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Exploring the psychological antecedents of private and public sphere behaviours to reduce household plastic consumption

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Abstract

In the last few years, plastic has become an issue of current interest as tremendous ecological effects from plastic littering have become visible. Taking the role of consumers into account, activities comprising purchasing decisions and political engagement are expected to help prevent plastic pollution. The goal of this study was to examine antecedents of three potential plastic reduction activities: purchasing, activism, and policy support. Based on well-established psychological models of pro-environmental behaviour (i.e. theory of planned behaviour, norm activation model), an online survey ($N = 648$) was administered and analysed via structural equation modelling. Results revealed that personal norms were a relevant predictor of all three intentions. Whereas sufficiency orientation and collective efficacy predicted only activism intention and policy support intention, perceived behavioural control was the strongest predictor of purchasing intentions. Regarding behaviour, people with high activism intentions and sufficiency orientation were more likely to choose a plastic-free incentive instead of the conventional shopping voucher. This study highlights psychological antecedents of plastic reduction. An integrated model showed that rational cost–benefit considerations as well as morality serve as drivers of reducing plastic consumption. Implications for the promotion of plastic-free consumption are discussed.

Keywords Environmental psychology · Pro-environmental intentions · Plastic consumption · Sufficiency orientation · TPB

1 Aims and background

Plastic pollution is a major global crisis: Worldwide, 359 million tons of plastic are produced every year (PlasticsEurope, 2019, p. 14). It is estimated that 79% of the plastic waste that humans have generated has ended up in landfills or in the natural environment (Geyer et al., 2017). Once plastic is released into the environment, animals ingest it, become sick, and die (Li et al., 2016; Sigler, 2014). Plastic residuals have also been detected in human bodies (Galloway, 2015). A reduction in plastic production and consumption is necessary

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to stop the plastic contamination of marine and terrestrial ecosystems (Horton et al., 2017; Jambeck et al., 2015). Here, the consumer plays a decisive role.

According to the *Sustainable Development Goals*, sustainable consumption and production means 'doing more and better with less' (Reisch et al., 2016, p. 234). Thus, taking the waste hierarchy into account, promoting a reduction in plastic use is an important step towards tackling the plastic problem (Gharfalkar et al., 2015). Whereas many studies have focussed on recycling behaviour, only a few have examined reduction-oriented behaviours in the field of purchasing decisions (Heidbreder et al., 2019). The factors that motivate people to reduce plastic consumption are still understudied. The current study fills this gap by examining psychological factors that determine behaviours that are oriented towards plastic reduction.

When referring to plastic pollution, current concerns primarily focus on single-use plastic with a short life and a fast subsequent disposal. As 40% of the demand for plastic in Europe can be traced to packaging (PlasticsEurope, 2019), this study examined single-use plastic. The European Commission has also tackled single-use plastic and proposed a directive to target the single-use plastic products that are most often found on European beaches (European Commission, 2018). Like many other areas of consumption, the current use of plastic needs to be transformed to meet global sustainability goals (Bengtsson et al., 2018). People in the roles of consumers, citizens, and responsible members of the public (European Commission, 2018) can engender change not only through private but also through political behaviour (Stern, 2000). Therefore, it is important to take several types of consumer responses into account and examine them in parallel. There is a lack of studies that have integrated several behavioural strategies to address plastic pollution in both the private and public spheres.

To fill this gap, this paper first reviews relevant literature on relevant psychological antecedents for lowering plastic consumption. Then, the study presents and tests an integrated model based on the literature review. The model is designed to contribute to a comprehensive understanding of various anti-plastic activities in both the private and public spheres. Based on the results from the tests of a structural equation model and the estimated parameters, theoretical and practical implications of the study are presented.

1.1 Literature review

To capture important antecedents of single-use plastic reduction, available theories that have been proposed to explain pro-environmental behaviour need to be consulted. First, the theory of planned behaviour (*TPB*; Ajzen, 1991) provides important predictors. It uses a rational choice approach to explain when and why people engage in pro-environmental behaviour. The theory proposes that intention is a direct predictor of behaviour. Attitude (in terms of cost–benefit considerations about a behaviour), perceived behavioural control (the belief that one is capable of performing the behaviour), and social norms (perceived social pressure to perform the behaviour) indirectly influence behaviour via intentions (Armitage & Conner, 2001). Furthermore, perceived behavioural control is expected to have a direct impact on behaviour.

The *TPB* has been widely applied to the context of sustainable behaviour (Si et al., 2019), such as recycling behaviour (Cheung et al., 1999; Nguyen et al., 2019; Tonglet et al., 2004a, 2004b; Valle et al., 2005). So far, however, the *TPB* has only rarely been applied to both plastic use and consumption reduction (Si et al., 2019). A few studies have

explored components of the *TPB*, such as social norms to predict the use of cloth bags instead of plastic bags (Ari & Yilmaz, 2017) or to predict waste minimisation (Tonglet et al., 2004a, 2004b). Beyond such private-sphere behaviours, *TPB* variables have been found to explain environmental activism (Fielding et al., 2008), indicating that people with positive attitudes towards environmental activism and stronger social norms were more likely to engage in pro-environmentalism.

