: Pro-environmental identity is positively related to pro-environmental behavior.

MORAL CHOICE CONSTRUCT: PROBLEM AWARENESS

The fundament for consciously acting environmentally friendly is to be aware of ecological problems. According to the norm activation model (NAM, Schwartz, 1977) problem awareness can be defined as the perceived or anticipated violation of a normative standard. Problem awareness activates a sense of obligation to protect, affirm, and re-establish the violated or threatened standard. The model predicts that threats to or violations of ecological standards motivate pro-environmental behavior (see also De Groot & Steg, 2009). In line with this prediction, a study by Whitmarsh, Capstick, and Nash (2017) found environmental problem awareness to explain differences in willingness to reduce consumption between different countries. Therefore, we propose:

H1d: Problem awareness is positively related to pro-environmental behavior.

HABITS

Habits are helpful in our daily life. They support us in overcoming the day without taking a decision in every little situation, weighing all advantages and disadvantages. However, when behavior change is pursued they can become an obstacle, as getting rid of a daily routine is very challenging (Jager, 2003). In previous studies, habits were good predictors for pro-environmental behavior even beyond TPB and NAM (Bamberg & Schmidt, 2003; Gkargkavouzi, Halkos, & Matsiori, 2019; Klöckner & Blöbaum, 2010). In a meta-analysis reviewing pro-environmental

behavior, habits have been emphasized as a key factor that should be incorporated in every comprehensive model (Klöckner, 2013). Therefore, we propose:

H1e: Habits are negatively related to pro-environmental behavior.

HABIT CHACNE DURING 'WINDOWS OF OPPORTUNITY'

By definition, habits are characterized as recurring, automatic, and unconscious reaction on stable circumstances (Kurz, Gardner, Verplanken, & Abraham, 2015; Schäfer, Jaeger-Erben, & Bamberg, 2012; Bas Verplanken & Aarts, 1999; Bas Verplanken & Wood, 2006), and these stable circumstances are the decisive point when aiming to encourage behavior change (e.g., for environmental reason). A range of studies has shown that change of circumstances can give the impulse to break old and form new habits. For example, people who were forced by a construction site to change from car to bus were more often using the bus afterwards (Fuji & Gärling, 2003). The same was found when Copenhagen car owners got a free month travel card: They increased their commuting by public transportation and an effect remained even five months later. The intervention was in particular effective when people had positive experiences with using public transportation (Thøgersen & Møller, 2008). Furthermore, it was shown that intervention for behavior change was most effective when people were in a phase of change anyway, like moving to another city or having a child. Promoting sustainable behavior was thus more effective when the target group consisted of people who recently moved (Verplanken & Roy, 2015). Relocation was also a good phase to change travel-mode choices and reduce car travels (Bamberg, 2006; Haggar, Whitmarsh, & Skippon, 2019; Müggenburg, Busch-Geertsema, & Lanzendorf, 2015; Thomas, Poortinga, & Sautkina, 2016; Verplanken, Walker, Davis, & Jurasek, 2008). Some other studies have focused on life-cycle -events (Gillison, Standage, & Verplanken, 2014; Schäfer et al., 2012; Thomas, Fisher, Whitmarsh, Milfont, & Poortinga, 2018) or workplace relocation (Walker, Thomas, & Verplanken, 2015). Even the fasting period has proven a good phase to reduce plastic consumption (Heidbreder & Schmitt, 2020).

A prominent approach to explain this phenomenon is the habit discontinuity hypothesis (Verplanken et al., 2008; Walker et al., 2015). It points to the destabilization of causal links between context cues and a behavioral response and thus provides an opportunity to break old habits and learn new ones. These phases are also called 'windows of opportunity' (Schäfer & Bamberg, 2008; Schäfer et al., 2012). Interventions presented in these phases are expected to be particularly effective (Verplanken & Roy, 2016). Based on the theoretical considerations above, we postulate:

H2: The creation and dissemination of campaigns based on a 'window of opportunity' are positively related to pro-environmental behavior.

Application of the Integrative Theoretical Framework to Plastic Consumption and Policy Support

A wide range of specific pro-environmental behaviors like mobility behavior (Bamberg & Schmidt, 2003), sustainable food consumption (Vermeir & Verbeke, 2008), or recycling (Tonglet, Phillips, & Read, 2004) was examined so far. Despite a variety of studies on recycling, the reduction of plastic consumption as waste-related pro-environmental behavior has been addressed in very few studies only (Heidbreder et al., 2019). To fill this gap, we applied the proposed integrative theoretical model to plastic consumption and conducted a study to examine what encourages people to reduce their single-use plastic consumption in daily life.

In order to achieve an environmental goal, people can either change their individual behavior in the private sphere, such as by consumption, or they can engage in changes in the public sphere, e.g., by supporting political measures (Stern, 2000). In a paper about consumer policy, Thøgersen emphasized that 'What matters is what large groups of consumers do' (John Thøgersen, 2005, p. 145). Policy has the opportunity to empower consumers to change towards a sustainable lifestyle (Schäfer & Bamberg, 2008) and play a critical role in tackling environmental problems (Zhao, 2017). By offering information (e.g., eco-labelling) and removing structural barriers, consumers can be encouraged to make informed choices and implement

their choices more easily. Pro-environmental behavior thus becomes less dependent of consumers' good will (Schäfer & Bamberg, 2008).

With regard to plastic pollution, only few studies have evaluated the effectiveness of policy measures in bringing about considerable change (Xanthos & Walker, 2017). All over the world, governments have taken measures to reduce plastic with a particular focus on plastic bags, either with bans or economic instruments such as fees, levies, or taxes (Ritch, Brennan, & MacLeod, 2009). The implementation of a plastic bag levy (0.15€) in Ireland in 2002, for example, reduced the national plastic bag use by up to 90% (Xanthos & Walker, 2017). While bans are obviously most effective looking at the outcome, they might be not feasible in every context and might provoke unintended reactions (e.g., reactance to regulation or use of even worse alternatives from an environmental outcome perspective) (Heidbreder et al., 2019). Thus, examining policy support and its predictors is crucial to encourage a reduction of plastic waste.

The Present Study

Responding to several research gaps, the present study pursued three related and novel research goals. First, our study will make a contribution to the literature by combining strong predictors of pro-environmental behavior and applying these predictors to the new field of plastic consumption. For this purpose, we propose a new framework which integrates constructs from prominent theories of pro-environmental behavior while simultaneously limiting the number of variables to an efficient minimum. The framework we propose combines constructs of rational choice theories (i.e., perceived difficulty, perceived barriers) and moral choice theories (i.e., pro-environmental identity, problem awareness) with habits and theories of habit change during 'windows of opportunity.' Including these constructs in a single study allows estimating their unique and joint effects on plastic consumption in a multivariate regression model.

Second, in order to explore whether the effects of the psychological predictors on plastic consumption can be generalized on public sphere behavior, we repeated the regression model for plastic consumption using policy support as a second outcome variable. Thus, the proposed hypotheses were tested for two forms of pro-environmental behavior: plastic consumption and policy support.

Third, the present study tested if opening a 'window of opportunity' for habit change will reduce plastic consumption and moderate the impact of variables from the integrative framework. For this purpose, we made use of the campaign 'Plastic Free July' (PFJ) (https://www.plasticfreejuly.org/). Started in Australia in 2011, this worldwide campaign encourages individuals from civil society to reduce single-use plastics during the month of July. We conducted an online survey with repeated measures (before and in July) including one experimental and one control group. According to the 'Plastic Free July', the experimental group was invited to reduce their single-use plastic consumption in July while the control group did not receive this invitation. In order to explore whether the effects of the psychological predictors on plastic consumption generalize across the two experimental groups or else vary across group membership, we tested group membership as a moderator of all predictors by including the relevant product terms in the regression model.

Materials and Methods

Sample

Participants were recruited via SoSciPanel, an open noncommercial survey portal where people can register for free to take part in scientific surveys (Leiner, 2016). As incentives, participants could win shopping vouchers in a lottery. Before July 2019, 509 participants of the German population completed an online survey and were randomly allocated to an experimental and a control group. The experimental group was comprised of 252 participants, and the control group contained 257. At the end of July, participants were asked to take part in a second survey. Three hundred and sixty-six participants filled out the second survey (72%). Table 6

presents sociodemographic information for the experimental and the control groups in both surveys before and at the end of July. The experimental and the control groups did not differ in their sociodemographic characteristics.

Table 6 Sociodemographic data for the experimental and control group before (n_1 = 509) and at the end of July (n_2 = 366)

	Experimental group (n_1 = 252, n_2 = 179)	**Control group (n_1 = 257, n_2 = 187)**	**Group comparison**
Age	M_1 = 42.85 (SD_1 = 15.83) M_2 = 43.77 (SD_2 = 15.75)	M_1 = 43.65 (SD_1 = 16.00) M_2 = 44.81 (SD_2 = 16.42)	t_1 (506) = -0.56, p = 0.57 t_2 (363) = -0.62, p = 0.54
Gender	t1: 58% female t2: 56% female	t1: 57% female t2: 58% female	F_1 (1,507) = 0.11, p = 0.74 F_2 (1,364) = 0.37, p = 0.54
Education	t1: 66% university degree 25% high school t2: 68% university degree 24% high school	t1: 65% university degree 23% high school t2: 67% university degree 33% high school	F_1 (1,507) = 0.70, p = 0.40 F_2 (1,364) = 0.16, p = 0.69
Household size	M_1 = 2.38 (SD_1 = 1.44) M_2 = 2.40 (SD_2 = 1.39)	M_1 = 2.26 (SD_1 = 1.16) M_2 = 2.14 (SD_2 = 1.09)	t_1 (507) = 1.03, p = 0.30 t_2 (364) = 1.93, p = 0.05
City	t1: 44% large city t2: 44% large city	t1: 51% large city t2: 52% large city	F_1 (1,364) = 0.82, p = 0.37 F_2 (1,364) = 1.33, p = 0.25
Holiday in July	t1: 22% yes t2: 21% yes	t1: 25% yes t2: 26% yes	F_1 (1,364) = 0.67, p = 0.41 F_2 (1,364) = 1.25, p = 0.27

Procedure and Intervention

All participants gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with ethical standards. In order to explore changes in behavior, two surveys (before and at the end of July) were scheduled. In the first survey, participants were randomly divided into an experimental and a control group. The control group filled out the survey without any further information. The experimental group received information about the campaign 'Plastic Free July' and problems of plastic pollution. They were in-

formed that, since 2011, millions of people take part in the challenge to reduce single-use plastic during the month of July. It was pointed out that one-third of the global plastic production can be traced back to packaging, and plastic waste in the environment can harm wildlife and pollute beaches. Participants were invited to participate in the challenge of reducing single-use plastic consumption in July. In a second step, participants received ten pieces of advice on how to reduce plastic consumption presented with photos (e.g., taking a bag or rucksack, buying milk or yoghurt in a glass container). Participants could then rate if they were willing to put the advice into practice in July (yes, maybe, no) or if they were doing it already. Furthermore, their intention to participate was measured by approval to the statement 'I plan to reduce my plastic consumption in July' on a five-point Likert scale (from 1 – 'strongly disagree' to 5 – 'strongly agree'). The intention to participate in the challenge to reduce single-use plastic consumption in July was M = 3.49 (SD = 1.07).

Manipulation Check

In the second survey at the end of July, a manipulation check was included. The statement 'For me, July was a good opportunity to try new plastic-free alternatives' was rated on a five-point Likert scale (from 1 – 'strongly disagree' to 5 – 'strongly agree'). It should explore if people perceived the month of July as a special month, according to the idea that a 'window of opportunity' can break old habits. People in the experimental group did not perceive July as a more special month, as pairwise-t-test showed no difference in perceptions between the experimental and control groups ($t(364) = -0.255$, $p = 0.80$, $d_{Coh} = 0.025$, $M_E = 2.26$, $M_C = 2.29$). However, those who perceived July as a good opportunity for plastic-free consumption also stated to have consumed less plastic in July (r = -0.29). Furthermore, to check if participants were familiar with the concept of PFJ, they were asked if they had heard about it before; 95% of the control group had never heard about the campaign of PFJ before.

Measures

All items of both surveys can be found in the appendix. In both surveys, participants completed a questionnaire about plastic consumption. In the first survey before July only, they filled out further questions about habits, perceived difficulty, pro-environmental identity, and problem awareness. In the second survey at the end of July, participants filled out further questions about policy support and perceived barriers. The separation of constructs was made to shorten each survey.

PLASTIC CONSUMPTION

Plastic consumption was measured in two surveys, before and at the end of July. Participants were presented with ten categories for daily consumer goods (e.g., fruits and vegetables, fresh products, dry products) and were asked which of these products they had consumed during the last week. To make retrieval easier, for all selected products, up to five items (e.g., bread or cake for pastries) were presented as subcategories and participants had to rate if they had consumed it with plastic packaging (1 – 'all without plastic,' 2 – 'partially in plastic,' 3 – 'all with plastic' or 'not bought at all'). For the general score, items with the rating 'not purchased at all' were excluded and a mean score of all remaining items was calculated ($\alpha_1 = 0.66$, $\alpha_2 = 0.69$).

POLICY SUPPORT

Support for different policy steps (e.g., ban or tax of single-use plastic products, deposit system for to-go packaging) was assessed using five-point Likert scales (from 1 – 'strongly disagree' to 5 – 'strongly agree'). A mean score over all items was calculated ($\alpha = 0.78$). Using the same response scale, one further item asked if political measures would limit personal freedom.

PERCEIVED DIFFICULTY

The same product categories as in the general measure of plastic consumption were used to examine the perceived difficulty of plastic-free consumption. All ten categories were rated on

a five-point Likert scale (from 1 – 'It's easy for me' to 5 – 'It's hard for me') with regard to the perceived difficulty of plastic-free purchase in daily life. A mean score over all items was calculated with higher scores indicating that people find it hard to buy products without plastic ($\alpha = 0.73$).

PERCEIVED BARRIERS

To examine what impedes plastic-free consumption, eight potential barriers (e.g., missing offers of plastic-free alternatives, higher costs, time effort) were presented, and participants could decide if these options were a barrier in their daily life and then rank them. The number of chosen barriers served as barrier score. A higher score indicated more perceived barriers.

PRO-ENVIRONMENTAL IDENTIY

A single-item measure was used for capturing pro-environmental identity. On a five-point Likert scale (from 1 – 'strongly disagree' to 5 – 'strongly agree'), participants responded to the statement 'I see myself as an environmental conscious person.'

PROBLEM AWARENESS

Based on the representative survey of the German Federal Environmental Agency (UBA, 2017), problem awareness was measured with a five-point Likert scale (from 1 – 'no problem' to 5 – 'very big problem'). Participants had to assess several problems (e.g., plastic waste in the ocean, species extinction through plastic in the environment, health impairment caused by plastic). A mean score over the eight items was calculated ($\alpha = 0.80$).

HABITS

Measurement of consumption habits was based on a German version of the Self-Reported Habit Index (SRHI) of Verplanken and Orbell (Verplanken & Orbell, 2003). The SRHI assesses differ-

ent features of habits like automaticity, experience of frequency, and unconsciousness. In comparison to the original twelve-item scale, items with a time context (e.g. 'I have been doing for a long time') were not included in this study because the study referred to a short time frame where potential habits change could be observed not in the long run. The shortened version applied to the habits to buy products without plastic. Eight items completing the stem 'To buy products without plastic is something...' represented the different features of habits (e.g., I do without thinking, I do automatically) and were rated on a five-point Likert scale (from 1 – 'strongly disagree' to 5 – 'strongly agree'). For each participant, the SRHI responses were averaged into an aggregated habits index ($\alpha = 0.67$) with high scores indicating strong habits.

Statistical Analysis Methods

In order to test if the creation and dissemination of campaigns based on a 'window of opportunity' were positively related to pro-environmental (H2), we assumed that single-use plastic consumption before July decreases in July in the experimental group while it rests stable in the control group. Therefore, we conducted a mixed-model ANOVA. With an ANOVA, we could examine differences in plastic consumption between the groups and over time. A mixed model was used as group differences were measured between different participants (between-subject factor) and the change in plastic consumption over time was measured within a person (within-subject factor). To statistically test the equality of means, ANOVA uses F-tests. When the p value of F is smaller than .05, we reject the null hypothesis. In addition to F and p, we report the partial eta η^2p as effect size coefficients. Subsequently, we used post-hoc t-tests with Bonferroni correction for the pairwise comparison of means. As effect size we report Cohen's d here.

To examine which psychological variables predict pro-environmental behavior (H1a-e) in form of plastic consumption and policy support, we estimated the parameters of a linear path model based on multiple regression analyses. Standardized path coefficients indicate the strength of

the relations between the independent and dependent variable with higher numbers indicating stronger relations. R^2 is the coefficient of determination indicating the proportion of variance of the dependent variables explained by the independent variables. Model fit was determined to detect misspecifications of the model, such as omitted interactions or nonlinear effects. The Chi-Square (X^2) test assesses overall model fit but is sensitive to sample size. The Comparative Fit Index (CFI) compares the target model with an independent baseline model. The Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMR) indicate the discrepancy between the empirical covariance matrix and the covariance matrix implied by the estimated parameters of the model. For a good model fit, CFI should be greater than .90 and RMSEA and SRMR smaller than .08, at least (Vandenberg & Lance, 2000).

We conducted all analyses with R (version 3.6.1) and used the packages psych (Revelle, 2018) for descriptive analyses and correlations, dplyr (Wickham et al., 2019) for preparation of data, lavaan (Rosseel, 2012) and sem (Fox et al., 2017) for path models. As descriptive statistics, we computed means (M) and standard deviations (SD) for continuous variables and report these values in parentheses as mean ± standard deviation. Raw data can be found in the supplementary material.

Results

Descriptive Results

PERCEIVED DIFFICULTY

Participants perceived it as rather difficult to buy products without plastic (3.10 ± 0.65), see also Table 7 for means and standard deviations of all variables separately for each group. Considering the item level, pastries (1.92 ± 1.17) as well as fruits and vegetables (2.09 ± 1.18) were products that were rated as easiest to buy plastic free, while cosmetics (4.13 ± 1.23) and household products (4.31 ± 1.07) were rated as most difficult.

PERCEIVED BARRIERS

Overall, 60% of participants chose all eight proposed options as a barrier. A missing offer of plastic-free alternatives was rated by far the highest barrier that hinders participants to purchase less products with plastic. Almost all participants chose it as a barrier and 81% ranked it as the most important one. About 79% of the sample perceived higher costs, an inconvenient transport, and expenditure of time to be barriers, which were mostly ranked on the second to fourth place. Still 70% ranked missing hygienic and limited shelf life as a barrier. The least important barriers that participants indicated were the purchase behavior of people in their close environment (65%) and too much interaction with the salesmen (64%).

PRO-ENVIRONMENTAL IDENTITY

Many participants ascribed themselves to have a pro-environmental identity (3.85 ± 0.78); 20% strongly agreed to be an environmental conscious person, 50% did so partly. Only 4% partly or strongly disagreed to this statement.

PROBLEM AWARENESS

Participants expressed a generally high problem awareness towards problems related to plastic (4.21 ± 0.61). Plastic waste in the ocean and species extinction were seen as the biggest problems, with 98% and 91% rating these issues as rather or very large problems. Plastics in soil (83%) and energy and resource depletion (77%) were also indicated as rather or very large problems. Topics with a direct link to the person (health impairment by plastics and aesthetic burden by plastic pollution) were rated as problematic by 70% and 75% of participants. Increase of climate change and social problems due to plastic were seen at least problematic: 67% and 65% rated it as a rather or very large problem.

HABITS

Habits to buy products without plastic were rated on a medium level (2.95 ± 0.61). Exceedingly few indicated to start doing so before realizing it (2.48 ± 1.12) or doing it without consciously remembering (2.56 ± 1.19). Most approval was given to the statements 'that's typically me' (3.03 ± 1.12) and 'that makes me feel weird' (4.54 ± 0.86, recoded), indicating that the automaticity of plastic-free purchase was not strongly internalized, unlike an identification with such a behavior.

PLASTIC CONSUMPTION

Overall, participants had a medium level of plastic consumption before July (2.07 ± 0.33). Considering the item level, snacks (2.58 ± 0.59), cosmetics (2.56 ± 0.51), fresh products (2.50 ± 0.48), and household goods (2.47 ± 0.55) were mostly bought with plastic, while fruit and vegetables (1.64 ± 0.52), food to go (1.51 ± 0.57), and bakery products (1.51 ± 0.62) were bought with less plastic.

POLICY SUPPORT

Policy support was moderately high (3.66 ± 0.95). Overall, 61% disagreed or rather disagreed to feel limited in their personal freedom because of political instructions, whereas 17% agreed or rather agreed to this. Regarding concrete measures, 77% appreciated a ban of single-use plastic and 70% would support a tax on this. In addition, 70% agreed to use a deposit system for a container of sausage or cheese counter and 62% to use one for to-go products. Regarding transparency, 67% would account a label indicating plastic-free products in all their purchase decisions and 37% would use an app for this.

Table 7 Means and standard deviations separately for each group

	Experimental group (n = 179)		Control group (n = 187)	
	M	*SD*	*M*	*SD*
Plastic consumption before July	2.05	0.33	2.09	0.34
Plastic consumption in July	2.01	0.34	2.10	0.34
Policy support	3.67	0.87	3.66	1.03
Perceived difficulty	3.11	0.67	3.08	0.63
Perceived barriers	6.20	2.42	6.36	2.44
Pro-environmental identity	3.87	0.80	3.84	0.77
Problem awareness	4.20	0.63	4.20	0.61
Habits	2.98	0.63	2.92	0.60

Note: The scales of plastic consumption ranged from 1 to 3; the number of perceived barriers ranged from 0 to 8; the scales of the further variables ranged from 1 to 5

Testing Hypothesis 2: Effectiveness of the Intervention

The effect of the 'Plastic Free July' intervention on plastic consumption (H2) was evaluated via a mixed-model ANOVA with all participants who had filled out both surveys. Plastic consumption was the dependent variable and time (two measurement points) was the within-subject factor and group (experimental and control group) was the between-subject factor. The results revealed no main effect of time on plastic consumption (F[1,363] = 1.348, p = 0.246, η^2_p < 0.001); thus, taking all participants into consideration, the plastic consumption did not change from the first survey (before July) to the second one (at the end of July). There was, however, a marginal main effect of group on plastic consumption (F[1,363] = 3.806, p = 0.052, η^2_p = 0.008), indicating that the plastic consumption tended to be lower in the experimental group than in the control group over both surveys. No interaction effect was found (F[1,363] = 2.692, p = 0.101, η^2_p = 0.001).

As we assumed directional effects, a Type 1 error risk of α = 0.1 was chosen for post hoc tests, which corresponds to the conventional significance level of α = 0.05 in two-tailed tests. Post hoc tests with Bonferroni correction showed no difference between the groups before the intervention but after the intervention (see Table 8), indicating that the experimental group used less plastic in July than the control group. Pairwise t-test revealed no difference

between the two measurement points in the control group but a small effect in the experimental group, indicating that the experimental group reduced their plastic consumption in July. Overall, the second hypothesis (H2) regarding the effect of the 'Plastic Free July' challenge was confirmed. At the end of July, single-use plastic consumption was slightly higher in the control than in the experimental group. Participants in the experimental group somewhat reduced their single-use plastic consumption compared to before the intervention. By contrast, the plastic consumption of the control group remained stable.

Table 8 Results of the Bonferroni post hoc tests for plastic consumption (N = 366)

			t	df	p	d
t1: EG vs. CG	$M_{1,EG}$ = 2.05	$M_{1,CG}$ = 2.09	-0.99	363	0.323	0.119
t2: EG vs. CG	$M_{2,EG}$ = 2.01	$M_{2,CG}$ = 2.10	-2.42	363	0.016	0.232
EG: t1 vs. t2	$M_{1,EG}$ = 2.05	$M_{2,EG}$ = 2.01	1.73	178	0.085	0.128
CG: t1 vs. t2	$M_{1,CG}$ = 2.09	$M_{2,CG}$ = 2.10	-0.40	185	0.687	0.042

Note: EG = experimental group, CG = control group, t1 = before July, t2 = at the end of July

Testing Hypotheses H1a – H1e: Predictors of Single-Use Plastic Consumption

As a precondition for analyzing the impact of predictors on plastic consumption, correlations between all measured variables were analyzed separately for each group (Table 9). In both groups, a strong correlation between plastic consumption before and at the end of July was found, indicating a substantial stability of individual differences in plastic consumption over time. Of note, the stability of plastic consumption was lower in the experimental group than in the control group, suggesting that the treatment did not affect the members of the experimental group equally but differentially. Among the other variables, perceived difficulty showed the strongest correlation with plastic consumption in both groups. Thus, the more participants perceived it difficult to buy products without plastic packaging, the less they did so. Habits to buy products without plastic were negatively correlated with plastic consumption. While the correlation of habits and plastic consumption was the same in both groups before July, the correlation at the end of July was lower in the experimental group than in the control group. This

indicates that former habits were less relevant after the intervention in the experimental group. Policy support showed medium-to-strong correlation with problem awareness and pro-environmental identity. Policy support and plastic consumption were negatively correlated on a low level.

Table 9 Correlations separately for each group

	PC1	PC2	PS	PD	PB	EI	PA	HB
PC1 [a]		0.54	-0.20	0.55	0.15	-0.34	-0.18	-0.39
PC2 [b]	0.75		-0.26	0.38	-0.03 *	-0.19	-0.13	-0.18
PS [b]	-0.18	-0.13 *		-0.14 *	-0.11	0.34	0.45	0.15
PD [a]	0.52	0.47	-0.06*		0.09 *	-0.23	-0.19	-0.38
PB [b]	0.07 *	0.05 *	-0.17	0.07 *		0.01 *	-0.08 *	0.16
EI [a]	-0.35	-0.36	0.29	-0.28	-0.20		0.24	0.27
PA [a]	-0.30	-0.26	0.43	-0.21	-0.14	0.35		0.16
HB [a]	-0.40	-0.28	0.19	-0.48	-0.02 *	0.34	0.29	

Note: Above diagonal: experimental group (n = 179); below diagonal: control group (n = 187); [a] measured before intervention, [b] measured after intervention; PC: plastic consumption before and at the end of July; PS: policy support; PD: perceived difficulty; PB: perceived barriers; EI: pro-environmental identity; PA: problem awareness; HB: habits; *insignificant

To test the unique impact of the psychological variables considered on plastic consumption and policy support (H1a-e), we conducted a path model with data of participants who had filled out both surveys. In the path model, habits, perceived difficulty, pro-environmental identity, problem awareness, and perceived barriers were included as independent variables to predict the two dependent variables plastic consumption before and in July as well as policy support. Except for perceived barriers and problem awareness, all independent variables were measured in the first survey before the intervention. As perceived barriers and problem awareness did not differ between the two groups, we assumed no treatment bias and integrated them as predictors in the model. In addition, group and plastic consumption before July were included as predictors of plastic consumption in July. Controlling plastic consumption before July is necessary to reveal how much of the variance of plastic consumption in July which is not due to the stability of plastic consumption can be explained by the remaining predictors. It allows separating direct effects of the remaining predictors of plastic consumption

in July from indirect effects of these predictors, with plastic consumption before July being the mediator. We also tested group membership as a moderator of all predictors by including the relevant product terms in the regression model. Group membership (dummy variable) was coded such that a value of 0 was assigned to the experimental group and a value of 1 to the control group.

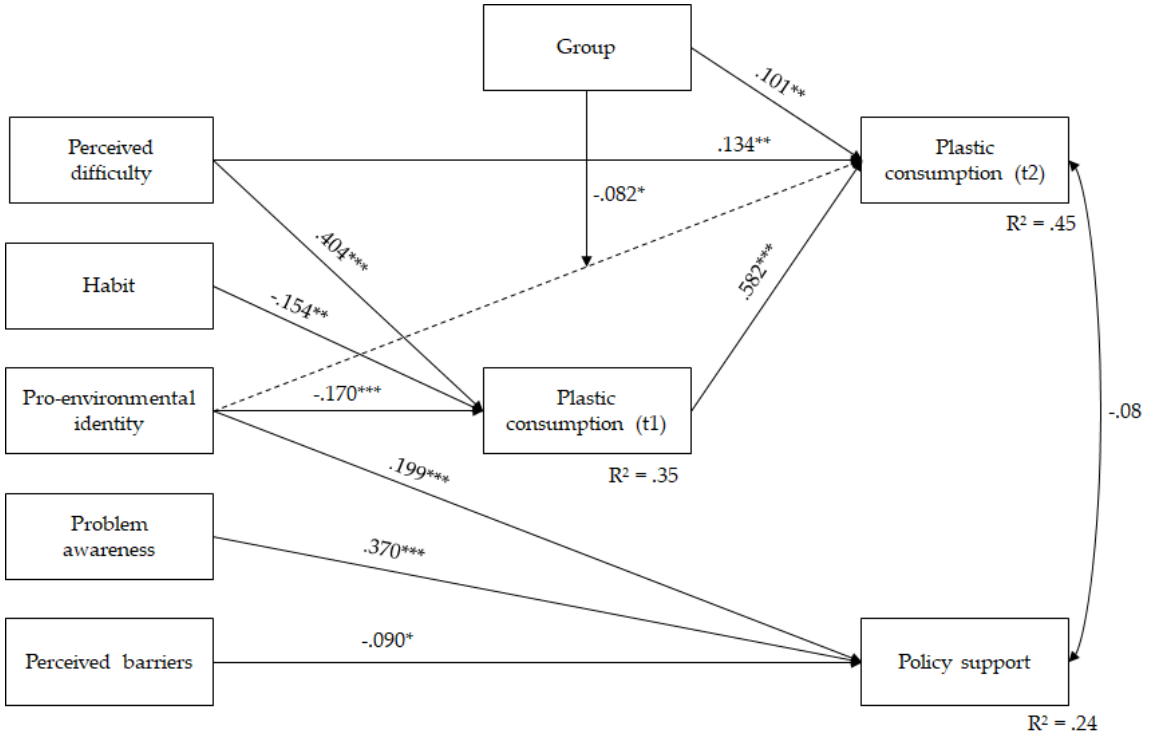

Figure 8 Results on predictors of single-use plastic consumption before and in July and policy support (N = 366)

Note. Only significant standardized path coefficients are shown.

The model (see Figure 8) had a good fit ($X^2(9) = 4.082$, $p = 0.906$, CFI = 1.00 RMSEA < 001 [0.000; 0.024], SRMR = 0.009). Supporting hypotheses H1a, H1c, and H1e, perceived difficulty, habits, and pro-environmental identity were significant predictors of plastic consumption before July. However, perceived barriers (H1b) and problem awareness (H1d) were not. In total, the predictors explained 35% of the variance of plastic consumption before July. Perceived difficulty was the strongest predictor for plastic consumption before July. Concerning plastic consumption in July, prior plastic consumption was the strongest predictor. Group and

perceived difficulty also had direct effects. Habits, pro-environmental identity, problem awareness, and perceived barriers were no direct predictors for plastic consumption in July. An interaction effect was found between pro-environmental identity and group, which indicates that plastic consumption in July differed between the two groups in dependence of pro-environmental identity. The interactions between group and the other predictors were not significant. In total, the model explained 45% of the variance of plastic consumption in July.

Policy support was predicted by problem awareness, pro-environmental identity, and perceived barriers. People who had a strong pro-environmental identity and a high problem awareness and who perceived more barriers in plastic consumption were more likely to support politics. Together, the three variables explained 24% of the variance of policy support. Policy support and plastic consumption at the end of July were slightly correlated (r = - 0.19).

To explore the interaction between group and pro-environmental identity in more detail, we conducted t-tests. For participants with a strong pro-environmental identity (above the mean), the experimental and control groups did not differ in plastic consumption in July (t[252] = -0.126, p = 0.21, M_E = 1.97, M_C = 2.02, d_{Coh} = 0.150). For those with weak pro-environmental identity (below the mean), participants in the experimental group purchased less plastic than participants in the control group (t[109] = -0.313, p < 0.05, d_{Coh} = 0.621, M_E = 2.10, M_C = 2.29). Thus, we found evidence that the intervention was only effective for participants with low pro-environmental identity (see Figure 9).

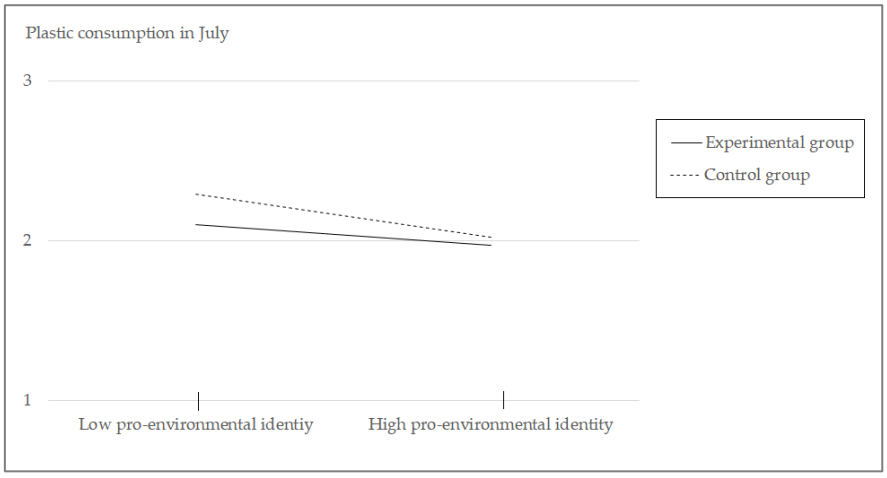

Figure 9 Interaction effect of pro-environmental identity and group allocation on plastic consumption in July

Discussion

This study analyzed if people reduce their single-use plastic consumption when the month of July is presented as an action month for behavior change in plastic purchase. Results revealed that participants to whom the idea of 'Plastic Free July' was presented used slightly, but significantly less plastic than those without any intervention. However, the intervention was more effective for participants with low pro-environmental identity, as group differences for plastic consumption in July were only found among participants with low pro-environmental identity. This indicates the importance of considering the target group to increase the effect of a campaign. The strongest predictor for initial plastic consumption before the intervention was the perceived difficulty of plastic-free purchase. Perceived difficulty also remained a stable predictor of plastic consumption during the intervention. This coincides with the result that the strongest barrier named by study participants was a perceived lack of plastic-free alternatives. This means that, in order to enable consumers to reduce their plastic consumption, barriers should be reduced and more plastic-free alternatives should be created.

Policy support was more likely when people had a strong pro-environmental identity, when they showed high problem awareness concerning plastic pollution, and when they perceived being exposed to external barriers of plastic consumption. Thus, a normative concern appears to be an important base to support policy regulation. Note that perceived difficulties and habits, which were strong predictors of plastic consumption, did not predict policy support. This result is highly plausible, because the difficulties in buying plastic free and habits in plastic consumption are theoretically relevant for plastic consumption but not for policy support. By contrast, moral and normative concerns as reflected in pro-environmental identity are relevant for both outcomes.

The strong role of perceived difficulty to predict plastic consumption is similar to other studies in the context of pro-environmental behavior by which the perceived behavior control was a prominent predictor of different ecological behaviors (Bamberg & Möser, 2007). However, when having a closer look at specific barriers that impede plastic consumption, they

slightly differ from other pro-environmental consumption patterns, such as purchasing organic food. While the price was the strongest barrier to consuming organic food (Bryła, 2016; Van Doorn & Verhoef, 2015; Vittersø & Tangeland, 2015), it appears to be only in a second place for plastic-free purchase. In addition, missing offers of plastic-free alternatives were by far the strongest barrier for plastic-free purchase, while availability of organic food was only a barrier for one-third in a Polish sample (Bryła, 2016) and was considered to be improved in Norway in the last decade (Vittersø & Tangeland, 2015). While organic food is available in ordinary supermarkets in the meanwhile, plastic-free consumption often requires new purchase patterns associated with more time effort, an inconvenient transport, and more interaction with the seller. Furthermore, conflicts between different ecological criteria, such as the choice between plastic waste versus food waste (Allen, Clifford, & Atkinson, 2019), which has been perceived as a barrier in the form of limited shelf life in this study, makes the reduction of plastic packaging a more complex issue. It implies the need for more convenient and ecofriendly solutions in plastic-free consumption offers.

Periods of Change

Framing a random month as a period of change for plastic consumption revealed significant effects and reduced single-use plastic consumption in the experimental group. However, these effects were quite small. Different explanations for this finding are plausible.

First, the intervention used information including a short problem description and practical advices on how to reduce single-use plastic. When performing habitual behavior such as consumption pattern, incoming information can be suppressed when not fitting one's habitual behavior (Aarts, Verplanken, & Van Knippenberg, 1998; Verplanken, Aarts, & Van Knippenberg, 1997). A campaign solely based on information can thus struggle to change habitual behavior. Although this intervention exceeded an information campaign, information was a focal point and might have reached only subgroups of participants.

Second, the main idea of the intervention was to create a 'window of opportunity' by framing a month as an action period of change. In previous studies, successful 'windows of opportunity' (e.g., moving to another city or having a child) were characterized by an obviously salient and inherent change (Schäfer et al., 2012). This was not given in the present intervention as the period of change was only based on construction of thought. While this has successfully worked for the fasting period where people reduced their plastic consumption in the 40 days before Easter (Heidbreder & Schmitt, 2020), July as an action month for change might be less embedded in tradition and people's minds. This interpretation is supported by the result that those participants who had perceived July as a good opportunity for change reduced their plastic consumption somewhat stronger. In consequence, one might need to make change more salient in such a random period. About 65% perceived it as a barrier that their close environment did not purchase plastic-free. This means, the presence of other people also taking part in a challenge might be crucial to make change salient. Future studies could explore the role of social and societal norms for creating a 'window of opportunity.'

Third, habits are reactions to stable circumstances (e.g., routinely doing weekly groceries in a supermarket that is situated on the way home). To break old habits, it is decisive to change such stable circumstances. The present intervention did not change such physical circumstances. Considering the mentioned barriers in the present study (e.g., time effort, missing offers), the restructuring and implementation of a new plastic-free section in the supermarket would eliminate such barriers while sparing changes of the shopping location. Simultaneously, the new presentation of products can interrupt routines of purchase by changing the circumstances within the supermarket. As the stable circumstances are not well specified in the current literature (Kurz et al., 2015), a combination of physical change of circumstances (e.g., new sections in supermarket) and change in mindset of the situation (e.g., fasting period or action month) as well as the process behind should be evaluated in future research.

Limitations

The intervention used in the present study was similar, but not identical to the original campaign 'Plastic Free July'. Thus, this study did not serve as an evaluation of the original campaign nor did it measure impact in the form of reduced plastic waste. It rather picked up the idea of a random action month and evaluated if people who have not heard of this idea before would change their behavior accordingly. In the original campaign, people gain access to a website where they can interact with others and get information about plastic pollution and action steps. One can expect that people taking part in such a challenge are already intrinsically motivated to change their plastic consumption. In this study, information material about action steps were based on the original Plastic Free July campaign but were presented to the participants only once. Thus, it seems reasonable that the present intervention has created only small effects.