In several studies, constructs from additional theories, such as personal norms (i.e. feeling a moral obligation to act), have predicted pro-environmental intentions (Bamberg et al., 2007; Klöckner, 2013; Rivis et al., 2009). Hence, pro-environmental behaviours result not only from rational cost–benefit analyses as proposed in the *TPB* 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 intentions (Bamberg & Möser, 2007). In the context of plastic use, *TPB* variables in combination with personal norms predicted recycling behaviour (Ofstad et al., 2017; Pakpour et al., 2014; Tonglet et al., 2004a, 2004b). In the case of packing choices, personal norms were influential and were an even stronger predictor than *TPB* variables (Thøgersen, 1999). On the basis of the stable finding that personal norms uniquely affect various kinds of pro-environmental behaviour, Klöckner (2013) proposed an integrated model that included personal norms, attitudes, perceived behavioural control, and social norms as direct predictors of pro-environmental intentions.

In the field of plastic handling, loss of biodiversity through marine littering and its consequences is a global challenge. Therefore, the question that arises is whether the behaviour of a single person can *in fact* make a significant difference or whether the problem can be solved only through collective action. Since individual behaviour sometimes appears to be only a 'drop in the ocean', the perception of collective efficacy is important. It captures the belief that a group that a person belongs to or identifies with can influence a person to move towards a certain goal (e.g. reducing waste by using re-usable coffee cups as the person's peers do; Hamann & Reese, 2020). In line with this reasoning, collective efficacy in terms of the expectation of attaining a goal through collective action was found to have additional power to predict pro-environmental behaviour (Chen, 2015; Homburg & Stolberg, 2006; Jugert et al., 2016) and thus influence plastic reduction (Reese & Junge, 2017).

Besides the constructs in the *TPB*, personal norms, and collective efficacy, sufficiency orientation is an additional construct that has recently been introduced into the pro-environmental debate. It captures people's general tendency to refrain from resource-intensive consumption in order to protect nature and to live a good life within planetary boundaries (Verfuerth et al., 2019). It is correlated with significantly lower individual CO_2 emissions in private behavioural domains, such as food consumption and everyday mobility (Loy et al., 2021; Verfuerth et al., 2019). The broader term sufficiency (lat. *sufficere*, enoughness) denotes a sustainability strategy that counteracts several effects of overconsumption, such as environmental degradation through fossil-fuel-based plastics by strictly reducing overall consumption (Samadi et al., 2017; Toulouse et al., 2019). In contrast to the efficiency sustainability strategy, which optimises input–output resource ratios on the level of technology and production (i.e. an example in the field of plastics is outlined by Milad et al., 2020), sufficiency goes beyond technical solutions by addressing the roots of (Western) consumerist lifestyles. It involves an understanding of how both the values that people hold and societal infrastructures constantly push fossil-fuel-based behaviours forwards. Sufficiency involves striving to implement ways of consumption that meet humans' basic needs without overburdening earth's natural resources and thus maintaining a good life within planetary boundaries (Spengler, 2016;

Tröger et al., 2021). However, not solely individual behaviour but also technologies and infrastructures (e.g. the materials used to provide to-go alternatives) can be judged on the basis of sufficiency criteria and thus incorporate socio-ecological standards in its foreground (Vargas-Elizondo, 2020). Such an infrastructure would require collective action and progressive policies, which probably might be a consequence from people's motivation to downsize consumption more broadly (Schierup & Alund, 2020; Tröger & Reese, 2021).

1.2 Theoretical model and hypotheses

According to Stern (2000), individuals can adopt a sustainable lifestyle, or they can support others (e.g. policy or business) to act accordingly. In his taxonomy, he distinguished between 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 organisation, signing a petition), and policy support (e.g. willingness to pay taxes for environmental goals). The current study adopted this differentiation and sought to identify shared and unique predictors in the field of anti-plastic use and activities. Using the integrative approach by Klöckner (2013), *TPB* variables and personal norms were combined as predictors of intentions. Taking the rational choice approach into account, the following hypotheses were tested:

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

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

Behaviour is not driven only by self-interest. In several studies, effects of the *TPB* were complemented by personal norms (the feeling that one has a moral obligation to act; Schwartz, 1977). According to Stern (2000), personal norms shape pro-environmental behaviour in both the private and public spheres (Stern, 2000). Following the original norm activation model (*NAM*, Schwartz, 1977), personal norms directly influence behaviour. Therefore, the following hypotheses were tested:

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

H2b Personal norms have a unique direct effect on behaviour.