Furthermore, the manipulation check failed as participants in the experimental group did not perceive July as a more special month than participants in the control group. This suggests that, in future applications of the treatment for research or intervention purposes, a more explicit frame of the upcoming 'window of opportunity' as a special time or a transition period might be advantageous and strengthen the treatment effect. However, this recommendation is conditional upon the validity of the validation check item we employed. Its significant correlation with plastic consumption in July ($r = - 0.29$) suggests some validity. Nevertheless, the item was probably not designed sufficiently well as it required an abstract interpretation of participants (i.e., perception of a good phase of change) rather than testing differences between the groups given by the intervention material. It might have been better to ask for differences in knowledge about information that was given only to the experimental group.

Scale reliability was somewhat low for plastic consumption and habits (< 0.70). Note, however, that low reliability can go along with sufficient validity if a relatively short measure is used for a broad construct including different facets. Pro-environmental identity, on the other hand, was measured with a single item only. This was due to economic reasons. Note,

however, that despite this limitation, pro-environmental identity was a significant predictor of both outcome variables. Nevertheless, we suggest to use a multiple-item scale in future studies (e.g., the Environmental Identity Scale (Olivos & Aragonés, 2011)) to replicate the interaction effect between group affiliation and pro-environmental identity.

Another limitation might lay in the time period itself. As July is predestinated for holidays (one fourth stated to have holiday plans during this period in this study), it might have counteracted the intervention. As holidays are kind of special periods during the year, people might have more difficulties to live with less plastic being in another country with even less opportunities or the feeling of less responsibility during this time of the year (Whitmarsh, Haggar, & Thomas, 2018). On the other hand, when the study was conducted, media attention towards the topic of plastic pollution (and, in accordance, problem awareness) was quite high and might have supported an overall willingness to reduce plastic consumption. Note, however, that the intervention effects cannot have been biased by prior knowledge of the campaign, since the idea of a 'Plastic Free July' was unknown by 95% of participants in the control group.

Looking at the behavioral output of this study, some might also argue that a solution offering only small actions steps (e.g., taking a rucksack instead of a plastic bag) is not that noteworthy. Taking lifestyle (e.g., zero-waste lifestyle) into account might have a bigger environmental impact (Arnold, Kibbe, Hartig, & Kaiser, 2018; Kaiser & Wilson, 2004). However, the feeling of being capable to show a certain behavior is quite important, and presenting concrete action steps seemed to be effective for people with low environmental consciousness at least. Further studies should examine if the technique of 'foot-in-the-door' (Freedman & Fraser, 1966) might work for plastic-free purchase, starting with small steps to get people to comply with larger challenges.

Implications

Although the intervention in the present study was not able to encourage great leaps of behavioral change, people with low pro-environmental identity who were less prone to a zero-waste

lifestyle moved their plastic consumption towards those with a high pro-environmental identity, when they were in the experimental condition. This might indicate that this kind of 'low-threshold' intervention based on one practical advice can have an impact on a less concerned target group which is often difficult to reach. Furthermore, people in different behavioral stages might need different interventions to progress (Bamberg, 2013). While people with high intention to reduce plastic (which can be expected from people with high pro-environmental identity) need support in planning and implementing their goals, people who have not generated such a strong will might already show progress by awareness campaigns and 'low-threshold' advices as employed in the present study. Presumably, different target groups experience different barriers and respond differently to information-based interventions (Gifford, 2011).

Overall, participants indicated a high problem awareness regarding plastic pollution which corresponds to surveys of the general public (UBA, 2017; Veiga et al., 2016). As plastic-related problems, such as marine pollution and loss of biodiversity, were rated as more severe than health impact or aesthetic burdens of plastic pollution, persuasive communication aiming to change people's attitude might more focus on topics of ecological impact rather than personal consternation. Same as for problem awareness, the approval rate for policy support was quite high and problem awareness served as an important predictor for policy support. This means that that we face a 'window of opportunity' that makes change in political regulations and offers quite profitable, as high acceptance of consumers can be expected. Thereby, policy support was independent of consumers' own behavior. Retailers and politics should take advantage of this high problem awareness and policy support in public. In particular, the results of the present study show that bans and taxes were highly accepted. Having the ecological impact in mind, offering ecological alternatives is likewise important. A ban of plastic bags could lead to an increase of other bags that are not even better but perceived as more ecological friendly (Synthia & Kabir, 2015). This misdirection has to be considered when banning plastic products. Offering ecological friendly alternatives (which might also be a complete removal of

plastic packaging) and providing appropriate information are decisive. Referring to information, an app that labels plastic-free products was only supported by one-third of participants. A reason for this might be a shift of responsibility from consumers towards political regulations. An app would offer more transparency but still leaves consumers in the responsibility to choose a product.

Although consumers are offered a variety of choices for their purchase, in terms of plastic-free packaging, oftentimes, there is a lack of alternatives. In addition, 75% in the present study's sample indicated time and costs as a barrier for plastic-free purchase. Thus, the crucial point is to make convenient plastic-free offers available in an appropriate price framework and as little time-consuming as the original product (Beitzen-Heineke, Balta-Ozkan, & Reefke, 2017). Good alternatives should become available in habitual shopping facilities such as supermarkets. Moreover, the demand for hygiene should be considered. Although it was not mentioned as the most relevant barrier, the majority of participants mentioned hygiene as a barrier of middle range. In addition, people were cautious with regard to plastic-free alternatives in the hygienic area (e.g., using a wooden toothbrush). This means that product marketing of plastic-free alternatives should take hygienic aspects particularly into account.

Changing habitual consumption patterns in the context of plastic remains challenging. Perceived structural barriers, such as a lack of plastic-free alternatives for conventional products, are important to tackle when striving for behavioral change. However, psychological barriers, such as habits, have to be considered, too. To get people started, periods in which change is salient can help to disrupt people's daily routines. An arbitrary month such as 'Plastic Free July' has to be accepted as a good opportunity to become such a promising phase of change. Combining a phase of change with convenient offers (and providing information about them) to reduce barriers might be a good strategy for successful campaigns to encourage a reduction of single-use plastic consumption.

Supplementary Materials

The following are available online at www.mdpi.com/xxx/s1, Data: Open Data

Author Contributions

Conceptualization, L.H.; methodology, L.H.; formal analysis, L.H.; investigation, L.H.; data curation, L.H.; writing – original draft preparation, L.H.; writing – review and editing, J.S. and M.S.; visualization, L.H.; supervision, M.S.; project administration, M.S. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Appendix

Questionnaire

SURVEY I & II

Consumption (1 = 'not consumed', 2 = 'consumed')

'Thinking of your last week: How many of these products have you consumed during the last week? '
Bh11: fruits & vegetables (e.g., apples, carrots)
Bh12: fresh products (e.g., milk, yoghurt, sausage)
Bh13: dry products (e.g., noodles, cereals)
Bh14: beverages (e.g., juice, water, soft drinks)
Bh15: pastries (e.g., cake, bread)
Bh16: snacks (e.g., chips, chocolate)
Bh17: food to go (e.g., kebab, pizza)
Bh18: drinks to go (e.g., coffee-to-go, cola)
Bh19: cosmetics and sanitary products (e.g., deodorant, shower gel)
Bh110: household goods (e.g., detergent, cleaning agent)

Plastic consumption (1 = 'all without plastic', 2 = 'partially in plastic', 3 = 'all with plastic', NA = 'not bought at all')

'How much of your fruits and vegetables have you bought in plastic(packaging) during the last week (e.g., apples in a plastic bag)?'
Cat11a: pressure-sensitive fruit, e.g., berries
Cat12a: less pressure-sensitive fruit, e.g. apples
Cat13a: pressure-sensitive vegetables, e.g. tomatoes
Cat14a: less pressure-sensitive vegetables, e.g. pumpkins

'How much of your fresh products have you bought in plastic (packaging) during the last week (e.g., milk in a Tetra Pak)?'
Cat11b: milk products, e.g., milk, yoghurt, quark
Cat12b: milk substitute, e.g., oat milk, soy yoghurt
Cat 13b: cheese, cream cheese
Cat 14b: sausage, meat
Cat 15b: convenience food (e.g., tortellini)

'How much of your dry products have you bought in plastic(packaging) during the last week (e.g., cereals in plastic packaging)?'
Cat11c: side dishes and legumes, e.g. noodles, rice, millet, couscous, quinoa, lentils
Cat12c: cereals, e.g., muesli, oat flakes, cornflakes, amaranth
Car13c: nuts, nuts and raisins, dry fruits
Car14c: baking ingredients, e.g., flour, baking soda, vanilla sugar
Car15c: tea, coffee

'How much of your beverages have you bought in plastic(packaging) during the last week (e.g., PET-bottle)?'
Cat11d: water
Cat12d: juice
Cat13d: soft drinks, e.g., cola
Cat 14d: alcoholic drinks

'How much of your pastries have you bought in plastic(packaging) during the last week (e.g., pre-baked bread rolls in plastic packaging)?'
Cat11e: bread
Cat12e: bread rolls, baguettes
Cat13e: sweet pastries, cake
Cat14e: hearty pastries, e.g., pretzels

'How much of your snacks have you bought in plastic(packaging) during the last week (e.g., chocolate bar in plastic packaging)?'
Cat11f: sweets, e.g. bonbons
Cat12f: nibbles, e.g. chips

'How much of your food on the go have you bought in plastic(packaging) during the last week (e.g., chocolate bar in plastic packaging)?'
Cat11g: hearty food, e.g., kebab
Cat12g: sweet food, e.g., ice cream
'How much of your drinks on the go have you bought in plastic(packaging) during the last week (e.g., coffee in a to-go mug)?'
Cat11h: hot drinks, e.g., coffee
Cat12h: cold drinks, e.g., cola

'How much of your cosmetics have you bought in plastic(packaging) during the last week (e.g., a plastic toothbrush or shampoo in a plastic bottle)?'
Cat11i: shampoo, soap, conditioner
Cat12i: make-up
Cat13i: deodorant, sanitary products
Cat14i: toothpaste, toothbrush

'How much of your housewares have you bought in plastic(packaging) during the last week (e.g., cleaning agent in a plastic bottle or a plastic dishwashing brush)?'
Cat11j: washing powder, detergent
Cat12j: cleaning agent
Cat13j: sponges, cleaning rags, brushes

SURVEY I

Perceived difficulty (from 1 – 'It's easy for me' to 5 – 'It's hard for me')

'How easy or difficult is it for you in daily life to consume the following products without plastic?'
Dif11: fruits & vegetables
Dif12: fresh products
Dif13: dry products
Dif14: beverages
Dif15: pastries
Dif16: snacks
Dif17: food-to-go
Dif18: drinks-to-go
Dif19: cosmetics
Dif110: household goods

Problem awareness (from 1 – 'no problem' to 5 – 'very big problem')

'Do you consider the following aspects as very big problem, rather big problem, rather no problem or no problem?'
Pa11: plastic waste in the ocean
Pa12: plastic in soil
Pa13: species extinction through plastic in the environment

Pa14: aesthetic burden through plastic in the environment
Pa15: health impairment caused by plastic
Pa16: energy and resource use of plastic production
Pa17: increase of climate change from plastic
Pa18: social inequality in terms of plastic production and disposal

Pro-environmental identity (from 1 – 'strongly disagree' to 5 – 'strongly agree')

'How far do you agree with the following statement?'
Env: I see myself as an environmental conscious person.

Habits (from 1 – 'strongly disagree' to 5 – 'strongly agree')

'To buy products without plastic is something...'
Hb11: … I start doing before I realize I'm doing it.
Hb12: … I do without having consciously remember.
Hb13: … that makes me feel weird. (r)
Hb14: … that requires effort. (r)
Hb15: … I would find hard not to do.
Hb16: … I do automatically.
Hb17: … that's typically me.
Hb18: … I do without thinking.

Intention [experimental group only] (from 1 – 'strongly disagree' to 5 – 'strongly agree')

'How far do you agree with the following statement?'
In1: I plan to reduce my plastic consumption during July.

Advices [experimental group only] (1 = 'yes', 2 = 'maybe', 3 = 'no', -1 = 'I'm doing it already')

'We have different opportunities to reduce plastic consumption in daily life. Thinking about the next four weeks in July, will you try the following ideas?'
Tip11: taking a bag or rucksack
Tip12: drinking tapped water
Tip13: going to a zero-waste shop
Tip14: using wax cloth instead of plastic wrap
Tip15: using a menstrual cup
Tip16: using a wooden tooth-brush
Tip17: buying soap or shampoo in a piece
Tip18: using reusable dishes for barbecue
Tip19: buying milk or yoghurt in glass container
Tip110: producing food by oneself

SURVEY II

Perceived barriers (ranking: 1 – strongest barrier up to 8 – lowest barrier, NA = not perceived as barrier)

'What keeps you from consuming (more) products without plastic in daily life? Please sort the following aspects. The strongest barrier should appear first. If an aspect does not represent a barrier to you, please leave it aside.'
Ba21: missing offers of plastic-free alternatives
Ba22: higher costs
Ba23: inconvenient transport
Ba24: missing hygiene
Ba25: time requirement
Ba26: limited shelf life
Ba27: too much interaction with the seller
Ba28: close circle that purchases differently

Policy support (from 1 – 'strongly disagree' to 5 – 'strongly agree')

'How far do you agree with the following statement?'
Ps21: I would use an app that shows plastic-free products.
Ps22: I would use a label that shows plastic-free products.
Ps23: I would use a deposit system for to-go-packaging (e.g., for pizza).
Ps24: I would use a deposit system for container at the counter (e.g., for cheese or sausage)
PS25: I would support a tax of single-use plastic products.
PS:26: I would support a ban of single-use plastic products (e.g., straws or balloons).
PS27: By political regulation, I feel restricted in my personal freedom.

References

Aarts, H., Verplanken, B., & Van Knippenberg, A. (1998). Predicting Behavior From Actions in the Past: Repeated Decision Making or a Matter of Habit ? *Journal of Applied Social Psychology*, *28*(15), 1355–1374.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Allen, M., Clifford, J., & Atkinson, D. (2019). Exploring consumers reliance on plastic in fresh food packaging: Adding to the waste? *Economic and Social Development: Book of Proceedings*, 15–27.

Ariely, B. D., Bracha, A., & Meier, S. (2009). Doing Good or Doing Well ? Image Motivation and Monetary Incentives in Behaving Prosocially. *American Economic Review*, *99*(1), 544–555.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, *40*(4), 471–499. https://doi.org/10.1348/014466601164939

Arnold, O., Kibbe, A., Hartig, T., & Kaiser, F. G. (2018). Capturing the Environmental Impact of Individual Lifestyles: Evidence of the Criterion Validity of the General Ecological Behavior Scale. *Environment and Behavior*, *50*(3), 350–372. https://doi.org/10.1177/0013916517701796

Bamberg, S. (2006). Is a residential relocation a good opportunity to change people's travel behavior? Results from a theory-driven intervention study, *38*(6), 820–840. https://doi.org/10.1177/0013916505285091

Bamberg, S. (2013). Applying the stage model of self-regulated behavioral change in a car use reduction intervention. *Journal of Environmental Psychology*, *33*, 68–75. https://doi.org/10.1016/j.jenvp.2012.10.001

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, *27*(1), 14–25. https://doi.org/10.1016/j.jenvp.2006.12.002

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz, and Triandis. *Environment and Behavior*, *35*(2), 264–285.

Bates, C. H. (2010). Use of social marketing concepts to evaluate ocean sustainability campaigns. *Social Marketing Quarterly*, *16*(1), 71–96. https://doi.org/10.1080/15245000903528357

Beaumont, N. J., Aanesen, M., Austen, M. C., Börger, T., Clark, J. R., Cole, M., … Wyles, K. J. (2019). Global ecological, social and economic impacts of marine plastic. *Marine Pollution Bulletin*, *142*, 189–195. https://doi.org/10.1016/j.marpolbul.2019.03.022

Beitzen-Heineke, E. F., Balta-Ozkan, N., & Reefke, H. (2017). The prospects of zero-packaging grocery stores to improve the social and environmental impacts of the food supply chain. *Journal of Cleaner Production*, *140*, 1528–1541. https://doi.org/10.1016/j.jclepro.2016.09.227

Bolderdijk, J. W., Steg, L., Geller, E. S., Lehman, P. K., & Postmes, T. (2012). Comparing the effectiveness of monetary versus moral motives in environmental campaigning. *Nature Climate Change*, *3*(4), 413–416. https://doi.org/10.1038/nclimate1767

Bradu, C., Orquin, J. L., & Thøgersen, J. (2014). The Mediated Influence of a Traceability Label on Consumer's Willingness to Buy the Labelled Product. *Journal of Business Ethics*, *124*(2), 283–295. https://doi.org/10.1007/s10551-013-1872-2

Brown, P. M., & Cameron, L. D. (2000). What can be done to reduce overconsumption? *Ecological Economics*, *32*(1), 27–41. https://doi.org/10.1016/S0921-8009(99)00093-2

Bryła, P. (2016). Organic food consumption in Poland: Motives and barriers. *Appetite*, *105*, 737–746. https://doi.org/10.1016/j.appet.2016.07.012

Chan, D. K., & Fishbein, M. (1993). Determinants of College Women's Intentions to Tell Their Partners to Use Condoms. *Journal of Applied Social Psychology*, *23*(18), 1455–1470. https://doi.org/10.1111/j.1559-1816.1993.tb01043.x

Cheung, S. F., Chan, D. K. S., & Wong, Z. S. Y. (1999). Reexamining the theory of planned behavior in understanding wastepaper recycling. *Environment and Behavior*, *31*(5), 587–612. https://doi.org/10.1177/00139169921972254

Cózar, A., Echevarría, F., González-Gordillo, J. I., Irigoien, X., Úbeda, B., Hernández-León, S., … Duarte, C. M. (2014). Plastic debris in the open ocean. *Proceedings of the National Academy of Sciences of the United States of America*, *111*(28), 10239–10244. https://doi.org/10.1073/pnas.1314705111

De Groot, J. I. M., & Steg, L. (2009). Mean or green: which values can promote stable pro-environmental behavior? *Conservation Letters*, *2*(2), 61–66. https://doi.org/10.1111/j.1755-263X.2009.00048.x

Dunning, D. (2007). Self-image motives and consumer behavior: How sacrosanct self-beliefs sway preferences in the marketplace. *Journal of Consumer Psychology*, *17*(4), 237–249. https://doi.org/10.1016/S1057-7408(07)70033-5

European Commission. (2018). *Proposal for a Directive of the European Parliament and of the Council on the Reduction of the Impact of Certain Plastic Products on the Environment* (Vol. 0172). https://doi.org/COM(2018) 340 final 2018/0172 (COD)

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford: University Press.

Fielding, K. S., McDonald, R., & Louis, W. R. (2008). Theory of planned behaviour, identity and intentions to engage in environmental activism. *Journal of Environmental Psychology*, *28*(4), 318–326.

Fox, J., Nie, Z., Byrnes, J., Culbertson, M., DebRoy, S., Friendly, M., & Fox, M. J. (2017). Package 'sem.'

Freedman, J. I., & Fraser, S. C. (1966). Compliance Without Pressure. *Journal of Personality and Social Psychology*, *4*(2), 195–202. https://doi.org/10.1037/h0025009

Fuji, S., & Gärling, T. (2003). Development of script-based travel mode choice after forced change. *Transportation Research Part F: Traffic Psychology and Behaviour*, *6*(2), 117–124.

Galloway, T. S., Cole, M., & Lewis, C. (2017). Interactions of microplastics throughout the marine ecosystem. *Nature Ecology and Evolution*, *1*(5), 1–8. https://doi.org/10.1038/s41559-017-0116

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, *3*(7), 1–5. https://doi.org/10.1126/sciadv.1700782

Gifford, R. (2011). The Dragons of Inaction: Psychological Barriers That Limit Climate Change Mitigation and Adaptation. *American Psychologist*, *66*(4), 290–302. https://doi.org/10.1037/a0023566

Gillison, F., Standage, M., & Verplanken, B. (2014). A cluster randomised controlled trial of an intervention to promote healthy lifestyle habits to school leavers: Study rationale, design, and methods. *BMC Public Health*, *14*(1), 1–9. https://doi.org/10.1186/1471-2458-14-221

Gkargkavouzi, A., Halkos, G., & Matsiori, S. (2019). Environmental behavior in a private-sphere context: Integrating theories of planned behavior and value belief norm, self-identity and habit. *Resources, Conservation and Recycling*, *148*(145–156). https://doi.org/10.1016/j.resconrec.2019.01.039

Haggar, P., Whitmarsh, L., & Skippon, S. M. (2019). Habit discontinuity and student travel mode choice. *Transportation Research Part F: Traffic Psychology and Behaviour*, *64*, 1–13. https://doi.org/10.1016/j.trf.2019.04.022

Hartley, B. L., Pahl, S., Veiga, J., Vlachogianni, T., Vasconcelos, L., Maes, T., … Thompson, R. C. (2018). Exploring public views on marine litter in Europe: Perceived causes, consequences and pathways to change. *Marine Pollution Bulletin*, *133*, 945–955. https://doi.org/10.1016/j.marpolbul.2018.05.061

Heidbreder, L. M., Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of the Total Environment*, *668*, 1077–1093. https://doi.org/10.1016/j.scitotenv.2019.02.437

Heidbreder, L. M., & Schmitt, M. (2020). Fasting Plastic – an Intervention Study to break Habits of Plastic Consumption. *Psyecology*. https://doi.org/10.1080/21711976.2020.1728652

Honkanen, P., & Verplanken, B. (2004). Understanding Attitudes Towards Genetically Modified Food: The Role of Values and Attitude Strength. *Journal of Consumer Policy*, *27*, 401–420.

Honkanen, Pirjo, Verplanken, B., & Olsen, S. O. (2006). Ethical values and motives driving organic food choice. *Journal of Consumer Behaviour*, *5*, 420–430.

Jager, W. (2003). Breaking 'bad habits': a dynamical perspective on habit formation and change. In L. Hendrickx, W. Jager, & L. Steg (Eds.), *Human Decision Making and Environmental Perception. Understanding and Assisting Human Decision Making in Real-life Settings* (University). Groningen.

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

https://doi.org/10.1126/science.1260352

Kaiser, F. G., & Wilson, M. (2004). Goal-directed conservation behavior: The specific composition of a general performance. *Personality and Individual Differences*, *36*(7), 1531–1544. https://doi.org/10.1016/j.paid.2003.06.003

Klöckner, C. A. (2013). A comprehensive model of the psychology of environmental behaviour - A meta-analysis. *Global Environmental Change*, *23*(5), 1028–1038. https://doi.org/10.1016/j.gloenvcha.2013.05.014

Klöckner, C. A., & Blöbaum, A. (2010). A comprehensive action determination model: Toward a broader understanding of ecological behaviour using the example of travel mode choice. *Journal of Environmental Psychology*, *30*(4), 574–586. https://doi.org/10.1016/j.jenvp.2010.03.001

Kurz, T., Gardner, B., Verplanken, B., & Abraham, C. (2015). Habitual behaviors or patterns of practice? Explaining and changing repetitive climate-relevant actions. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(1), 113–128. https://doi.org/10.1002/wcc.327

Leiner, D. J. (2016). SoSci Survey (Version 2.6.00) [Computer Software]. Retrieved from https://www.soscisurvey.de

Li, W. C., Tse, H. F., & Fok, L. (2016). Plastic waste in the marine environment: A review of sources, occurrence and effects. *Science of the Total Environment*, *566*, 333–349. https://doi.org/10.1016/j.scitotenv.2016.05.084

Little, D. (1991). Rational-Choice Models and Asian Studies. *The Journal of Asian Studies*, *50*(1), 35–52.

Mazar, N., Amir, O., & Ariely, D. (2008). The Dishonesty of Honest People: A Theory of Self-Concept Maintenance. *Journal of Marketing Research*, *45*(6), 633–644. https://doi.org/10.1509/jmkr.45.6.633

Müggenburg, H., Busch-Geertsema, A., & Lanzendorf, M. (2015). Mobility biographies: A review of achievements and challenges of the mobility biographies approach and a framework for further research. *Journal of Transport Geography*, *46*, 151–163.

Nigbur, D., Lyons, E., & Uzzell, D. (2010). Attitudes, norms, identity and environmental behaviour: Using an expanded theory of planned behaviour to predict participation in a kerbside recycling programme. *British Journal of Social Psychology*, *49*(2), 259–284. https://doi.org/10.1348/014466609X449395

Olivos, P., & Aragonés, J. I. (2011). Psychometric properties of theEnvironmental Identity Scale (EID). *Psyecology*, *2*(1), 65–74.

PlasticsEurope. (2019). *Plastics - the Facts 2019*. Retrieved from https://www.plasticseurope.org/application/files/1115/7236/4388/FINAL_web_version_Plastics_the_facts2019_14102019.pdf

Revelle, W. (2018). psych: Procedures for Personality and Psychological Research. Retrieved from https://cran.r-project.org/package=psychVersion=1.8.12.

Risch, S. J. (2009). Food Packaging History and Innovations. *Journal of Agricultural and Food Chemistry*, *57*(18), 8089–8092. https://doi.org/10.1021/jf900040r

Rise, J., Sheeran, P., & Hukkelberg, S. (2010). The role of self-identity in the theory of planned behavior: A meta-analysis. *Journal of Applied Social Psychology*, *40*(5), 1085–1105. https://doi.org/10.1111/j.1559-1816.2010.00611.x

Ritch, E., Brennan, C., & MacLeod, C. (2009). Plastic bag politics : modifying consumer behaviour for sustainable development. *International Journal of Consumer Studies*, *33*, 168–174. https://doi.org/10.1111/j.1470-6431.2009.00749.x

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, *48*(2), 1–36. https://doi.org/http://www.jstatsoft.org/v48/i02/

Schäfer, M., & Bamberg, S. (2008). Breaking habits: Linking sustainable consumption campaigns to sensitive life events. In *Proceedings sustainable consumption and production: Framework for action, conference of the sustainable consumption research exchange* (pp. 213–228).

Schäfer, M., Jaeger-Erben, M., & Bamberg, S. (2012). Life Events as Windows of Opportunity for Changing Towards Sustainable Consumption Patterns? *Journal of Consumer Policy*, *35*(1), 65–84. https://doi.org/10.1007/s10603-011-9181-6

Schultz, P. W. (2014). Strategies for promoting proenvironmental behavior: Lots of tools but few instructions. *European Psychologist*, *19*(2), 107–117. https://doi.org/10.1027/1016-9040/a000163

Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (pp. 221–279). San Diego: Academic Press.

Sparks, P., & Shepherd, R. (1992). Self-Identity and the Theory of Planned Behavior: Assesing the Role of Identification with "Green Consumerism." *American Sociological Association*, *55*(4), 388–399.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. C. (2000). Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, *56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175

Synthia, I. J., & Kabir, S. (2015). An Investigation of Consumer Attitudes Towards New Varieties of Shopping Bags: Exploring Eco-Awareness and the Possibility of Behavior Change. *The Journal of Developing Areas*, *49*(5), 183–196. https://doi.org/10.1353/jda.2015.0062

Terry, D. J., Hogg, M. A., & White, K. M. (1999). The theory of planned behaviour : Self- Identity, social identity and group norms. *British Journal of Social Psychology*, *38*(3), 225–244. https://doi.org/10.1348/014466699164149

Thøgersen, J., & Møller, B. (2008). Breaking car use habits: The effectiveness of a free one-month travelcard. *Transportation*, *35*(3), 329–345.

Thøgersen, John. (2005). How may consumer policy empower consumers for sustainable lifestyles? *Journal of Consumer Policy*, *28*(2), 143–177. https://doi.org/10.1007/s10603-005-2982-8

Thøgersen, John. (2006). Understanding repetitive travel mode choices in a stable context: A panel study approach. *Transportation Research Part A: Policy and Practice*, *40*(8), 621–638. https://doi.org/10.1016/j.tra.2005.11.004

Thomas, G. O., Fisher, R., Whitmarsh, L., Milfont, T. L., & Poortinga, W. (2018). The impact of parenthood on environmental attitudes and behaviour: a longitudinal investigation of the legacy hypothesis. *Population and Environment*, *39*(3), 261–276.

Thomas, G. O., Poortinga, W., & Sautkina, E. (2016). Habit discontinuity, self-activation, and the diminishing influence of context change: evidence from the UK understanding society survey. *PLoS ONE*, *11*(4). https://doi.org/10.1371/journal.pone.0153490

Thompson, R. C., Moore, C. J., vom Saal, F. S., & Swan, S. H. (2009). Plastics, the environment and human health: current consensus and future trends. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 2153–2166. https://doi.org/10.1098/rstb.2009.0053

Tonglet, M., Phillips, P. S., & Read, A. D. (2004). Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: A case study from Brixworth, UK. *Resources, Conservation and Recycling*, *41*(3), 191–214. https://doi.org/10.1016/j.resconrec.2003.11.001

UBA. (2017). *Umweltbewusstsein in Deutschland 2016*. Retrieved from https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/umweltbewusstsein_deutschland_2016_bf.pdf

Van Doorn, J., & Verhoef, P. C. (2015). Drivers of and barriers to organic purchase behavior. *Journal of Retailing*, *91*(3), 436–450. https://doi.org/10.1016/j.jretai.2015.02.003

Vandenberg, R. J., & Lance, C. E. (2000). A Review and Synthesis of the Measurement Invariance Literature: Suggestions, Practices, and Recommendations for Organizational Research. *Organizational Research Methods*, *3*(1), 4–70. https://doi.org/10.1177/109442810031002

Veiga, J. M., Vlachogianni, T., Pahl, S., Thompson, R. C., Kopke, K., Doyle, T. K., … Alampei, I. (2016). Enhancing public awareness and promoting co-responsibility for marine litter in Europe: The challenge of MARLISCO. *Marine Pollution Bulletin*, *102*(2), 309–315. https://doi.org/10.1016/j.marpolbul.2016.01.031

Vermeir, I., & Verbeke, W. (2008). Sustainable food consumption among young adults in Belgium: Theory of planned behaviour and the role of confidence and values. *Ecological Economics*, *64*(3), 542–553. https://doi.org/10.1016/j.ecolecon.2007.03.007

Verplanken, B, Aarts, H., & Van Knippenberg, A. (1997). Habit, information acquisition, and the process of making travel mode choices. *European Journal of Social Psychology*, *27*(5), 539–560. https://doi.org/10.1002/(sici)1099-0992(199709/10)27:5<539::aid-ejsp831>3.0.co;2-a

Verplanken, Bas. (2012). Old Habits and New Routes to Sustainable Behaviour. In O. Whitmarsh, I. Lorenzoni, & S. O'Neill (Eds.), *Engaging the Public with Climate Change* (pp. 43–56). London: Routledge. https://doi.org/10.4324/9781849775243

Verplanken, Bas, & Aarts, H. (1999). Habit, attitude, and planned behaviour: is habit an empty construct or an interesting case of goal-directed automaticity? *European Review of Social Psychology*, *10*(1), 101–134. https://doi.org/10.1080/14792779943000035

Verplanken, Bas, & Orbell, S. (2003). Reflections on Past Behavior: A Self-Report Index of Habit Strength1. *Journal of Applied Social Psychology*, *33*(6), 1313–1330. https://doi.org/10.1111/j.1559-1816.2003.tb01951.x

Verplanken, Bas, & Roy, D. (2015). Sustainable Consumption . Elgar Original Reference . Edward Opus : University of Bath Online Publication Store 15 . Consumer habits and sustainable consumption, 243–253.

Verplanken, Bas, & Roy, D. (2016). Empowering interventions to promote sustainable lifestyles: Testing the habit discontinuity hypothesis in a field experiment. *Journal of Environmental Psychology*, *45*, 127–134. https://doi.org/10.1016/j.jenvp.2015.11.008

Verplanken, Bas, Walker, I., Davis, A., & Jurasek, M. (2008). Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology*, *28*(2), 121–127. https://doi.org/10.1016/j.jenvp.2007.10.005

Verplanken, Bas, & Wood, W. (2006). Interventions to Break and Create Consumer Habits. *American Marketing Associationarketing Association*, *25*(1), 90–103. https://doi.org/10.1509/jppm.25.1.90

Vittersø, G., & Tangeland, T. (2015). The role of consumers in transitions towards sustainable food consumption. The case of organic food in Norway. *Journal of Cleaner Production*, *92*, 91–99. https://doi.org/10.1016/j.jclepro.2014.12.055

Walker, I., Thomas, G. O., & Verplanken, B. (2015). Old Habits Die Hard: Travel Habit Formation and Decay During an Office Relocation. *Environment and Behavior*, *47*(10), 1089–1106. https://doi.org/10.1177/0013916514549619

Whitmarsh, L., Capstick, S., & Nash, N. (2017). Who is reducing their material consumption and why? A cross-cultural analysis of dematerialization behaviours. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *375*(2095). https://doi.org/10.1098/rsta.2016.0376

Whitmarsh, L. E., Haggar, P., & Thomas, M. (2018). Waste reduction behaviors at home, at work, and on holiday: What influences behavioral consistency across contexts? *Frontiers in Psychology*, *9*(DEC), 1–13. https://doi.org/10.3389/fpsyg.2018.02447

Whitmarsh, L., & O'Neill, S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *Journal of Environmental Psychology*, *30*(3), 305–314.

Wickham, H., Averick, M., Bryan, J., Chang, W., D', L., Mcgowan, A., … Yutani, H. (2019). Welcome to the Tidyverse. *Journal of Open Source Software*, *4*(43), 1686. https://doi.org/10.21105/joss.01686

Woodhouse, E. J. (2001). Curbing overconsumption: Challenge for ethically responsible engineering. *IEEE Technology and Society Magazine*, *20*(3), 23–30. https://doi.org/10.1109/44.952762

Xanthos, D., & Walker, T. R. (2017). International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review. *Marine Pollution Bulletin*, *118*(1–2), 17–26. https://doi.org/10.1016/j.marpolbul.2017.02.048 0025-326/©

Zhao, J. (2017). Communication: Influencing policymakers. *Nature Climate Change*, *7*(3), 173–174. https://doi.org/10.1038/nclimate3215

PART III

7 DISCUSSION

Plastic pollution is a major challenge modern society is facing. To tackle plastic pollution at source, reduction of single-use plastic consumption becomes urgent. This dissertation addresses consumer behavior to mitigate single-use plastic consumption. One pitfall of behavior change is the fact that consumer behavior often runs habitually inhibiting the transition from intention to behavior. When starting behavior change, one needs to interrupt people in their daily routines. Therefore, approaches to break people's habits are in demand. To initiate new behavior, 'windows of opportunity' where people experience a discontinuity of their usual context are promising. This dissertation examines 'windows of opportunity' at the example of single-use plastic consumption. Four manuscripts were approached with the aims to understand and initiate behavior change to mitigate plastic consumption, by examining psychological determinants (RQ_a) and 'windows of opportunity' (RQ_{b+c}). The manuscripts are summarized below, emphasizing the main contributions of the studies in this dissertation. Theoretical and practical implications as well as limitations are discussed subsequently. The chapter concludes by discussing the limitations of the four manuscripts and of the overall dissertation as well as by identifying future research directions.

7.1 Summary of the manuscripts

Table 10 summarizes the key findings of the four manuscripts. Manuscript 1 gave an overview of perceptions, behaviors, and interventions to tackle the plastic problem. In this dissertation, examination and change of plastic consumption are of focus. The review of the literature showed that the provision of alternatives (e.g., reusable coffee cups, refill systems) was effective to reduce disposable products (Poortinga & Whitaker, 2018; Santos & Van Der Linden, 2016). Advertisements (Muralidharan & Sheehan, 2016), direct approach by the salesperson (Ohtomo & Ohnuma, 2014), public commitment (Rubens, Gosling, Bonaiuto, Brisbois, & Moch,

2015) and regulatory measures such as bans, taxes or levies (Ritch, Brennan, & MacLeod, 2009; Saidan, Ansour, & Saidan, 2017; Wagner, 2017) also decreased the use of single-use plastic bags. However, these interventions had only selective effects for specific products (e.g., plastic bags) and therefore questioned the transfer to a larger set of products. In addition, these interventions were related to high financial or administrative costs. Educational and informational approaches were particularly effective to raise awareness for plastic pollution but often failed to change behavior (Hartley, Thompson, & Pahl, 2015; Owens, 2018; So, Cheng, Chow, & Zhan, 2016; Veiga et al., 2016). Overall, the review showed that the studies in social-scientific literature focused more on recycling than reduction strategies so far.

Due to the lack of empirical studies that examining reduction strategies, the second manuscript addressed the antecedents of behavioral intentions to reduce single-use plastic in the private-sphere and the public-sphere. Purchase intention, activism intention and policy intention were identified as individual outcome variables with different antecedents respectively. With regard to purchase intention, perceived behavioral control, personal norms, and attitudes were significant predictors of purchase intention (in descending order). People for whom it was easy and morally convincing to reduce plastic packaging were more willing to reduce their plastic packaging consumption. A positive attitude towards plastic packaging served as a barrier to reduce plastic consumption. Activism intention was predicted by personal norms, attitudes, sufficiency orientation, and collective efficacy. Policy support intention was predicted by personal norms, sufficiency orientation, collective efficacy, and negatively by perceived behavioral control. Overall, a strong role of a moral obligation to act was apparent.

The third manuscript picked up the two strongest predictors of purchase intention in an intervention study, namely perceived behavioral control and personal norms. The intervention provided either information about solutions to increase the perceived behavioral control or about problems to increase personal norms. According to the norm activation model, problem awareness is an antecedent of personal norms (Schwartz, 1977). Thus, it was expected that

information about plastic pollution could raise problem awareness and in order to that people's personal norms to reduce plastic packaging consumption.

Furthermore, the intervention took place in Lent. This period was assumed as a 'window of opportunity' for behavior change. People who were invited to fast plastic during Lent, reduced their plastic packaging consumption in this period and even beyond. However, the information about solutions to increase perceived behavior control (i.e., action steps) or problems to increase personal norms (i.e., plastic pollution) had no additional effect. Considering the antecedents of behavior in this study, the intention to fast plastic during Lent, personal norms to do so, and prior behavior were relevant predictors for plastic consumption during Lent.

Lent is a period that is well-known and well-practiced to fast and give up selected behavior patterns by practicing Christians and non-believers (Heiser, 2020). A subsequent question is if a random period that is only framed as a period of change can interrupt and encourage behavior shifts accordingly. Therefore, manuscript 4 focuses on the campaign 'Plastic Free July' where people are asked to reduce their plastic consumption during July. An experimental group was introduced to the idea of 'Plastic Free July' while a control group received no further information. While the experimental group slightly reduced their plastic consumption, the control group did not change their plastic consumption. Apart from group allocation, perceived difficulty of plastic-free consumption and consumption behavior before July were relevant predictors for plastic consumption in July.

Overall, the experimental studies showed that interventions during a window of opportunity are promising to reduce plastic consumption. Beyond the time point, personal norms as perceived moral obligation to act and perceived behavioral control were the strongest predictors to mitigate plastic consumption.

Table 10 Key findings of the manuscripts

Manuscript 1: Heidbreder, L.M., Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of The Total Environment, 668*, 1077–1093

Focus/ Realm	Research Questions	Method	Key findings
Perceptions, psychological factors to determine behavior and behavior-based solutions	RQ1: How do people perceive advantages and disadvantages of plastic use and disposal? RQ2: Which factors determine plastic use? RQ3: What are promising behavior-based interventions to reduce plastic use or disposal?	Literature review	• Gap between problem awareness and behavior • Strong role of norms and habits for plastic consumption • Interventions are understudied

Manuscript 2: Heidbreder, L.M., Troeger, J. & Schmitt, M. (under review). Why do people engage in a plastic-free world? Exploring antecedents of anti-plastic activities.