Two additional predictors were also added to Klöckner's (2013) model. First, the impact of engaging in anti-plastic behaviour can primarily be detected on a collective level. Collective efficacy has been found to predict pro-environmental behaviour and intentions in the private and public spheres (see Hamann & Reese, 2020). Therefore, collective efficacy was included as an additional predictor in the integrated model. Thus, the following hypotheses were tested:

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

H3b Collective efficacy has a unique direct effect on behaviour.

Second, current models are missing an anti-overconsumption attitude and have thus failed to present an alternative to the emphasis on efficiency that exists in the field of pro-environmental behaviour. To include such a predictor, the current study proposes that sufficiency orientation can be used to represent people's attitudinal stance towards reducing consumption, leading to private-sphere intentions of anti-plastic-activities. Furthermore, living in a sufficiency-oriented manner is often very hard for one individual within an infrastructure that generally causes (over-)consumption (e.g. the fossil-fuel based energy infrastructure in many European countries). Therefore, it is probable that an individual's sufficiency orientation goes hand in hand with a vote for stricter political measures that make sufficiency-oriented decisions easier. People who express a high sufficiency orientation are also likely to support public sphere behaviour that is aimed at bringing about structural changes. Thus, the following hypotheses were tested:

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

H4b Sufficiency orientation has a unique direct effect on behaviour.

Thus, the model proposes that anti-plastic activity intentions in the private and public spheres can be predicted by people's perceived behavioural control, attitude, social and personal norms, collective efficacy, and sufficiency orientation. Behaviour is further expected to be directly predicted by intentions, perceived behavioural control, personal norms, collective efficacy, and sufficiency orientation.

1.3 The goals of the study

This study pursued four goals: First, it was aimed at increasing knowledge in the field of consumption-related plastic reduction by testing an integrated model of several anti-plastic activities. The focus was 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 (2000) approach, several dimensions of anti-plastic activities were considered as outcome variables. By testing the integrated model in both the private and public spheres, unique and shared predictors of various anti-plastic activities can be identified and can reveal spillover effects as reflected by correlations between activities originating from shared sources of variance. Third, and following the interdisciplinary debate on transformation and sustainability, sufficiency orientation was integrated into the model, and its potential in one particular field of reduction-oriented behaviour was explored. Psychological research on sufficiency orientation is still in its infancy, but a deeper understanding is necessary to make sufficiency policies more attractive and feasible (Gosse, et al., 2019; Spangenberg & Lorek, 2019). Fourth, by combining several theories (*TPB, NAM*) and including constructs that have not yet been investigated in the context of these theories (sufficiency orientation),

the current study aimed to explore whether the proposed integrated model has surplus value in predicting plastic behaviour over and above each theory and construct alone.

2 Methods

The flowchart in Fig. 1 depicts the methodological steps that were taken to move towards the four goals of the current research. The steps are numbered and match the order of the gullwing paragraphs.

2.1 Measures

Several psychological variables that, according to the integrated model, should be important predictors of plastic-related activities were included in the questionnaire[1] (cf. *Step I* in Fig. 1). If not otherwise stated, answers were recorded on Likert-type scales ranging from 0 (do not agree at all) to 4 (agree completely). The questionnaire can be found in the supplementary material.

Attitude: To measure people's attitude towards plastic packaging and its use, participants answered the question 'In my opinion, using plastic packaging is…', and indicated their personal opinions by rating four statements that could complete this sentence, such as, 'practical' or 'cheap'. Higher numbers indicated a positive attitude towards plastic packaging use.

Perceived behavioural control: Participants indicated their beliefs in their ability to avoid using plastic packaging by responding to four items (e.g. 'For me, it is easy to avoid using 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 using plastic packaging'). Confirmatory factor analysis revealed that the items had one factor in common; hence, descriptive and injunctive norms were combined into one social norm variable.

Personal norms: To measure personal norms, three items were adopted from previous work (e.g. Bamberg et al., 2007; Harland et al., 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 the plastic packaging problem together'.

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 indicated their agreement with six statements, for instance, 'It's unnecessary to have such a large 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 the private and public spheres. A confirmatory factor analysis revealed a three-factor solution (see Sect. 3.2), with three items capturing purchasing intentions, two items

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[1] The questionnaire was part of a broader survey, but only constructs that fit the theoretical framework of this study are reported here.

Step I Selection of measures based on the constructs proposed for the integrated model

Step II Recruiting the sample (N = 648) and collecting the data with an online survey

Step III Data analyses

Step IIIa Validation of predictors

Establishing the **discriminant and convergent construct validity** of the predictor measures

Step IIIb Revealing the structure of anti-plastic activity intentions

Two-factor solution private vs. public sphere intentions *moderate model fit*

Exlusion of one item due to a low factor loading (< .50) *no improvement of model fit*

Three-factor solution purchase, activism and policy support intentions *good model fit*

Establishing the **discriminant and convergent construct validity** of the three intentions

Step IIIc Testing and estimating the parameters of an integrated path-model for the prediction of anti-plastic activity intentions and behaviour

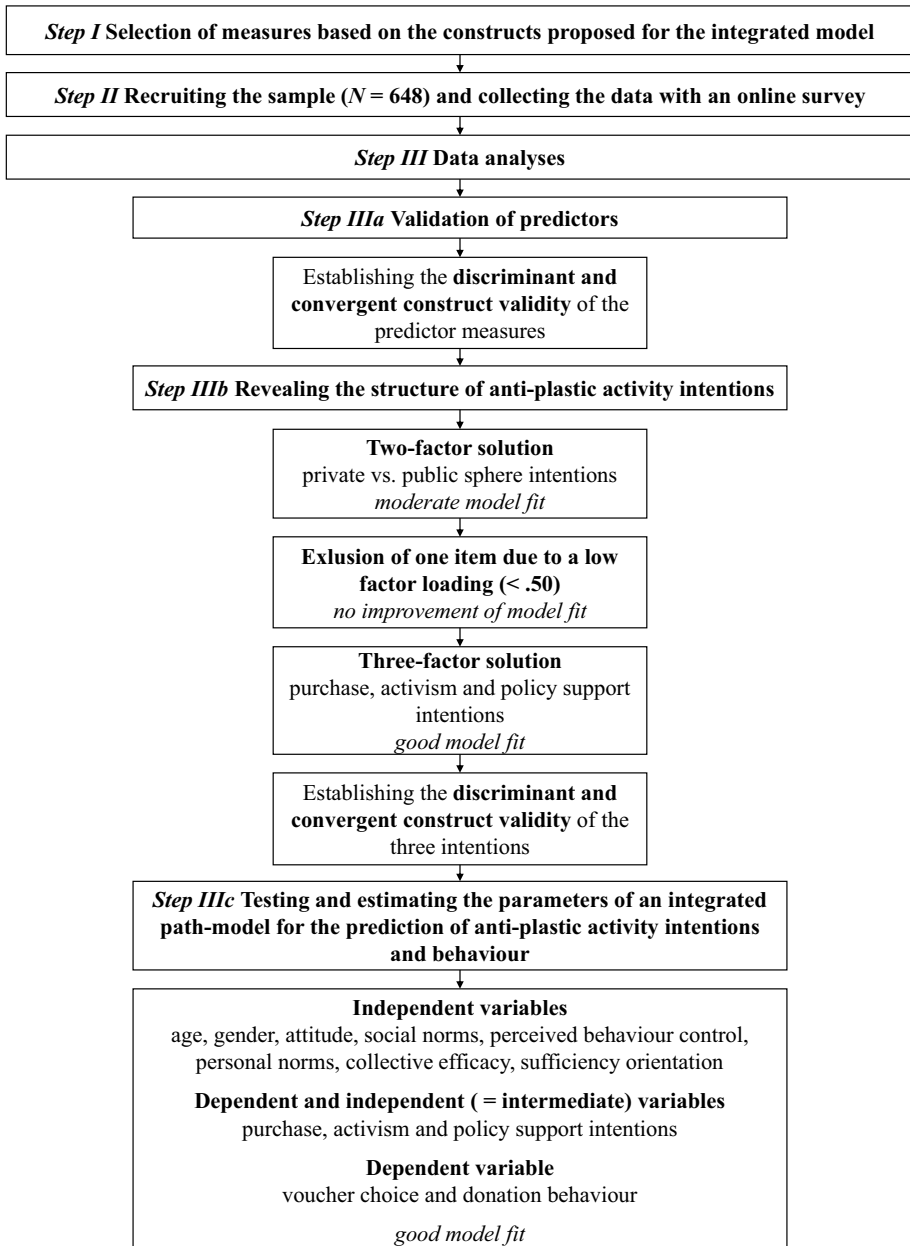| **Independent variables** age, gender, attitude, social norms, perceived behaviour control, personal norms, collective efficacy, sufficiency orientation **Dependent and independent (= intermediate) variables** purchase, activism and policy support intentions **Dependent variable** voucher choice and donation behaviour *good model fit* |
|---|

Fig. 1 Flowchart of research methodology and data analysis; the authors' own design and production

measuring activism intentions, and three items assessing policy support intentions. One item indicating the willingness to pay for plastic-free products was excluded due to a low factor loading (see Results).

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

2.2 Procedure and participants

$N = 648$ German participants completed an online survey during summer 2017. Participants were recruited via mailing lists from German universities and social media (cf. *Step II* in Fig. 1). Shopping vouchers were offered as incentives for participation. The survey was implemented on Sosci Survey (Leiner, 2016). The mean time to complete the survey was 15 min ($M = 14.42$, $SD = 5.14$; median $= 13.87$). Participants' ages ranged from 18 to 76 years ($M = 30.34$, $SD = 10.56$). The sample was predominantly female (77% women, 22% men, and 2% who did not indicate their gender). Educational level was above the German national average (Destatis, 2018): 35% indicated that they had a high school diploma (national average $= 32\%$), and 56% had a university degree (national average $= 18\%$).