Focus/ Realm	Research Questions	Method	Key findings
Determinants of private-sphere and public-sphere behavior to reduce single-use plastic	RQ1: Which activities to mitigate plastic pollution can be distinguished? RQ2: What are psychological factors determining the public-sphere and private-sphere behavior intention?	Online-Survey	• One can distinguish different forms of anti-plastic behavior • Personal norms, perceived behavior control and attitudes are relevant psychological factors of private-sphere behavior intention

Manuscript 3: Heidbreder, L.M. & Schmitt, M. (2020). Fasting plastic: an intervention study to break habits of plastic consumption. *PsyEcology, 11*(2).

Focus/ Realm	Research Questions	Method	Key findings
Plastic packaging consumption during Lent	RQ1: Can Lent be a 'window of opportunity' to reduce plastic packaging consumption? RQ2: Can provision of problem- or action-based information reduce plastic packaging consumption?	Experimental study, student sample	• Lent is a promising period to interrupt routines and reduce plastic consumption • Intentions, personal norms, and prior behavior influence plastic consumption during Lent • Information-based interventions have no further effect

Manuscript 4: Heidbreder, L.M., Steinhorst, J. & Schmitt, M. (2020). Plastic Free July: An experimental study of limiting and promoting factors in encouraging a reduction of single-use plastic consumption. *Sustainability, 12*(11), 4698.

Focus/ Realm	Research Questions	Method	Key findings
Plastic packaging consumption in an arbitrary month framed as 'Plastic Free July'	RQ1: Can an arbitrary month framed as an opportunity of change lead to a reduction of plastic consumption?	Experimental study, population sample	• People slightly reduced their plastic packaging consumption when the month was framed as 'Plastic Free July' • Prior behavior, perceived behavior control and group allocation influence plastic consumption during the action month

7.2 Theoretical integration of the manuscripts

The theoretical contributions of the four manuscripts are discussed in the following chapters. Following the research questions, theoretical implications for (a) models of pro-environmental behavior as well as (b) 'windows of opportunity' to break habitual behavior are discussed in this subsection. Starting with the behavior models to explain pro-environmental behavior, this dissertation focuses on TPB (Ajzen, 1991) and NAM (Schwartz, 1977) as prominent theories in the context of pro-environmental behavior. The second subitem refers to the habit discontinuity hypothesis (Verplanken & Roy, 2015) and discusses extensions against the background of the two intervention studies.

7.2.1.1 MODELS OF PRO-ENVIRONMENTAL BEHAVIOR

Starting with the TPB, the literature review (manuscript 1) showed that the TPB was mostly applied to recycling and a systematic application of TPB to the context of plastic reduction was missing. This was in line with Si (2019) who stated that recycling was the main topic in environmental science research when TPB was considered. In contrast, plastic use and behavior reduction were identified as a gap in TPB research (Si et al., 2019). Generalized statements of the TPB in the new application field of plastic consumption and its mitigation cannot be made yet. However, the three empirical studies of this dissertation gave first evidence to this topic. In manuscript 2 and 3, the TPB was empirically tested while in manuscript 4 only perceived difficulty as a subdimension of perceived behavioral control was included in the model.

In the empirical studies, the TPB was only partly confirmed to explain the reduction of single-use plastic consumption. Having a closer look at the theoretical variables, in all three empirical studies, perceived behavior control (or its subdimension) was the most dominant predictor. Thus, the extension of the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) by perceived behavior control in the development of the TPB can be considered positive. The studies confirm that people's perception of ability and opportunities

to show a target behavior can explain their willingness to show this behavior. This also indicates that individual behavior reaches its limits if the external conditions are not supportive. Structural barriers can hinder engagement (Gifford, 2011) and in many contexts it is hard for people to avoid plastic packaging. Also, the studies in the literature review has shown, that it is important to make behavior change easy, by provision of alternatives, or even by bans of harmful products (e.g., Santos & Van Der Linden, 2016; Wagner, 2017).

Simultaneously, people's willingness to get engaged can decrease if a behavior appears too simple. People can interpret a simple task as having only low impact (i.e., low efficacy beliefs). Thus, simplicity can make the task feel not worthwhile to get engaged. This was shown in a field study of a plastic challenge card game. Only plastic-free behavior that was neither too difficult nor too easy increased collective efficacy beliefs and thus motivated the willingness to act (Reese & Junge, 2017). The perceived influence on a target goal, thus, the feeling to make a difference with one's own behavior (i.e. goal efficacy beliefs) should be considered in further studies (Hamann & Reese, 2020). To sum up, in line with further studies in the context of pro-environmental behavior (Bamberg & Möser, 2007), perceived behavior control was the strongest predictor of purchase intention in our studies. As the TPB implies perceived behavior control to have not only an indirect impact on behavior via intention but also a direct one (Ajzen, 1991), which was confirmed in our last study, it makes this construct even more relevant in the application context (see Chapter "practical implications"). As it is not only relevant to feel able to show a target behavior but to have an impact with one's behavior on a superior goal (Hamann & Reese, 2020), efficacy beliefs might be a good supplement to the construct of perceived behavior control.

Contrary to the theoretical assumption of the TPB, a positive attitude towards the target behavior was no relevant predictor (manuscript 2). However, in another study (manuscript 3) a positive attitude towards the contrary behavior (i.e., assessing plastic packaging to be useful) served as a barrier for the intention to the aimed behavior. People who had a positive attitude towards plastic-use were less willing to reduce their single-use plastic consumption. The

TPB assumes that an attitude has to be salient to determine people's intentions (Ajzen, 1991). People might be used to plastic purchases but to a lesser extent to plastic-free purchases. Thus, missed experience might have led to weaker attitudes towards plastic-free purchases and therefore was not considered in people's behavioral choice. Furthermore, familiarity (e.g., by repeated exposure) with an object leads to a positive attitude towards it (i.e., mere-exposure effect, Zajonc, 1968), even in the context of consumer products (Kirmani, 1997; Rindfleisch & Inman, 1998). Thus, the ubiquity of plastic packaging might have led to a familiarization effect and, subsequently, a positive attitude. According to Festinger's theory of cognitive dissonance (1957), this strong attitude might hinder behavior change as people try to act in accordance with their attitudes and vice versa. Summing up, people's attitudes are an important predictor of their intention to mitigate plastic consumption. However, these attitudes have to be salient.

In two of the empirical studies (manuscripts 2+3), social norms had no or only weak impact on plastic consumption. This stands in contrast to some studies reported in the literature review (manuscript 1) where social norms were relevant predictors of the reduction of plastic bags (Arı & Yılmaz, 2017; Cherrier, 2006). Other studies showed that information presented by role models (Arlt, Kuhlmann, & Wolling, 2012; Spranz, Schlüter, & Vollan, 2018) or direct approach by sales persons (Musa, Hayes, Bradley, Clayson, & Gillibrand, 2013; Ohtomo & Ohnuma, 2014) influenced the mitigation of plastic consumption. Furthermore, social norms rather than monetary loss triggered plastic bag reduction after the implementation of a plastic bag charge (Rivers, Shenstone-Harris, & Young, 2017). Thus, there is empirical support that others do have an impact on people's plastic-free purchase. In the empirical studies of this dissertation, the impact of social norms was examined via self-report. Thus, the weak impact of social norms in these studies is likely due to the fact that in self-reports, people regularly underestimate the role of social norms (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). The impact of social norms at the point of sale where behavior of others is salient is stronger than in self-reports. It might also be a problem that the behavior of others was not perceptible

by participants in the application field of reduction behavior. While buying organic food or taking a textile bag is visible, "not-buying" plastic products is hard to observe. In this case, again, norms were not salient and therefore not predictive for behavioral intentions.

The relation between intention and behavior was examined in the third manuscript. It was striking that the intention was a predictor for behavior during Lent but not afterwards. Thus, intention only had an impact on behavior in the phase of change where habitual behavior was broken. The assumption by Aarts and Custer (2009) that intentions are predictive for conscious behavioral choice but not for habitual behavior was thus confirmed.

In addition to the TPB, personal norms as a key concept of the NAM (Schwartz, 1977) complemented the behavior model by a moral component. In the present studies, it was a strong predictor and was a useful supplement to the TPB in the context of plastic consumption. In accordance with the NAM, personal norms had not only an impact on intention (manuscripts 2+3) but also a direct impact on behavior (manuscript 2). This was in line with other studies, where personal norms explained variance beyond TPB variables in intention and self-reported behavior in household recycling (Ofstad, Tobolova, Nayum, & Klöckner, 2017; Pakpour, Zeidi, Emamjomeh, Asefzadeh, & Pearson, 2014; White, Smith, Terry, Greenslade, & McKimmie, 2009) or packaging choice (Thøgersen, 1999). The more people are morally convinced of a target behavior the more they are willing and actually showing it. Although personal norms have a strong empirical support to predict pro-environmental behavior, other authors argue that infrastructural change are even more important than raising awareness (Eversberg, 2020). Thus, when aiming at a broad socio-ecological transformation, situational, cultural as well as psychological barriers should be considered.

To conclude, a comprehensive model including normative and rational choice components as it was used in the studies is promising. One further has to make sure that constructs in the model are salient. Then, rational deliberation and normative conviction come together in an integrated framework to understand behavior.

7.2.1.2 WINDOWS OF OPPORTUNITY

The habit discontinuity hypothesis states that if a stable context is disrupted, habitual behavior can be easily changed as the link between habitual behavior and its context-cue is severed (Verplanken & Roy, 2015). In prior studies, habit discontinuity is associated with changes in physical or social context. Accordingly, critical life events, such as moving to another city, were prominent 'windows of opportunity' (Schäfer et al., 2012). The two experimental research papers of this dissertation suggest that this concept of a 'window of opportunity' might be expandable. It might be not only the real perceptible context that cue habitual behavior but also a "mindset" of a mood for change.

In the first research paper, Lent as a period of curtailment in the Christian tradition was effective to interrupt people's habitual behavior and reduce their plastic packaging consumption. In the second research paper, people reduced their plastic consumption in July when the month was presented as "Plastic Free July" – a period for change in plastic consumption – while people in the control group who were just asked for their plastic consumption during July did not reduce it. What can we conclude from these intervention studies?

First, the effect size of plastic reduction was higher in the first study than in the second one. It is plausible that the association as a period of change is stronger for Lent than for the PFJ. Lent is not only traditionally anchored in Christianity but transferred to Western society as a period of curtailment. It is highly accepted as a period of change for daily behavior patterns and even unbelieving people use this period to change the behavior pattern (Heiser, 2020). This is supported by the result of the first study: Religious background had no impact on plastic reduction but people who were used to fast during Lent reduced their plastic consumption stronger than people who had never fasted before. Familiarity with the concept of Lent as a period of change might support the effectiveness of behavior change. In contrast, PFJ was hardly known by participants. In line, we found only small effect sizes for behavior change.

However, a difference between the experimental and control groups existed. A short introduction to the concept of PFJ, thus, making a change in this actual arbitrary month salient, was enough to reduce plastic consumption at least on a low level.

The classical 'window of opportunity' is characterized as a period of change that is independent of the behavior that is targeted to be changed (Thompson et al., 2011). Moving to another city might be motivated by a new place of work. The change to go by bike instead of a car in the new city can follow from this life event but is totally unrelated to the prior motivation for relocation. This was different in our studies. The addressed change in PFJ was not that of a global feeling of change but focused on a specific behavior. A reduction of plastic consumption was the target behavior and also the topic for the period of change. In contrast, Lent offers a broader picture. Here, people are asked for a general curtailment. Although, one has to admit that Lent is mostly associated with a reduction of a consumption pattern, such as sugar or meat, which is not far from the idea to reduce plastic consumption. Are we thus concerned with a completely different 'window of opportunity' in our two experimental studies? In fact, moving to another city as a 'window of opportunity' could be also related to the target behavior. If a person decides to move to a compact city with short distances the step to switch from car to bike will be not that groundless. Thus, a life event may not always be totally unrelated to the change of a behavior. Future studies should examine if the framing of change, in general, could also open a 'window of opportunity' for concrete behavior such as PFJ does for plastic-free consumption.

Finally, a period of change can only have an impact if an appropriate attitude is proceeding. According to Wood and Neal (2009), such periods of change can "free" people to act in line with their attitudes. Thus, without the right occasion, an attitude cannot be put into practice. Same as, without a preceding attitude an occasion cannot make a change. To conclude, 'windows of opportunity' should be considered in an expanded sense. Not only physical and social changes can make an occasion but also framing a change can. Thereby, traditionally grown periods of change seem particularly effective.

7.3 Practical implications for societal actors

Apart from theoretical contributions, this dissertation concentrates on application-orientated research. Accordingly, practical implications addressing societal actors are noteworthy. To reduce single-use plastic consumption, finally, multilevel responses are needed and different actors have to pull together (Villarrubia-Gómez, Cornell, & Fabres, 2018). Therefore, implications for important societal groups, derived from the four papers, are presented below. Well known, that the choice of groups is not exhaustive and the groups in themselves are diverse, the implications can be only understood as impulses. The following groups are considered as actors having an expectable impact on business and political transitions in the context of plastic consumption: politicians, distributors, non-governmental organizations (NGOs), and consumers.

7.3.1 Politicians

Although the need for political action in the context of plastic pollution is evident, politicians need support and acceptance from society for imposing political measures (Sundblad, Biel, & Gärling, 2007). The study of manuscript 4 showed that, overall, people hold high policy support, even for strict measures such as bans. This was also shown in the literature review (Santos, Sousa, Sampaio, & Fagundes, 2013; Wagner, 2017). In the survey (manuscript 2) and the experimental study (manuscript 4) people with a strong problem awareness were more likely to support policy. In addition, those who perceived more obstacles to reduce plastic consumption were also more likely to support policy measures (manuscript 4). This indicates, that those who wanted to reduce plastic consumption driven by a feeling of moral obligation but simultaneously felt not capable to behave accordingly, seek solutions in policy regulation. Politicians should take this positive mood in society and openness for regulation into account to set regulations (Ritch et al., 2009; Wagner, 2017). However, current developments should be considered, too. Taking the COVID-19 crisis into account, the use of plastic has increased during the last few months of writing this thesis (Klemeš, Van Fan, Tan, & Jiang, 2020; Vanapalli et al., 2020). New needs (e.g. for hygienic packaging, Venter, van der Merwe, de Beer, Kempen, &

Bosman, 2011) might become more salient and stand in conflict with ecological attitudes. Further studies have shown that change in situational context, for instance being on vacation, can lower waste reduction and recycling behavior (Oliver, Benjamin, & Leonard, 2019; Whitmarsh, Haggar, & Thomas, 2018). Thus, such phases can also work as 'window of opportunity' in an opposite sense.

To use 'windows of opportunity' in the required direction, politicians should consider phases where people are open to positive changes to present new strategies and regulations. When the topic is present in the media anyway or the NGOs present the Plastic Free July campaign, politicians may join (Convery, McDonnell, & Ferreira, 2007; Zen, Ahamad, & Omar, 2013). In cooperation with local disposal business, politics may develop plastic reduction strategies for new citizens to use their mood of change when coming to a new city. With regard to regulatory options, the review paper (manuscript 1) showed, that bans of and charges for single-use plastic products such as plastic bags were evaluated as effective instruments (e.g., (Wagner, 2017). However, such measures should be implemented in coordination with the distributors as people tend to purchase alternatives without assurance of an ecological value (Synthia & Kabir, 2015). To create an appositive environmental impact, these alternatives have to be more ecofriendly than their plastic predecessors – which guides us to the role of business and production.

7.3.2 Distributors

Distributors hold a central role in single-use plastic reduction. The review (manuscript 1) has shown that it is crucial to make use of alternatives easy at the point of action (Poortinga & Whitaker, 2018; Santos & Van Der Linden, 2016). Convenient plastic-free offers should be made available. Time pressure has been mentioned as a relevant barrier for plastic reduction in the last study (manuscript 4). Furthermore, time pressure goes hand in hand with hanging on to habitual behavior (Aarts et al., 1998). Thus, a change towards reduced plastic consump-

tion under time pressure is doubly hard. Therefore, it would be best to make plastic-free alternatives available at the shopping facilities where consumers stop at anyway. Taking the idea of the two experimental studies (manuscript 3 +4) into account, opening a 'window of opportunity', e.g., with a plastic-free action month at the supermarket where alternatives are presented at a central place and a message of "giving it a try" is promoted. As positive emotions were a relevant predictor for the willingness to continue curtailment of plastic use (manuscript 3), consumers should make positive experiences in such an action month. Well-chosen alternatives can support this experience. Here, the role of hygiene should be considered as it was (at least for some people) a relevant barrier to choose plastic-free alternatives (manuscript 4).

7.3.3 Non-governmental organizations

Interventions and campaigns to tackle the plastic problem are often initiated by NGOs (see Bates, 2010 for a review of ocean sustainability campaigns). Some implications derived from the three papers are noteworthy for this group of actors. When setting an intervention, not only the content but also the time point has to be considered carefully. In the empirical studies (manuscript 2-4), the perception of possibilities to purchase plastic-free as well as the feeling of moral obligation to act were relevant motivators, within and out of a 'window of opportunity'. Consequently, non-governmental organizations should emphasize what people *can* as well as what they *should* do. Using phases where people are in a mood of change and creating such a 'window of opportunity' are a useful addition. Absorbing information that is not in line with the habitual behavior is difficult (Aarts et al., 1998). Therefore, a mood of change has to be created first.

7.3.4 Consumers

Finally, one can derive implications for the individual consumer. It is not up to the consumer to offer new alternatives or determine regulations. But it is up to the consumer to take an opportunity if it is provided. And there are mostly different opportunities. To either choose alternative products or to renounce concrete ones. If someone is willing but it feels to cost a lot to

implement new behavior, the studies show that one can outsmart oneself by creating a 'window of opportunity'. It does not have to be the relocation (Bamberg, 2006) but a period such as Lent to give new behavior a chance. Consumers can give themselves an occasion. Joining forces, e.g., within a family, can help to pull through such an occasion (Homburg & Stolberg, 2006; Jugert et al., 2016; Reese & Junge, 2017). Finally, if consumption behavior seems too hard to change one has the opportunity to obtain new conditions by policy behavior. Policy support or activism is a way forward if private behavior reaches its limits (Hamann & Reese, 2020; Schulte, Bamberg, Rees, & Rollin, 2020).

To conclude, it is all about creating and taking opportunities. An overall awareness of the topic of plastic pollution and a need for change does exist. All societal actors can contribute to the solution instead of showing reluctance to doing the first step (Ma et al., 2020). Consumers should be enabled to reclaim their volitional control and then take the chance to act. As plastic consumption is closely linked to habitual behavior, strategies to break such habits and facilitate positive experiences in the phases of change are crucial.

7.4 Limitations of the dissertation and directions for future research

Despite the insights the papers provide for theoretical and practical implications, limitations should not be withheld. As limitations are discussed respectively in each paper, this section will pick up only the most important ones and set them in a broader context. Thus, this section touches upon four topics, namely the theory choice, methodical approach, generalizability, and the scope. Based on the limitations, an outlook for future research is presented respectively.

In the empirical manuscripts, the TPB formed the basis for the theoretical model. Some might argue that this was an inappropriate choice to address habitual behavior, i.e., plastic consumption. Stemming from a rational perspective, the TPB refers to conscious decision making rather than automatic behavioral responses (Ajzen, 1991). To this, it can be responded in three points: First, this dissertation gives first insights into the very new field of plastic consumption. There was a gap in the literature to examine reduction behavior (Si et al., 2019). Thus, well-

established theories can work as a starting point to discover relevant predictors within a new application field. Second, the outcome variable (i.e. plastic consumption) is not fully equated or explained by habits. Although habit strength reduces the predictive validity of the TPB (Murtagh, Rowe, McMinn, & Nelson, 2012), it might be a good supplement to explain plastic use. Prior studies have shown that TPB variables and habits were independent predictors of behavior such as recycling (Knussen, Yule, MacKenzie, & Wells, 2004). Thus, a comprehensive model of intentional and habitual processes can provide good explanatory power of plastic consumption. Finally, this dissertation focuses on 'windows of opportunity'. Within a 'window of opportunity' where habitual behavior is interrupted, determinants of the TPB can have an even stronger significant impact. This was confirmed in the study of Lent where intention had an impact during but not after the period of change.

Regarding the information-based intervention in the two experimental studies, the habitual behavior as a target behavior might be more critical. A meta-analysis has shown that interventions based on information or persuasive messages were only effective to change non-habitual behavior (Webb & Sheeran, 2006). If habitual behavior was addressed, interventions based on information alone could not encourage behavior change. To justify the choice for an information-based intervention, one may probably assume that in combination with a 'window of opportunity' people might have been more open for persuasive messages. However, this was not the case as the study during Lent has shown. When addressing habitual behavior in future research, other forms of intervention should be considered. For instance, self-regulation has been a promising approach in food choice (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011; Taufik, Verain, Bouwman, & Reinders, 2019) or to reduce meat consumption (Loy, Wieber, Gollwitzer, & Oettingen, 2016). Rewards, repetition of new behavior, reminders, and implementation intentions are further approaches to implement new behavior pattern (Gollwitzer & Sheeran, 2006). Thus, people require not only motivational but also cognitive effort to act counter to their habitual behavior.

Reflecting upon the theory choice, one might also question if the TPB is the right choice to understand behavior change. A meta-analysis of 82 papers evaluating 123 intervention studies based on the TPB has shown the effectiveness of these interventions for behavior change (Steinmetz, Knappstein, Ajzen, Schmidt, & Kabst, 2016). Thus, using the TPB as a starting point for intervention studies seems promising. However, the TPB aims at explaining behavior and does not demonstrate a process of change. A differentiation between motivational (i.e., forming an intention) and implementational processes (i.e., bridging the gap between intention and behavior) is crucial (Steinmetz et al., 2016). When aiming at understanding the process of change, accompanied by an intervention, future studies might better refer to models of behavior change. For instance, the stage model of self-regulated behavioral change (SSBC) takes self-regulatory aspects of behavior change and different phases of transition into account (Bamberg, 2013). Within such a process model it could be further examined in which phase a 'window of opportunity' has the strongest effect and if it is only relevant for the implementation process when people have already formed an intention.

Regarding the experimental design, using a control group is crucial. This was done for the Plastic Free July campaign but not for Lent. We cannot say for sure if effects go back to the period of Lent or the intervention in itself. Future studies should include a control period of continuity when examining 'windows of opportunity'. To further examine, which characteristics of Lent might form a 'window of opportunity' for behavior change similar periods such as Islamic Ramadan (Trepanowski & Bloomer, 2010) or other behavior pattern such as social media use (Schoenebeck, 2014) could be integrated in experimental studies. Moreover, the long-term effects of an intervention in a period of discontinuity should be examined. Longitudinal designs to examine pro-environmental behavior are rare and there is a need for intervention studies monitoring long-term effects (Steg & Vlek, 2009). The study of Lent suggest that people hold their low level of plastic consumption even one year after the intervention but the sample size was too small for valid statements and future studies have to verify these results.

With regard to the measurement of psychological constructs, one has to critically note that social norms were measured in different ways across the three empirical manuscripts. While injunctive and descriptive norms were handled separately in the first empirical study (manuscript 2), they were taken together in the second (manuscript 3) and not used in the third (manuscript 4). Although they showed no relevant effects in the papers, this should be standardized or systematically varied in future studies. Prior studies have shown that descriptive and injunctive norms have their own independent effect on behavior (Klöckner, 2013; Niemiec, Champine, Vaske, & Mertens, 2020). Moreover, interventions based on descriptive norms were more effective to change conservation behavior than interventions based on injunctive norms (Farrow, Grolleau, & Ibanez, 2017). Furthermore, the impact of norms depends on the familiarity with the target behavior. When a behavior is new, descriptive norms play a more important role while personal norms are more important when behavior is familiar (Lapinski & Rimal, 2005). Overall, Ajzen (1991) mentioned that the importance of single predictors varies within situations and across different behaviors. Thus, the role of norms should be considered more carefully. To increase comparability, a stringent use of scales in future studies is indispensable.

Regarding generalizability, the perspective of these studies was that of Western society. And even limited to German characteristics as Germany is considered to be good in recycling but has the highest plastic packaging demand in Europe (PlasticsEurope, 2019). Characteristics mentioned in the studies, such as deposit systems or zero-waste shops, are not completely transferable to other countries. Furthermore, all samples were highly educated and expressed an overall high environmental consciousness. Future studies should verify the given results within more representative samples and also across different countries. The literature review has shown the worldwide distribution of research addressing the topic of behavior-based plastic solutions and more cross-cultural designs would be fruitful as it was already done within Western society (Herbes, Beuthner, & Ramme, 2018; Veiga et al., 2016).

Some might argue that the focus on small action steps that are proposed in the intervention studies (e.g., buying fruits without plastic packaging) is only a drop in the ocean and negligible given the big challenges of environmental pollution. However, small action steps can trigger spillover effects, initiating further action steps within the private or public sphere (Thøgersen & Ölander, 2003) and encourage others to join in (Nolan et al., 2008). Thus, a stronger focus on collective action is recommended for future studies. Picking up models addressing collective action, such as the Social Identity Model of Pro-Environmental Action (SIMPEA; Fritsche, Barth, Jugert, Masson, & Reese, 2018) might be useful to understand behavior towards a socio-ecological transformation beyond personal decision-making. Appraisal and response of individuals to collective challenges and within a collective context (i.e., group identity) should be considered.

Nevertheless, communicating small action steps, even for individuals, should not be skipped. Not communicating small action steps or badmouthing them can discourage people from doing anything (Bilharz & Schmitt, 2011). And communicating bigger efforts, might also reach fewer people or even create resistance (Bilharz & Schmitt, 2011). It is however clear: the ecological impact of a behavior is what matters in the end (Geiger, Fischer, & Schrader, 2017). People often overestimate the impact of small steps and rest on performing them. Focusing on key points of sustainable consumption that have the biggest impact from an environmental point of view is more important than struggling with 'peanuts' (Bilharz & Schmitt, 2011), even if it requires greater effort to encourage such behavior. Furthermore, Henn, Otto, and Kaiser, (2020) state that for long-term effects, behavior should be changed comprehensively and not with a single behavior. From their point of view, one needs to change people's overall attitude rather than single behavior to inspire change in a new behavior.

Thus, it is important to create an awareness of what matters. To create a broad societal discourse, communicating a specific vision (i.e. "100 percent renewable energy") is fruitful (Bilharz & Schmitt, 2011). It is also promising to create a social identity. People do not only start to avoid eating meat but they are becoming vegan or vegetarian which express more a

form of identity (Kurz, Prosser, Rabinovich, & O'Neill, 2020). In the context of plastic pollution, the 'zero-waste' lifestyle fell in this category. A preferably encompassing reduction of waste and resources is the objective of this lifestyle (Săplăcan & Márton, 2019). The role of social integration, e.g. in social media groups, is also crucial here (Săplăcan & Márton, 2019). Although the studies in this dissertation focus on a single behavior, it is plausible that the periods of discontinuity not only open a 'window of opportunity' for single behavior but also for broader lifestyle changes. In particular, the Plastic Free July campaign but also Lent are periods where extensive behavior pattern could be addressed. Future studies could integrate these findings and integrate interventions to encourage a 'zero-waste' lifestyle and periods of discontinuity.

While social science is essential for understanding and promoting behavior change in the context of plastic pollution (van Veelen & Hasselbalch, 2020), we need natural sciences to understand impacts on the ecosystem and examine the key points that should be addressed (Bilharz & Schmitt, 2011), turning from intent- to impact-oriented behavior (Geiger et al., 2017). Turning off the light when leaving the room or buying energy-saving bulls might be easy to initiate but does not decrease emissions significantly (Bilharz & Schmitt, 2011). Reducing the size of people's residence or the extent of car use have a significantly stronger impact on energy reduction but is simultaneously difficult to encourage. So far, big sources of plastic pollution, such as tire abrasion, are understudied with regard to behavioral options although they are a main source of plastic in the environment (Bertling, Bertling, & Hamann, 2018). Natural and social science should go hand in hand to address the key environmental challenges.

Psychological research reaches its limits at some point and so does this dissertation. Focusing on individual behavior might disregard that in the case of plastic pollution, we deal with a collective problem (Müller et al., 2020). In recent years, plastic has become a part of our modern society and the modern way of living. Thus, when addressing the handling of plastic, cultural and sociological aspects should be considered just like selling structures or economic perspectives. Taking the whole life cycle into account, producers, designers, waste managers,

and many other actors should be consulted. However, anthropogenic plastic pollution is a result of human behavior and addressing solution always tackles behavior at a certain point (IPCC, 2019). Understanding this behavior and how to initiate behavior change is therefore crucial. Focusing on individual behavior from a psychological perspective can also mean to examining perception and behavior not only of consumers but of relevant actors, such as teachers, journalists, campaigners, product designers, distributors, sellers, artists, politicians, or investors.

As Carl Popper said: "Problems may cut right across the boundaries of any subject matter of discipline" (1963, cited from Menken & Keestra, 2016). It would be wrong to originate from a too simple solution for complex problems. Such complex problems have multiple causes and determining factors that should be addressed by different disciplines to achieve an adequate understanding (Danermark, 2019). Interdisciplinary cooperation is indispensable. Psychology can play a crucial role to understand and manage complex problems within an interdisciplinary team (Dreyer et al., 2020).

7.5 Conclusion

Human behavior is complex and difficult to explain (Ajzen, 1991). At least, it is an equally difficult task to change human behavior. Within the field of plastic consumption, this dissertation takes both issues into account: the explanation of behavior and opportunities for change. One literature review and three empirical studies addressed relevant factors to mitigate single-use plastic consumption and focus on behavior change within so-called 'windows of opportunity'.

This dissertation emphasized the important role of moral and rational determinants of plastic-free consumption. People who perceived to act in line with their conviction and felt able to do so were more willing to reduce single-use plastic consumption. Thus, strengthening problem awareness to create a moral obligation to act or providing infrastructure to make plastic-free consumption easier can encourage behavior change. At the same time, raising an occasion can facilitate behavior change.

Overall, it is all about creating opportunities. First, by reducing situational barriers (e.g., by offering plastic-free alternatives in the supermarket) to strengthen people's ability to show a target behavior. Second, by reducing psychological barriers (e.g., by setting interventions during a 'window of opportunity' such as Lent) to break people's habits and enable people to act in accordance with their convictions. What counts is the interplay between the appropriate willingness, perceived ability and the right occasion.

To draw a broader picture, these insights can be transferred to other application fields. Planetary boundaries comprise a range of environmental challenges. What all these challenges have in common is the impact of human behavior. Thus, we have to find "social tipping interventions" to reach the necessary socio-ecological transformation (Otto et al., 2020, p. 2354). When understanding human behavior and the implementation of interventions, we can provide analogies for different contexts. Mitigation of plastic consumption, as it was examined in this dissertation, is closely related to an overall curtailment behavior including avoidance or choice of ecological alternatives. The role of sufficiency as a general stance to reduce resources is worthwhile to pursue in this context.

To solve the plastic crisis, it will not be enough to start at the end of the waste hierarchy with garbage separation and collection, but reduction and prevention has to be taken into account (Gharfalkar, Court, Campbell, Ali, & Hillier, 2015). A future without any plastic products is not realistic (Andrady & Neal, 2009). However, a shift towards waste avoidance, reduction, and consideration of the whole life cycle is needed. This requires effort from different societal actors. An inter- or even transdisciplinary approach is needed to tackle these environmental challenges. We need an interplay of product-related solutions (e.g., development of ecofriendly and convenient packaging), policy advice (e.g., incentives for plastic-free innovation) and the consumer who initiates policy and market responses by his or her consumption behavior. It is up to the different societal actors to take their part. If a 'window' opens it is up to every individual to take his or her opportunity.

8 REFERENCES

Aarts, H., & Custer, R. (2009). Habit, action, and consciousness. In W. P. Banks (Ed.), *Encyclopedia of Consciousness* (pp. 315–328). Amsterdam: Academic Press. https://doi.org/10.1016/B978-012373873-8.00035-9

Aarts, H., Verplanken, B., & Van Knippenberg, A. (1998). Predicting behavior from actions in the past: Repeated decision making or a matter of habit ? *Journal of Applied Social Psychology*, *28*(15), 1355–1374. https://doi.org/10.1111/j.1559-1816.1998.tb01681.x

Adriaanse, M. A., Vinkers, C. D., De Ridder, D. T., Hox, J. J., & De Wit, J. B. (2011). Do implementation intentions help to eat a healthy diet? A systematic review and meta-analysis of the empirical evidence. *Appetite*, *56*(1), 183–193. https://doi.org/10.1016/j.appet.2010.10.012

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior* (Englewood). NJ: Prentice-Hall.

Anbumani, S., & Kakkar, P. (2018). Ecotoxicological effects of microplastics on biota: a review. *Environmental Science and Pollution Research*, *25*(15), 14373–14396. https://doi.org/10.1007/s11356-018-1999-x

Andrady, A. L., & Neal, M. A. (2009). Applications and societal benefits of plastics. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 1977–1984. https://doi.org/10.1098/rstb.2008.0304

Arı, E., & Yılmaz, V. (2017). Consumer attitudes on the use of plastic and cloth bags. *Environment, Development and Sustainability*, *19*(4), 1219–1234. https://doi.org/10.1007/s10668-016-9791-x

Arlt, D., Kuhlmann, C., & Wolling, J. (2012). Ecological role models? The effect of the depiction of ecological activities in the media on the behavioral intentions of the recipients. *Studies in Communication and Media*, *1*(3–4), 411–442. https://doi.org/10.5771/2192-4007-2012-3-411

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, *40*(4), 471–499. https://doi.org/10.1348/014466601164939

Bamberg, S. (2006). Is a residential relocation a good opportunity to change people's travel behavior? Results from a theory-driven intervention study, *38*(6), 820–840. https://doi.org/10.1177/0013916505285091

Bamberg, S. (2013). Applying the stage model of self-regulated behavioral change in a car use reduction intervention. *Journal of Environmental Psychology*, *33*, 68–75. https://doi.org/10.1016/j.jenvp.2012.10.001

Bamberg, S. (2014). Psychological contributions to the development of car use reduction interventions. In *Handbook of sustainable travel* (pp. 131–149). Dordrecht: Springer. https://doi.org/10.1007/978-94-007-7034-8_9

Bamberg, S., Hunecke, M., & Blöbaum, A. (2007). Social context, personal norms and the use of public transportation: Two field studies. *Journal of Environmental Psychology*, *27*(3), 190–203. https://doi.org/10.1016/j.jenvp.2007.04.001

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, *27*(1), 14–25. https://doi.org/10.1016/j.jenvp.2006.12.002

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz, and Triandis. *Environment and Behavior*, *35*(2), 264–285.

Barnes, D. K. A., Galgani, F., Thompson, R. C., & Barlaz, M. (2009). Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 1985–1998. https://doi.org/10.1098/rstb.2008.0205

Barr, S., Gilg, A. W., & Ford, N. J. (2001). Differences between household waste reduction , reuse and recycling behaviour: a study of reported behaviours, intentions and explanatory variables. *Waste Management*, *4*(2), 69–82.

Bates, C. H. (2010). Use of social marketing concepts to evaluate ocean sustainability campaigns. *Social Marketing Quarterly*, *16*(1), 71–96. https://doi.org/10.1080/15245000903528357

Beaumont, N. J., Aanesen, M., Austen, M. C., Börger, T., Clark, J. R., Cole, M., … Wyles, K. J. (2019). Global ecological, social and economic impacts of marine plastic. *Marine Pollution Bulletin*, *142*, 189–195. https://doi.org/10.1016/j.marpolbul.2019.03.022

Bergmann, M., Gutow, L., & Klages, M. (2015). *Marine anthropogenic litter*. Springer. https://doi.org/10.1007/978-3-319-16510-3

Bertling, J., Bertling, R., & Hamann, L. (2018). *Kunststoffe in der Umwelt: Mikro- und Makroplastik*. Oberhausen: Fraunhofer Umsicht. https://doi.org/10.24406/UMSICHT-N-497117

Bilharz, M., & Schmitt, K. (2011). Going big with big matters: The key points approach to sustainable consumption. *Gaia*, *20*(4), 232–235. https://doi.org/10.14512/gaia.20.4.5

Botterell, Z. L. R., Beaumont, N., Dorrington, T., Steinke, M., Thompson, R. C., & Lindeque, P. K. (2019). Bioavailability and effects of microplastics on marine zooplankton: A review. *Environmental Pollution*, *245*(2019), 98–110. https://doi.org/10.1016/j.envpol.2018.10.065

Bucci, K., Tulio, M., & Rochman, C. M. (2020). What is known and unknown about the effects of plastic pollution: A meta-analysis and systematic review. *Ecological Applications*, *30*(2), 1–16. https://doi.org/10.1002/eap.2044

Chang, S.-H., & Chou, C.-H. (2018). Consumer intention toward bringing your own shopping bags in Taiwan: An application of ethics perspective and theory of planned behavior. *Sustainability (Switzerland)*, *10*(6), 1–14. https://doi.org/10.3390/su10061815

Cherrier, H. (2006). Consumer identity and moral obligations in non-plastic bag consumption: a dialectical perspective. *International Journal of Consumer Studies*, *30*(5), 515–523. https://doi.org/10.1111/j.1470-6431.2006.00531.x

Clayton, S., & Myers, G. (2015). Promoting sustainable behavior. In *Conservation psychology: Understanding and promoting human care for nature* (2nd ed., pp. 191–211). Oxford, UK: Wiley Blackwill.

Convery, F., McDonnell, S., & Ferreira, S. (2007). The most popular tax in Europe? Lessons from the Irish plastic bags levy. *Environmental and Resource Economics*, *38*(1), 1–11. https://doi.org/10.1007/s10640-006-9059-2

Danermark, B. (2019). Applied interdisciplinary research: a critical realist perspective. *Journal of Critical Realism*, *18*(4), 368–382. https://doi.org/10.1080/14767430.2019.1644983

Dreyer, S. J., Kurz, T., Prosser, A. M. B., Abrash Walton, A., Dennings, K., McNeill, I., … Swim, J. K. (2020). Towards a psychology of the food-energy-water nexus: costs and opportunities. *Journal of Social Issues*, *76*(1), 136–149. https://doi.org/10.1111/josi.12361

Eriksen, M., Lebreton, L. C. M., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., … Reisser, J. (2014). Plastic pollution in the world's oceans: More than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. *PLoS ONE*, *9*(12), 1–15. https://doi.org/10.1371/journal.pone.0111913

European Commission. (2018). *Proposal for a Directive of the European Parliament and of the Council on the Reduction of the Impact of Certain Plastic Products on the Environment* (Vol. 0172). https://doi.org/COM(2018) 340 final 2018/0172

Eversberg, D. (2020). Who can challenge the imperial mode of living? The terrain of struggles for social-ecological transformation in the German population. *Innovation: The European Journal of Social Science Research*, *33*(2), 233–256. https://doi.org/10.1080/13511610.2019.1674129

Farrow, K., Grolleau, G., & Ibanez, L. (2017). Social norms and pro-environmental behavior: a review of the evidence. *Ecological Economics*, *140*, 1–13. https://doi.org/10.1016/j.ecolecon.2017.04.017

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford: University Press.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research* (Reading). MA: Addison-Wesley.