3 Results

All analyses were conducted with R (version 3.5.2). The *psych* package (Revelle, 2018) was used for descriptive analyses and correlations, and *lavaan* (Rosseel, 2012) and *sem* (Fox et al., 2017) were used for structural equation modelling. Statistical analyses were based on the general linear model (Rencher & Schaalje, 2008). Except for gender and behaviour, manifest and latent variables were considered interval scales. Gender was considered a binary categorial variable. Behaviour was considered an ordinal scale. Only linear correlations and regression effects were estimated. Nonlinear and interaction effects were not estimated because such effects were not predicted by the hypotheses. Model tests and parameter estimation for all structural equation models, including confirmatory factor analysis models (linking manifest and latent variables) and structural models (linking latent variables), were performed according to current statistical standards (Bagozzi & Yi, 2012; Kline, 2016). The models were fit to covariance matrices. Latent means were not estimated. ML (maximum likelihood) estimators were used if the variables in question were considered interval scales and if their distributions did not deviate significantly from a normal distribution. Otherwise, robust WLSMV (weighted least squares mean and variance adjusted) estimators were used.

3.1 Validation of predictors

Table 1 presents results on convergent and discriminant validity as well as on the reliabilities of the five predictors in the model that was based on confirmatory factor analysis (cf.

Table 1 Assessment of the convergent and discriminant validity and reliability of the predictors of anti-plastic activity intentions

Scales	AVE	MSV	ASV	REL
Perceived behaviour 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

Step IIIa in Fig. 1). 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 for the predictors. The average variance extracted (AVE) of each construct was higher than its correlation with other constructs, indicating convergent validity (see Alumran et al., 2014).

3.2 Revealing the structure of anti-plastic activity intentions

According to Stern's basic classification, a confirmatory analysis (cf. *Step IIIb* in Fig. 1) of two factors that differentiated between private sphere intentions (three items) and public sphere intentions (six items) was conducted. The model did not demonstrate a good fit: $X^2(26) = 152.35$ ($p < 0.001$), CFI = 0.931, RMSEA = 0.087 [0.074; 0.100], SRMR = 0.051. One item (willingness to pay more for plastic-free products) was excluded due to a low factor loading (< 0.50). However, the fit showed only minimal improvement: $X^2(19) = 115.04$ ($p < 0.001$), CFI = 0.942, RMSEA = 0.088 [0.073; 0.104], SRMR = 0.046. Therefore, Stern's model was modified by differentiating between activism and non-activist behaviour within the public sphere (see Table 2). The fit of the resulting three-factor model was good: $X^2(17) = 38.24$ ($p = 0.002$), CFI = 0.987, RMSEA = 0.044 [0.025; 0.063], SRMR = 0.028. Importantly, the three-factor model fit the data significantly better than the two-factor model did, $X^2(2) = 76.8$, $p < 0.001$. The results indicated a strong correlation between the factors, particularly between the two public sphere factors. This is plausible due to the content-related proximity of the two constructs. As the confidence interval around the value, $0.67 \leq \phi_{23} \leq 0.89$, did not include 1.00, the constructs were concluded to be distinct. Table 3 contains the results on convergent and discriminant validity and reliability based on the confirmatory factor analysis of the three anti-plastic activity intentions. The small difference between AVE and ASE reflects the strong correlations between the three factors. On the basis of the content and the better fit, the three-factor solution was retained.

The first factor reflected 'purchasing intentions' and was measured with three items that indicated a willingness to buy food without packaging. The second factor reflected 'activism intentions' and was measured with two items that captured the willingness to actively engage in organisational structures against plastic use or to participate in a demonstration. The third factor reflected 'policy support intentions' and was measured with three items that expressed support for policy regulations, such as voting and signing a petition.

Table 2 Parameter estimates and fit indices for the two- and three-factor models of anti-plastic activities