Fritsche, I., Barth, M., Jugert, P., Masson, T., & Reese, G. (2018). A social identity model of pro-environmental action (SIMPEA). *Psychological Review*, *125*(2), 245–269. https://doi.org/http://dx.doi.org/10.1037/rev0000090

Galloway, T. S. (2015). Micro-and nano-plastics and human health. In M. Bergmann, L. Gutow, & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 343–366). Cham: Springer.

Galloway, T. S., Cole, M., & Lewis, C. (2017). Interactions of microplastics throughout the marine ecosystem. *Nature Ecology and Evolution*, *1*(5), 1–8. https://doi.org/10.1038/s41559-017-0116

Gardner, B., & Abraham, C. (2008). Psychological correlates of car use: A meta-analysis. *Transportation Research Part F: Traffic Psychology and Behaviour*, *11*(4), 300–311. https://doi.org/10.1016/j.trf.2008.01.004

Geiger, S. M., Fischer, D., & Schrader, U. (2017). Measuring what matters in sustainable consumption: an integrative framework for the selection of relevant behaviors. *Sustainable Development*. https://doi.org/10.1002/sd.1688

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, *3*(7), 1–5. https://doi.org/10.1126/sciadv.1700782

Gharfalkar, M., Court, R., Campbell, C., Ali, Z., & Hillier, G. (2015). Analysis of waste hierarchy in the European waste directive 2008/98/EC. *Waste Management*, *39*, 305–313. https://doi.org/10.1016/j.wasman.2015.02.007

Gibb, B. C. (2019). Plastics are forever. *Nature Chemistry*, *11*, 394–395. https://doi.org/10.1038/s41557-019-0260-7

Gifford, R. (2011). The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, *66*(4), 290–302. https://doi.org/10.1037/a0023566

Gkargkavouzi, A., Halkos, G., & Matsiori, S. (2019). Environmental behavior in a private-sphere context: Integrating theories of planned behavior and value belief norm, self-identity and habit. *Resources, Conservation and Recycling*, *148*(145–156). https://doi.org/10.1016/j.resconrec.2019.01.039

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: a meta-analysis of effects and processes. *Advantages in Experimental Social Psychology*, *38*, 69–119. https://doi.org/10.1016/S0065-2601(06)38002-1

Halden, R. U. (2010). Plastics and health risks. *Annual Review of Public Health*, *31*(1), 179–194. https://doi.org/10.1146/annurev.publhealth.012809.103714

Hamann, K. R. S., & Reese, G. (2020). My influence on the world (of others) – goal efficacy beliefs and efficacy affect predict private, public, and activist pro-environmental intentions. *Journal of Social Issues*. https://doi.org/10.1111/josi.12369

Hartley, B. L., Pahl, S., Veiga, J., Vlachogianni, T., Vasconcelos, L., Maes, T., … Thompson, R. C. (2018). Exploring public views on marine litter in Europe: Perceived causes, consequences and pathways to change. *Marine Pollution Bulletin*, *133*, 945–955. https://doi.org/10.1016/j.marpolbul.2018.05.061

Hartley, B. L., Thompson, R. C., & Pahl, S. (2015). Marine litter education boosts children's understanding and self-reported actions. *Marine Pollution Bulletin*, *90*, 209–217. https://doi.org/10.1016/j.marpolbul.2014.10.049

Heidbreder, L. M., Steinhorst, J., & Schmitt, M. (2020). Plastic-Free July: An experimental study of limiting and promoting factors in encouraging a reduction of single-use plastic consumption. *Sustainability*, *12*(11), 4698. https://doi.org/10.3390/su12114698

Heidbreder, Lea Marie, Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of the Total Environment*, *668*, 1077–1093. https://doi.org/10.1016/j.scitotenv.2019.02.437

Heidbreder, Lea Marie, & Schmitt, M. (2020). Fasting plastic – an intervention study to break habits of plastic consumption. *Psyecology*. https://doi.org/10.1080/21711976.2020.1728652

Heidbreder, Lea Marie, Tröger, J., & Schmitt, M. (n.d.). Why do people engage in a plastic-free world? Exploring antecedents of anti-plastic activities.

Heiser, P. (2020). *Fasten in Deutschland: Ein Forschungsbericht*. Retrieved from https://www.ssoar.info/ssoar/bitstream/handle/document/70639/ssoar-2020-heiser-Fasten_in_Deutschland_Ein_Forschungsbericht.pdf?sequence=1&isAllowed=y&lnkname=ssoar-2020-heiser-Fasten_in_Deutschland_Ein_Forschungsbericht.pdf

Henn, L., Otto, S., & Kaiser, F. G. (2020). Positive spillover: The result of attitude change. *Journal of Environmental Psychology*, *69*, 101429. https://doi.org/10.1016/j.jenvp.2020.101429

Herbes, C., Beuthner, C., & Ramme, I. (2018). Consumer attitudes towards biobased packaging - A cross-cultural comparative study. *Journal of Cleaner Production*, *194*, 203–218. https://doi.org/10.1016/j.jclepro.2018.05.106

Homburg, A., & Lange, F. (2020). *Klimaschonendes Verhalten fördern - Beiträge der Umweltpsychologie*. Retrieved from https://www.umweltpsychologie.de/wissen/klimaschonendes-verhalten/

Homburg, A., & Stolberg, A. (2006). Explaining pro-environmental behavior with a cognitive theory of stress. *Journal of Environmental Psychology*, *26*(1), 1–14. https://doi.org/10.1016/j.jenvp.2006.03.003

IPCC. (2019). *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change,*. Retrieved from https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_Low_Res.pdf

IPSOS. (2018). *Plastic Free July worldwide uptake - Ipsos Global advisor survey*. Retrieved from https://www.plasticfreejuly.org/wp-content/uploads/2019/06/Plastic-Free-July-worldwide-uptake-Ipsos-Global-Advisor-Survey.pdf

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., … Law, K. L. (2015). Plastic waste inputs from land into the ocean. *Marine Pollution*, *347*(6223), 768–771. https://doi.org/10.1126/science.1260352

Jefferson, M. (2019). Whither plastics? Petrochemicals, plastics and sustainability in a garbage-riddled world. *Energy Research and Social Science*, *56*, 101229. https://doi.org/10.1016/j.erss.2019.101229

Jones, C. H., & Ogilvie, D. (2012). Motivations for active commuting: a qualitative investigation of the period of home or work relocation. *Journal of Behavioral Nutrition and Physical Activity*, *9*(109), 1–12. https://doi.org/10.1186/1479-5868-9-109

Jugert, P., Greenaway, K. H., Barth, M., Büchner, R., Eisentraut, S., & Fritsche, I. (2016). Collective efficacy increases pro- environmental intentions through increasing self-efficacy. *Journal of Environmental Psychology*, *48*, 12–23. https://doi.org/10.1016/j.jenvp.2016.08.003

Kirmani, A. (1997). Advertising repetition as a signal of quality: If it's advertised so much, something must be wrong. *Journal of Advertising*, *26*(3), 77–86. https://doi.org/10.1080/00913367.1997.10673530

Klemeš, J. J., Van Fan, Y., Tan, R. R., & Jiang, P. (2020). Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19. *Renewable and Sustainable Energy Reviews*, *127*, 109883. https://doi.org/10.1016/j.rser.2020.109883

Klöckner, C. A. (2013). A comprehensive model of the psychology of environmental behaviour - A meta-analysis. *Global Environmental Change*, *23*(5), 1028–1038. https://doi.org/10.1016/j.gloenvcha.2013.05.014

Klöckner, C. A., & Blöbaum, A. (2010). A comprehensive action determination model: Toward a broader understanding of ecological behaviour using the example of travel mode choice. *Journal of Environmental Psychology*, *30*(4), 574–586. https://doi.org/10.1016/j.jenvp.2010.03.001

Knussen, C., & Yule, F. (2008). "I'm not in the habit of recycling" - The role of habitual behavior in the disposal of household waste. *Environment and Behavior*, *40*(5), 683–702. https://doi.org/10.1177/0013916507307527

Knussen, C., Yule, F., MacKenzie, J., & Wells, M. (2004). An analysis of intentions to recycle household waste: The roles of past behaviour, perceived habit, and perceived lack of facilities. *Journal of Environmental Psychology*, *24*(2), 237–246. https://doi.org/10.1016/j.jenvp.2003.12.001

Kurz, T., Prosser, A. M. B., Rabinovich, A., & O'Neill, S. (2020). Could vegans and Lycra cyclists be cad for the planet? Theorizing the role of moralized minority practice identities in processes of societal-level change. *Journal of Social Issues*, *76*(1), 86–100. https://doi.org/10.1111/josi.12366

Lapinski, M. K., & Rimal, R. N. (2005). An explication of social norms. *Communication Theory*, *15*(2), 127–147. https://doi.org/10.1093/ct/15.2.127

Levin, K., Cashore, B., Bernstein, S., & Auld, G. (2012). Overcoming the tragedy of super wicked problems: Constraining our future selves to ameliorate global climate change. *Policy Sciences*, *45*(2), 123–152. https://doi.org/10.1007/s11077-012-9151-0

Li, P., Wang, X., Su, M., Zou, X., Duan, L., & Zhang, H. (2020). Characteristics of plastic pollution in the environment: A review. *Bulletin of Environmental Contamination and Toxicology*, 1–8. https://doi.org/10.1007/s00128-020-02820-1

Li, W. C., Tse, H. F., & Fok, L. (2016). Plastic waste in the marine environment: A review of sources, occurrence and effects. *Science of the Total Environment*, *566*, 333–349. https://doi.org/10.1016/j.scitotenv.2016.05.084

Little, D. (1991). Rational-Choice Models and Asian Studies. *The Journal of Asian Studies*, *50*(1), 35–52.

Loy, L. S., Wieber, F., Gollwitzer, P. M., & Oettingen, G. (2016). Supporting sustainable food consumption: Mental contrasting with implementation intentions (MCII) aligns intentions and behavior. *Frontiers in Psychology*, *7*(607), 1–12. https://doi.org/10.3389/fpsyg.2016.00607

Ma, X., Park, C., & Moultrie, J. (2020). Factors for eliminating plastic in packaging: The European FMCG experts' view. *Journal of Cleaner Production*, *256*, 120492. https://doi.org/10.1016/j.jclepro.2020.120492

Mederake, L., & Knoblauch, D. (2019). Shaping EU plastic policies: The role of public health vs. environmental arguments. *International Journal of Environmental Research and Public Health*, *16*(20). https://doi.org/10.3390/ijerph16203928

Menken, S., & Keestra, M. (2016). *An introduction to interdisciplinary research: Theory and practice*. Amsterdam: University Press.

Müller, R., Schönbauer, S., Decker, T., Hentschel, A., Lippl, M., Loges, B., … Steinhorst, J. (2020). *Plastik in der Umwelt: Sozialwissenschaftliche Perspektiven*. Retrieved from https://bmbf-plastik.de/de/publikation/diskussionspapier_qst4

Muralidharan, S., & Sheehan, K. (2016). "Tax" and "fee" message frames as inhibitors of plastic bag usage among shoppers: A social marketing application of the theory of planned behavior. *Social Marketing Quarterly*, *22*(3), 200–217. https://doi.org/10.1177/1524500416631522

Murtagh, S., Rowe, D. A., McMinn, D., & Nelson, N. M. (2012). Active travel in school children: role of habit strength in the theory of planned behavior. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(65), 1–9. https://doi.org/10.1249/01.mss.0000400909.69120.a0

Musa, H. M., Hayes, C., Bradley, M. J., Clayson, A., & Gillibrand, G. (2013). Measures aimed at reducing plastic carrier bag use: A consumer behaviour focused study. *Natural Environment*, *1*(1), 17–23. https://doi.org/10.12966/ne.06.02.2013

Neal, D. T., Wood, W., & Quinn, J. M. (2006). Habits - A repeat performance. *Current Directions in Psychological Science*, *15*(4), 198–202. https://doi.org/10.1111/j.1467-8721.2006.00435.x

Nielsen, T. D., Hasselbalch, J., Holmberg, K., & Stripple, J. (2020). Politics and the plastic crisis: A review throughout the plastic life cycle. *Wiley Interdisciplinary Reviews: Energy and Environment*, *9*(1), 1–18. https://doi.org/10.1002/wene.360

Niemiec, R. M., Champine, V., Vaske, J. J., & Mertens, A. (2020). Does the impact of norms vary by type of norm and type of conservation behavior? A meta-analysis. *Society and Natural Resources*, *33*(8), 1024–1040. https://doi.org/10.1080/08941920.2020.1729912

Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative social influence is underdetected. *Personality and Social Psychology Bulletin*, *34*(7), 913–923. https://doi.org/10.1177/0146167208316691

Obbard, R. W., Sadri, S., Wong, Y. Q., Khitun, A. A., Baker, I., & Thompson, R. C. (2014). Global warming releases microplastic legacy frozen in Arctic Sea ice. *Earth's Future*, *2*(6), 315–320. https://doi.org/10.1002/2014ef000240

Ofstad, S. P., Tobolova, M., Nayum, A., & Klöckner, C. A. (2017). Understanding the mechanisms behind changing people's recycling behavior at work by applying a comprehensive action determination model. *Sustainability (Switzerland)*, *9*(2). https://doi.org/10.3390/su9020204

Ohtomo, S., & Ohnuma, S. (2014). Psychological interventional approach for reduce resource consumption: Reducing plastic bag usage at supermarkets. *Resources, Conservation and Recycling*, *84*(November), 57–65. https://doi.org/10.1016/j.resconrec.2013.12.014

Oliver, J., Benjamin, S., & Leonard, H. (2019). Recycling on vacation: Does pro-environmental behavior change when consumers travel? *Journal of Global Scholars of Marketing Science*, *29*(2), 266–280. https://doi.org/10.1080/21639159.2019.1577158

Orbell, S., & Verplanken, B. (2018). Progress and prospects in habit research. In V. B. (Ed.), *The Psychology of Habit* (pp. 397–409). Cham: Springer. https://doi.org/10.1007/978-3-319-97529-0_22

Orbell, Sheina, & Verplanken, B. (2010). The automatic component of habit in health behavior: Habit as cue-contingent automaticity. *Health Psychology*, *29*(4), 374–383. https://doi.org/10.1037/a0019596

Otto, I. M., Donges, J. F., Cremades, R., Bhowmik, A., Hewitt, R. J., Lucht, W., ... & Lenferna, A. (2020). Social tipping dynamics for stabilizing Earth's climate by 2050. *Proceedings of the National Academy of Sciences*, *117*(5), 2354-2365. https://doi.org/10.1073/pnas.1900577117

Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior, *124*(1), 54–74. https://doi.org/http://dx.doi.org/10.1037/0033-2909.124.1.54

Owens, K. A. (2018). Using experiential marine debris education to make an impact: Collecting debris, informing policy makers, and influencing students. *Marine Pollution Bulletin*, *127*, 804–810. https://doi.org/10.1016/j.marpolbul.2017.10.004

Pakpour, A. H., Zeidi, I. M., Emamjomeh, M. M., Asefzadeh, S., & Pearson, H. (2014). Household waste behaviours among a community sample in Iran: An application of the theory of planned behaviour. *Waste Management*, *34*(6), 980–986. https://doi.org/10.1016/j.wasman.2013.10.028

Penca, J. (2018). European plastics strategy: What promise for global marine litter? *Marine Policy*, *97*, 197–201. https://doi.org/10.1016/j.marpol.2018.06.004

PlasticsEurope. (2019). *Plastics - the Facts 2019*. Retrieved from https://www.plasticseurope.org/application/files/1115/7236/4388/FINAL_web_version_Plastics_the_facts2019_14102019.pdf

Poortinga, W., & Whitaker, L. (2018). Promoting the use of reusable coffee cups through environmental messaging, the provision of alternatives and financial incentives. *Sustainability (Switzerland)*, *10*(3), 1–10. https://doi.org/10.3390/su10030873

Reese, G., & Junge, E. A. (2017). Keep on rockin' in a (plastic-)free world: Collective efficacy and pro-environmental intentions as a function of task difficulty. *Sustainability (Switzerland)*, *9*(2). https://doi.org/10.3390/su9020200

Reese, G., & Tröger, J. (n.d.). Talkin' bout a revolution: an expert interview study exploring barriers and keys to engender change towards societal sufficiency orientation. *Journal of Sustainability Science*. https://doi.org/10.1007/s11625-020-00871-1.

Reisch, L. A., Cohen, M. J., Thøgersen, J. B., & Tukker, A. (2016). Frontiers in sustainable consumption. *GAIA-Ecological Perspectives for Science and Society*, *25*(4), 234–241. https://doi.org/10.14512/gaia.25.4.4

Rindfleisch, A., & Inman, J. J. (1998). Explaining the familiarity-liking relationship: Mere exposure, information availability, or social desirability? *Marketing Letters*, *9*(1), 5–19. https://doi.org/10.1023/A:1007958302123

Ritch, E., Brennan, C., & MacLeod, C. (2009). Plastic bag politics: modifying consumer behaviour for sustainable development. *International Journal of Consumer Studies*, *33*, 168–174. https://doi.org/10.1111/j.1470-6431.2009.00749.x

Rivers, N., Shenstone-Harris, S., & Young, N. (2017). Using nudges to reduce waste? The case of Toronto's plastic bag levy. *Journal of Environmental Management*, *188*, 153–162. https://doi.org/10.1016/j.jenvman.2016.12.009

Rivis, A., Sheeran, P., & Armitage, C. J. (2009). Expanding the affective and normative components of the theory of planned behavior: A meta-analysis of anticipated affect and moral norms. *Journal of Applied Soc*, *39*(12), 2985–3019. https://doi.org/10.1111/j.1559-1816.2009.00558.x

Rockström, J., Steffen, W., Noone, K., Persson, Å., Iii, F. S. C., Lambin, E., … Liverman, D. (2009). Planetary boundaries: Exploring the safe operating space for humanity. *Ecology and Society*, *14*(2).

Rubens, L., Gosling, P., Bonaiuto, M., Brisbois, X., & Moch, A. (2015). Being a hypocrite or committed while I am shopping? A comparison of the impact of two interventions on environmentally friendly behavior. *Environment and Behavior*, *47*(1), 3–16. https://doi.org/10.1177/0013916513482838

Ruby, M. B., Walker, I., & Watkins, H. M. (2020). Sustainable consumption: The psychology of individual choice, identity, and behavior. *Journal of Social Issues*. https://doi.org/10.1111/josi.12376

Saidan, M. N., Ansour, L. M., & Saidan, H. (2017). Management of plastic bags waste: An assessment of scenarios in Jordan. *Journal of Chemical Technology and Metallurgy*, *52*(1), 148–154.