Two-factor		Three-factor	
$\lambda 11$	.66	$\lambda 11$	.65
$\lambda 21$	.75(.11)	$\lambda 21$	.74(.11)
$\lambda 31$	.69(.11)	$\lambda 31$	.70(.11)
$\lambda 42$	.68	$\lambda 42$	.77
$\lambda 52$	.69(.08)	$\lambda 52$	.75(.07)
$\lambda 62$	.65(.05)	$\lambda 63$	.80
$\lambda 72$	.73(.06)	$\lambda 73$	.70(.05)
$\lambda 82$	.69(.06)	$\lambda 83$	.67(.05)
$\lambda 92$	.50(.06)		
$\theta_\delta 11$	.58(.04)	$\theta_\delta 11$	.58(.04)
$\theta_\delta 22$	.44(.07)	$\theta_\delta 22$	.45(.07)
$\theta_\delta 33$	.53(.08)	$\theta_\delta 33$	.51(.08)
$\theta_\delta 44$	.54(.05)	$\theta_\delta 44$	.40(.06)
$\theta_\delta 55$	.53(.06)	$\theta_\delta 55$	.45(.07)
$\theta_\delta 66$	.58(.03)	$\theta_\delta 66$	.36(.04)
$\theta_\delta 77$	.47(.04)	$\theta_\delta 77$	.51(.04)
$\theta_\delta 88$	.53(.03)	$\theta_\delta 88$	.55(.03)
$\theta_\delta 99$	.76(.05)		
$\phi 21$	.62(.04)	$\phi 21$	.64(.04)
		$\phi 31$	.50(.04)
		$\phi 23$	.78(.06)
$\chi 2(df)$	152.35(26), $p < .001$	$\chi 2(df)$	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 3 Assessments of the convergent and discriminant validity 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 between the latent variables, behaviour, and socio-demographic variables from the 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

3.3 Descriptive analyses

Table 4 presents the bivariate correlations between the latent variables, behaviour, and socio-demographic variables from the CFA model. When aggregating the intention items into manifest scales, policy support intentions ($M = 3.18$, $SD = 0.83$) reached higher approval rates than purchasing intentions ($M = 2.55$, $SD = 0.99$) and activism intentions ($M = 2.14$, $SD = 1.14$). Considering socio-demographics, age was not significantly correlated with policy support or activism intentions, but it was weakly correlated with purchasing intentions, indicating that elderly people were more willing to purchase products with less plastic packaging ($r = 0.16$). Women were also more likely to purchase products with less packaging ($r = 0.33$), to show more activism ($r = 0.19$), and to show more policy support ($r = 0.23$).

3.4 Establishing a path model to predict anti-plastic activity intentions and behaviour

To test the integrated model, a structural equation model (SEM) that reflected the hypotheses was specified, the model was tested, and its parameters were estimated (see Bagozzi & Yi, 2012); see *Step IIIc* in Fig. 1. Because the variables did not reflect multivariate normality and the dependent variables were measured on an ordinal scale, the robust WLSMV estimator was used. The three intentions were included as latent endogenous (dependent) variables in the model and as latent exogenous (independent) variables that predicted behaviour. *TPB* variables (attitude, social norms, perceived behavioural control), personal norms, collective efficacy, and sufficiency orientation were included as latent exogenous (independent) variables in the model, and age and gender were included as control variables. The choice of voucher at the end of the survey was used as a behavioural measurement. People could decide to receive 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). The last two choices were combined into one category representing a plastic-free option, and the binary variable representing a conventional versus a plastic-free choice was entered into the model as an ordered endogenous (dependent) variable (see Fig. 2). As 121 participants did not choose any of these options, the SEM was calculated with n = 527 participants.

Testing the SEM revealed a good fit of the model, $X^2(545) = 912.20$ ($p < 0.001$), CFI = 0.978, RMSEA = 0.036 [0.032; 0.040], SRMR = 0.036. The predictors explained 78% of the variance in purchasing intentions, 45% of the variance of activism intentions, and 55% of the variance of policy support intentions. 52% of the variance in behaviour was explained. Personal norms strongly predicted all three intentions. Attitude towards plastic use had a negative influence on purchasing intentions and activism intentions. Perceived behavioural control had a strong positive influence on purchasing intentions and a negative influence on policy support intentions. Social norms were not significant predictors at all, whereas collective efficacy and sufficiency orientation were predictors of activism intentions and policy support intentions. Gender predicted all three intentions, and age had a positive impact on purchasing intentions. Activism intentions, age, and sufficiency orientation predicted behaviour.
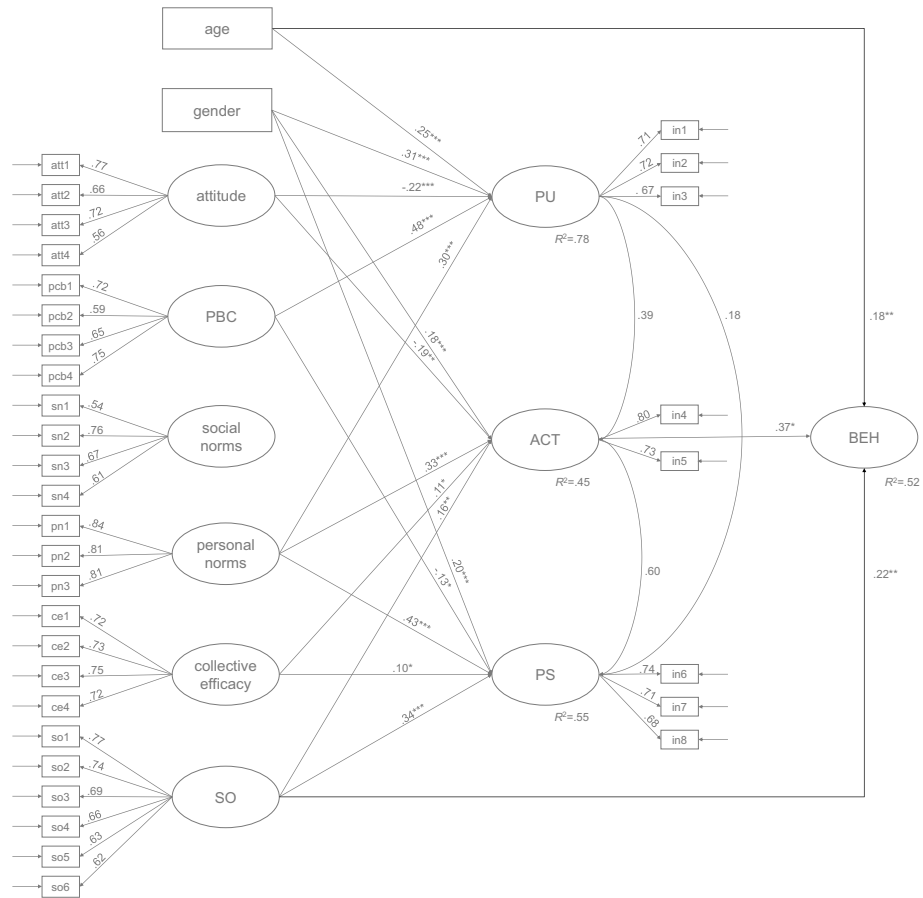
Fig. 2 Structural equation model of anti-plastic activities ($n = 527$) Note. *** $p < .001$, ** $p < .01$, * $p < .05$