Samadi, S., Gröne, M. C., Schneidewind, U., Luhmann, H. J., Venjakob, J., & Best, B. (2017). Sufficiency in energy scenario studies: Taking the potential benefits of lifestyle changes into account. *Technological Forecasting and Social Change*, *124*, 126–134. https://doi.org/10.1016/j.techfore.2016.09.013

Santos, J. M., & van der Linden, S. (2016). Changing norms by changing behavior: The princeton drink local program. *Environmental Practice*, *18*(2), 116–122. https://doi.org/10.1017/S1466046616000144

Santos, S. C., Sousa, C. V. e, Sampaio, D. de O., & Fagundes, A. F. A. (2013). The impact of using compostable carrier bags on consumer behaviour in the City of Belo Horizonte, Brazil. *Ambiente and Sociedade*, *16*(4), 1–20. https://doi.org/10.1590/S1414-753X2013000400002

Săplăcan, Z., & Márton, B. (2019). Determinants of adopting a zero waste consumer lifestyle. *Regional and Business Studies*, *11*(2), 25–39. https://doi.org/10.33568/rbs.2410

Schäfer, M., Jaeger-Erben, M., & Bamberg, S. (2012). Life Events as Windows of Opportunity for Changing Towards Sustainable Consumption Patterns? *Journal of Consumer Policy*, *35*(1), 65–84. https://doi.org/10.1007/s10603-011-9181-6

Schoenebeck, S. Y. (2014). Giving up twitter for lent: How and why we take breaks from social media. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 773–782). https://doi.org/10.1145/2556288.2556983

Schulte, M., Bamberg, S., Rees, J., & Rollin, P. (2020). Social identity as a key concept for connecting transformative societal change with individual environmental activism. *Journal of Environmental Psychology*, 101525. https://doi.org/10.1016/j.jenvp.2020.101525

Schultz, P. W. (2014). Strategies for promoting proenvironmental behavior: Lots of tools but few instructions. *European Psychologist*, *19*(2), 107–117. https://doi.org/10.1027/1016-9040/a000163

Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (pp. 221–279). San Diego: Academic Press.

Si, H., Shi, J. G., Tang, D., Wen, S., Miao, W., & Duan, K. (2019). Application of the theory of planned behavior in environmental science: a comprehensive bibliometric analysis. *International Journal of Environmental Research and Public Health*, *16*(15). https://doi.org/10.3390/ijerph16152788

So, W.-M. W., Cheng, N.-Y. I., Chow, C.-F., & Zhan, Y. (2016). Learning about the types of plastic wastes: effectiveness of inquiry learning strategies. *Education 3-13*, *44*(3), 311–324. https://doi.org/10.1080/03004279.2014.976239

Spranz, R., Schlüter, A., & Vollan, B. (2018). Morals, money or the master: The adoption of eco-friendly reusable bags. *Marine Policy*, *96*, 270–277. https://doi.org/10.1016/j.marpol.2018.01.029

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., … Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, *347*(6223). https://doi.org/10.1126/science.1259855

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Steinmetz, H., Knappstein, M., Ajzen, I., Schmidt, P., & Kabst, R. (2016). How effective are behavior change interventions based on the theory of planned behavior? A three-level meta-analysis. *Zeitschrift Fur Psychologie / Journal of Psychology*, *224*(3), 216–233. https://doi.org/10.1027/2151-2604/a000255

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, *56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175

Sun, Y., Wang, S., Li, J., Zhao, D., & Fan, J. (2017). Understanding consumers' intention to use plastic bags: Using an extended theory of planned behaviour model. *Natural Hazards*, *89*(3), 1327–1342. https://doi.org/10.1007/s11069-017-3022-0

Sundblad, E. L., Biel, A., & Gärling, T. (2007). Cognitive and affective risk judgements related to climate change. *Journal of Environmental Psychology*, *27*(2), 97–106. https://doi.org/10.1016/j.jenvp.2007.01.003

Synthia, I. J., & Kabir, S. (2015). An investigation of cosumer attitudes towards new varieties of shopping bags: Exploring eco-awareness and the possibility of behavior change. *The Journal of Developing Areas*, *49*(5), 183–196. https://doi.org/10.1353/jda.2015.0062

Taufik, D., Verain, M. C. D., Bouwman, E. P., & Reinders, M. J. (2019). Determinants of real-life behavioural interventions to stimulate more plant-based and less animal-based diets: A systematic review. *Trends in Food Science and Technology*, *93*, 281–303. https://doi.org/10.1016/j.tifs.2019.09.019

Thøgersen, J. (1999). The ethical consumer. Moral norms and packaging choice. *Journal of Consumer Policy*, *22*(4), 439–460. https://doi.org/10.1023/A:1006225711603

Thøgersen, J. (2012). The importance of timing for breaking commuters' car driving habits. In A. Warde & D. Southerton (Eds.), *The habits of consumption* (pp. 130–140). Helsinki, Finland: Helsinki Collegium for Advanced Studies.

Thøgersen, J., & Ölander, F. (2003). Spillover of environment-friendly consumer behaviour. *Journal of Environmental Psychology*, *23*(3), 225–236. https://doi.org/10.1016/S0272-4944(03)00018-5

Thompson, R. C., Moore, C. J., vom Saal, F. S., & Swan, S. H. (2009). Plastics, the environment and human health: current consensus and future trends. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 2153–2166. https://doi.org/10.1098/rstb.2009.0053

Thompson, Richard C., Swan, S. H., Moore, C. J., & Vom Saal, F. S. (2009). Our plastic age. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 1973–1976. https://doi.org/10.1098/rstb.2009.0054

Thompson, S., Michaelson, J., Abdallah, S., Johnson, V., Morris, D., Riley, K., & Simms, A. (2011). *'Moments of change' as opportunities for influencing behaviour: A research report completed for the Department for Environment, Food and Rural Affairs*. *Nef (the New Economics Foundation)*. London. Retrieved from http://randd.defra.gov.uk/Document.aspx?Document=MomentsofChangeEV0506FinalReportNov2011(2).pdf

Trepanowski, J. F., & Bloomer, R. J. (2010). The impact of religious fasting on human health. *Nutrition Journal*, *9*(57), 1–9. https://doi.org/10.1186/1475-2891-9-57

Triandis, H. C. (1977). *Interpersonal behavior*. Monterey: Brooks.

Triebskorn, R., Braunbeck, T., Grummt, T., Hanslik, L., Huppertsberg, S., Jekel, M., … Köhler, H. R. (2019). Relevance of nano- and microplastics for freshwater ecosystems: A critical review. *TrAC - Trends in Analytical Chemistry*, *110*, 375–392. https://doi.org/10.1016/j.trac.2018.11.023

UBA. (2017). *Umweltbewusstsein in Deutschland 2016*. Retrieved from https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/umweltbewusstsein_deutschland_2016_bf.pdf

Van Cauwenberghe, L., Vanreusel, A., Mees, J., & Janssen, C. R. (2013). Microplastic pollution in deep-sea sediments. *Environmental Pollution*, *182*, 495–499. https://doi.org/10.1016/j.envpol.2013.08.013

van Veelen, B., & Hasselbalch, J. (2020). Power and politics in plastics research: A critique of "Whither plastics." *Energy Research and Social Science*, *61*, 101445. https://doi.org/10.1016/j.erss.2020.101445

Vanapalli, K. R., Sharma, H. B., Ranjan, V. P., Samal, B., Bhattacharya, J., Dubey, B. K., & Goel, S. (2020). No title challenges and strategies for effective plastic waste management during and post COVID-19 pandemic. *Science of the Total Environment*, *750*, 141514. https://doi.org/10.1016/j.scitotenv.2020.141514

Veiga, J. M., Vlachogianni, T., Pahl, S., Thompson, R. C., Kopke, K., Doyle, T. K., … Alampei, I. (2016). Enhancing public awareness and promoting co-responsibility for marine litter in Europe: The challenge of MARLISCO. *Marine Pollution Bulletin*, *102*(2), 309–315. https://doi.org/10.1016/j.marpolbul.2016.01.031

Venter, K., van der Merwe, D., de Beer, H., Kempen, E., & Bosman, M. (2011). Consumers' perceptions of food packaging: an exploratory investigation in Potchefstroom, South Africa. *International Journal of Consumer Studies*, *35*(3), 273–281. https://doi.org/10.1111/j.1470-6431.2010.00936.x

Verfuerth, C., Henn, L., & Becker, S. (2019). Is it up to them? Individual leverages for sufficiency. *GAIA-Ecological Perspectives for Science and Society*, *28*(4), 374–380. https://doi.org/10.14512/gaia.28.4.9

Verplanken, B., & Aarts, H. (1999). Habit, attitude, and planned behaviour: is habit an empty construct or an interesting case of goal-directed automaticity? *European Review of Social Psychology*, *10*(1), 101–134. https://doi.org/10.1080/14792779943000035

Verplanken, B., & Roy, D. (2015). Sustainable Consumption. In L. A. Reisch & J. Thøgersen (Eds.), *Handbook of Research on Sustainable Consumption* (pp. 243–253). Cheltenham, UK: Edward Elgar.

Verplanken, B., & Roy, D. (2016). Empowering interventions to promote sustainable lifestyles: Testing the habit discontinuity hypothesis in a field experiment. *Journal of Environmental Psychology*, *45*, 127–134. https://doi.org/10.1016/j.jenvp.2015.11.008

Verplanken, B., Walker, I., Davis, A., & Jurasek, M. (2008). Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology*, *28*(2), 121–127. https://doi.org/10.1016/j.jenvp.2007.10.005

Verplanken, B., & Wood, W. (2006). Interventions to break and create consumer habits. *American Marketing Associationarketing Association*, *25*(1), 90–103. https://doi.org/10.1509/jppm.25.1.90

Villarrubia-Gómez, P., Cornell, S. E., & Fabres, J. (2018). Marine plastic pollution as a planetary boundary threat – The drifting piece in the sustainability puzzle. *Marine Policy*, *96*, 213–220. https://doi.org/10.1016/j.marpol.2017.11.035

Vogel, I. C., Werling, K., Barkela, B., & Milde, J. (n.d.). Plastics in mass media. A content analysis of German media coverage of plastic-associated risks and sustainable alternatives to plastics.

Wagner, M., Scherer, C., Alvarez-Muñoz, D., Brennholt, N., Bourrain, X., Buchinger, S., … Reifferscheid, G. (2014). Microplastics in freshwater ecosystems: what we know and what we need to know. *Environmental Sciences Europe*, *26*(12), 1–9. https://doi.org/10.1016/0163-8343(83)90040-3

Wagner, T. P. (2017). Reducing single-use plastic shopping bags in the USA. *Waste Management*, *70*, 3–12. https://doi.org/10.1016/j.wasman.2017.09.003

Walker, I., Thomas, G. O., & Verplanken, B. (2015). Old habits die hard: Travel habit formation and decay during an office relocation. *Environment and Behavior*, *47*(10), 1089–1106. https://doi.org/10.1177/0013916514549619

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, *132*(2), 249–268. https://doi.org/10.1037/0033-2909.132.2.249

White, K. M., Smith, J. R., Terry, D. J., Greenslade, J. H., & McKimmie, B. M. (2009). Social influence in the theory of planned behaviour: the role of descriptive, injunctive, and ingroup norms. *British Journal of Social Psychology*, *48*(1), 135–158. https://doi.org/10.1348/014466608X295207

Whitmarsh, L. E., Haggar, P., & Thomas, M. (2018). Waste reduction behaviors at home, at work, and on holiday: What influences behavioral consistency across contexts? *Frontiers in Psychology*, *9*(2447), 1–13. https://doi.org/10.3389/fpsyg.2018.02447

Wilcox, C., Puckridge, M., Schuyler, Q. A., Townsend, K., & Hardesty, B. D. (2018). A quantitative analysis linking sea turtle mortality and plastic debris ingestion. *Scientific Reports*, *8*(1), 1–11. https://doi.org/10.1038/s41598-018-30038-z

Wood, W., & Neal, D. T. (2009). The habitual consumer. *Journal of Consumer Psychology*, *19*(4), 579–592. https://doi.org/10.1016/j.jcps.2009.08.003

Wood, W., Quinn, J. M., & Kashy, D. A. (2002). Habits in everyday life: Thought, emotion, and action. *Journal of Personality and Social Psychology*, *83*(6), 1281–1297. https://doi.org/10.1037/0022-3514.83.6.1281

Wood, W., Tam, L., & Witt, M. G. (2005). Changing circumstances, disrupting habits. *Journal of Personality and Social Psychology*, *88*(6), 918–933. https://doi.org/10.1037/0022-3514.88.6.918

Worm, B., Lotze, H. K., Jubinville, I., Wilcox, C., & Jambeck, J. (2017). Plastic as a persistent marine pollutant. *Annual Review of Environment and Resources*, *42*, 1–26. https://doi.org/10.1146/annurev-environ-102016-060700

Xanthos, D., & Walker, T. R. (2017). International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review. *Marine Pollution Bulletin*, *118*(1–2), 17–26. https://doi.org/10.1016/j.marpolbul.2017.02.048 0025-326/©

Yin, H. H., & Knowlton, B. J. (2006). The role of the basal ganglia in habit formation. *Nature Reviews Neuroscience*, *7*(6), 464–476. https://doi.org/10.1038/nrn1919

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology*, *9*(2), 1–27. https://doi.org/10.1037/h0025848

Zalasiewicz, J., Waters, C. N., Ivar, J., Corcoran, P. L., Barnosky, A. D., Cearreta, A., … Yonan, Y. (2016). The geological cycle of plastics and their use as a stratigraphic indicator of the Anthropocene. *Anthropocene*, *13*, 4–17. https://doi.org/10.1016/j.ancene.2016.01.002

Zen, I. S., Ahamad, R., & Omar, W. (2013). No plastic bag campaign day in Malaysia and the policy implication. *Environment, Development and Sustainability*, *15*(5), 1259–1269. https://doi.org/10.1007/s10668-013-9437-1

CURRICULUM VITAE

Lea Marie Heidbreder

Date of Birth: 26/03/1991, in Bielefeld
Place of Residence: Landau (Pfalz)

Education

Since 11/2016	Ph.D. Candidate in Environmental Psychology at the University of Koblenz-Landau, Germany
10/2014-10/2016	Master of Science in Psychology for Work, Education and Society Friedrich-Schiller University Jena, Germany, degree: M. Sc. (1.3) Master thesis: "Motivational explanatory approaches for young adults' decision of not owning a car based on the theory of planned behavior and the norm activation model"
10/2010-02/2014	Bachelor of Science in Psychology University of Kassel, Germany, degree: B. Sc. (1.2) Bachelor thesis: "Risk perception and acceptance of hydraulic fracturing: Consideration of a new technology by environmental psychology perspective"
08/2001-06/2010	Ceciliengymnasium Bielefeld, Germany, degree: Abitur (1.4)

Work Experience

Since 11/2016	Research associate at the University of Koblenz-Landau - member of the project PLAST (Interdisciplinary Research Group for Environmental Studies) - 11/2016-12/2018: Institute of Personality, Psychological Assessment, and Psychological Methods - Since 01/2019: Institute of Communication Psychology and Media Pedagogics
08/2015-09/2015	Internship in the Federal Environment Agency, Dessau
03/2014-07/2014	Internship in the Environmental Communication Department of the German Railway Company, Berlin
03/2012-02/2013	Chair and Environmental Representative in the Students Union at the University of Kassel
05/2011-03/2012	Student Assistant in the Department of General Psychology, Kassel

Teaching Experience

Psychology courses:

- Personality and performance diagnostics
- Methodical critique, scientific reading, writing and presenting
- Basics of test theory

Interdisciplinary courses:

- Case study
- Introduction to scientific and practical interdisciplinary work I + II

Publications

- Heidbreder, L.M., Tröger, J. & Schmitt, M. (under review). Why do people engage in a plastic-free world?
- Heidbreder, L.M., Lange, M. & Reese, G. (under review). #PlasticFreeJuly - Analyzing a worldwide campaign to reduce single-use plastic consumption with twitter.
- Heidbreder, L.M. & Schmitt, M. (2020). Fasting plastic: an intervention study to break habits of plastic consumption. *PsyEcology, 11*(2). https://doi.org/10.1080/21711976.2020.1728652
- Heidbreder, L.M., Steinhorst, J. & Schmitt, M. (2020). Plastic Free July: An experimental study of limiting and promoting factors in encouraging a reduction of single-use plastic consumption. *Sustainability, 12*(11), 4698. https://doi.org/10.3390/su12114698
- Menzel, C. & Heidbreder, L.M (2020). 360° Plastik in Sicht! Wie kann uns eine Kurskorrektur beim Plastikkonsum gelingen? *InMind, 2*.
- Reese, G., Haman, K.R.S., Heidbreder, L.M., Loy, L.S., Menzel, C., Neubert, S., Tröger, J. & Wullenkord, M.C. (2020). SARS-Cov-2 and environmental protection: A collective psychology agenda for environmental psychology research. *Journal of Environmental Psychology, 70.* https://doi.org/10.1016/j.jenvp.2020.101444
- Wullenkord, M.C., Heidbreder, L.M. & Reese, G. (2020). Reactions to Environmental Changes: Place Attachment Predicts Interest in Earth Observation Data. *Frontiers in Psychology, 11*, 1442. https://doi.org/10.3389/fpsyg.2020.01442
- Hamann, K.R.S., Heidbreder, L.M., & Tröger, J. (2019). Mit Psychologie die Hebel zum Umweltschutz verstehen und fördern. *Report Psychologie, 2/2019*, 4-6.
- Heidbreder, L.M., Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of The Total Environment, 668,* 1077–1093. https://doi.org/10.1016/j.scitotenv.2019.02.437
- Heidbreder, L.M. (2019). The influence of morality on private and political behavior involving a reduction in plastic use. *BfN-Skript, 529,* 65-71.

Conferences

- 02/2020: Presentation "Phasen des Wandels - Zwei Interventionsstudien zur Veränderungen von Gewohnheiten beim Plastikkonsum", Winterschool, Döllnsee, Germany
- 09/2019: Presentation "Fasting plastic - Intervention studies to break habits of plastic consumption", International Conference of Environmental Psychology, Plymouth, UK
- 09/2018: Presentation "Homo moralis - the influence of moral norm and ethical emotions on private and political intention of a sufficient plastic use", DGPS-Congress, Frankfurt, Germany
- 07/2018: Poster "Fasting Plastic – An Intervention study to break old habits of plastic consumption", IAPS, Rom

Transfer

- 11/2020: Guest lecture „360 Grad Plastik in Sicht – Wie kann uns eine Kurskorerktur beim Plastikkonsum gelingen?“, Ministry of the Environment of Rhineland-Palatinate, Mainz, Germany
- 12/2019: Interview „Plastiknutzung im Alltag“, Deutschlandfunk Nova https://www.deutschlandfunknova.de/beitrag/inkonsequente-nachhaltigkeit-warum-wir-nicht-plastikfrei-leben-koennen
- 10/2019: Guest lecture "Umweltpsychologie – vom Denken zum Handeln", Greenworld, Münster, Germany
- 06/2019: Guest lecture "Plastikkonsum - Wie verändern sich Gewohnheiten?", DBU-Sommerakademie, Loccum, Germany
- 02/2019: Panel discussion "Mikroplastik im Boden", BioFach Nürnberg, Germany

Landau, den 30. November 2020

EIDESSTATTLICHE ERKLÄRUNG

Hiermit erkläre ich eidesstattlich, dass ich, Lea Marie Heidbreder,

- die Dissertation selbst angefertigt habe und alle Hilfsmittel in der Dissertation angegeben habe,
- dass die Dissertation noch nicht als Prüfungsarbeit für eine staatliche oder andere wissenschaftliche Prüfung eingereicht wurde und
- die gleiche oder eine andere Abhandlung nicht bei einer anderen Hochschule als Dissertation eingereicht habe.

Bei gemeinsam verfassten Publikationen habe ich folgende individuelle Beiträge erbracht:

Manuskript I

- Literaturrecherche
- Verfassen von Teilen des Manuskripts (Einleitung, Methoden und Diskussion wurden gemeinsam mit den Co-Autorinnen verfasst, Eigenanteil 33%; im Ergebnisteil das Kapitel „Psychological Interventions“ zu 90%; geteilte Erstautorenschaft)

Manuskript II

- Planung, Durchführung und Analysen
- Verfassen des Manuskriptes (die Einleitung und Diskussion wurde gemeinsam mit der Co-Autorin verfasst, Eigenanteil: 60%; Methoden- und Ergebnissteil zu 90%)

Manuskript III

- Planung, Durchführung und Analysen
- Verfassen des Manuskriptes (90%)

Manuskript IV

- Planung, Durchführung und Analysen
- Verfassen des Manuskriptes (90%)

Landau, den 30. November 2020