4 Discussion

This paper addressed different anti-plastic activities people can engage in to reduce plastic waste. This paper sheds light on purchasing decisions, political engagement, and policy support. As hypothesised, psychological variables from *TPB* and *NAM* predicted people's willingness to engage in anti-plastic activities (see Fig. 2). Sufficiency orientation was also a significant predictor of the plastic-free choice of reward.

4.1 Three dimensions of anti-plastic activity intentions

Using confirmatory factor analyses, three intentions of anti-plastic activities were identified: purchasing intentions, activism intentions, and policy support intentions. Purchasing intentions referred to the willingness to buy products without plastic packaging and corresponded with Stern's factor of private sphere behaviour (Stern, 2000). Activism intentions

and policy support intentions corresponded with public sphere behaviour and were substantially correlated with each other. These results are in line with results from Dono and colleagues (2010), who also showed that private sphere pro-environmental behaviour and activism were distinct constructs.

A confirmatory factor analysis identified policy support intentions and activism intentions as two distinct public-sphere intentions which is in line with Stern (2000). However, in contrast to Stern's findings, signing a petition was part of policy support instead of civic engagement. Due to digitisation and commercialised activism, it is nowadays much easier to sign an online petition than was the case when Stern established his typology (see a comment on the commercialisation and digitisation of social movements by Yang, 2016). Notwithstanding these differences, the necessity of taking a closer look at a specific target behaviour and its antecedents, a practice that Stern (2000) had already highlighted, was confirmed by the present study in the field of anti-plastic behaviour.

4.2 Spillover effects among anti-plastic activity intentions

In the present study, private and public sphere intentions were positively correlated, pointing out potential spillover effects in the domain of anti-plastic activities. Residuals of purchasing intentions and activism intentions were moderately correlated in the model ($r = 0.39$); thus, they shared variance that was not explained by the predictors. As spillover refers to the activation of an intention by another intention (Maki et al., 2019), a willingness to buy less plastic might lead to a willingness to engage in this field (and the other way around), independent of other predictors. As activism intentions and policy support intentions shared a strong common source of variance over and above the predictors ($r = 0.60$), a spillover effect of these two intentions was also likely. Spillover was smaller for purchasing intentions and policy support intentions because the variance they shared that was independent of the predictors was lower ($r = 0.18$).

Previous studies revealed inconsistent results with respect to spillover effects from private- to public-sphere behaviour (Truelove et al., 2016). On the one hand, people with pro-environmental lifestyles were more willing to sign a petition (De Moor & Verhaegen, 2020), and sustainable consumption in the private sphere predicted support for policies that pertained to wind power and political activism (Thøgersen & Noblet, 2012; Willis & Schor, 2012). On the other hand, negative spillover effects were found between recycling behaviour and policy support (i.e. the support of a green fund; Truelove et al., 2016). No spillover from public- to private-sphere behaviour was found with respect to the introduction of a fee for plastic bags (Poortinga et al., 2013).

In the present study, the negative impact of perceived behavioural control over plastic-free purchasing on policy support intentions led to the conclusion that, for people who fail to purchase less plastic (e.g. because of a lack of infrastructure to support plastic-free shopping), policy support constitutes an opportunity to request structural change. Thus, a negative spillover effect from 'failed' private sphere behaviour to public sphere behaviour is also feasible. Policy support for regulations might therefore be strengthened by including people who show a high level of awareness for the topic but who do not feel capable of taking corrective action through their private purchasing decisions.

4.3 Predicting anti-plastic activity intentions

(a) *Purchasing intentions*

The predictors in the model explained 78% of the variance in purchasing intentions. Compared with other models that have targeted pro-environmental behaviour, the current result represents a comparatively precise prediction (Bamberg & Möser, 2007). The first hypothesis, which proposed a unique direct effect of each *TPB* variable, was partly supported (H1a). Perceived behavioural control of anti-plastic purchasing was the strongest predictor, a finding that is in line with previous results on general pro-environmental behaviour (for a meta-analysis, see Bamberg & Möser, 2007). Moreover, people who expressed a positive attitude towards plastic packaging were less willing to refrain from consumption in this domain. Failing to support the hypothesis, the results indicated that social norms did not predict purchasing intentions in the current study. Although social norms had either a small (Armitage & Conner, 2001) or only an indirect impact through personal norms on intentions in previous research (Bamberg & Möser, 2007), social norms have often demonstrated a positive impact in intervention studies. Communicating social norms was found to be successful in reducing the consumption of bottled water (van der Linden, 2015) or plastic bag use (De Groot et al., 2013). In addition, they strongly influenced recycling and waste minimisation in a cross-cultural study (Mintz et al., 2019). Considering these studies, social norms might become more relevant for behaviour at the point of sale and might be less relevant for the intention to purchase less plastic.

　　Beyond the *TPB* variables, personal norms strongly predicted purchasing intentions (H2a). Thus, raising moral consciousness with respect to the problems that come with the use of plastic should facilitate behavioural change. Collective efficacy (H3a) and sufficiency orientation (H4a) did not predict purchasing intentions. These findings underline the rational choice approach that the intention to reduce plastic purchasing is less affected by collective beliefs and more governed by individual decision-making. The low importance of sufficiency orientation might be surprising at first glance as it has predicted food consumption in previous studies (Verfuerth et al., 2019). However, sufficiency orientation is conceptualised as a general attitudinal stance on the relationships between individual consumption, resource use, and the impact of using resources on the climate, whereas the items that measured purchasing intentions described very concrete behavioural options (e.g. to buy fresh products packaged in glass instead of plastic). This difference in specificity levels between sufficiency orientation and purchasing intentions may explain the nonsignificant effect of sufficiency orientation. When also considering socio-demographics, gender and age were significant predictors. Female and elderly people seem to be more willing to purchase plastic-free products. This finding on females corresponds with research indicating that gender plays a significant role in many ecological behaviours in the private sphere (for a review on gender and sustainable consumption, see Bloodhart & Swim, 2020).

(b) *Activism intentions*

The psychological predictors explained 45% of the variance in activism intentions. This was the lowest percentage of explained variance for all three intentions. This result is probably due to the degree of overlap between the content of the predictors and the content of intentions. Specifically, the content of the *TPB* variables overlapped more with the content

of purchasing intentions than with the content of the other two intentions. Accordingly, not supporting the first hypothesis (H1a), perceived behavioural control and social norms did not have unique impacts on activism intentions. People holding a positive attitude towards plastic packaging were less willing to engage in activism. Personal norms (H2a) were the strongest predictor of activism intentions. People who were morally convinced of the need to reduce plastic packaging showed a greater willingness to participate in demonstrations or join a pro-environmental organisation. Sufficiency orientation (H4a) played a subordinate role in activism intentions.

People with high collective efficacy beliefs (H3a) in the reduction of plastic packaging were more willing to engage in activism. This finding is in line with previous studies that have highlighted that collective efficacy is an essential predictor of activism against climate change (van Zomeren et al., 2010). The processes of self-identifying as an environmental activist and belonging to an environmental organisation are essential for public-sphere engagement (Brick & Lai, 2018; Fielding et al., 2008; McFarlane & Boxall, 2003). A recent meta-analysis supported the overarching role of social identity processes as a key driver of pro-environmental activism (Schulte et al., 2020). This underlines collectivism as an integral part of activism. To increase impact, people team up with like-minded people who are striving for a collective goal. With regards to socio-demographics, women were more likely to show activism intentions, but age had no impact. The particular role of gender with respect to environmental activism is a question of recent interest. For instance, more women than men consistently participate in Fridays for Future climate protests (De Moor et al., 2020). It is very probable that gender norms play a crucial role in who protests against plastic packaging and who does not.

(c)   *Policy support intentions*

Overall, the predictor variables explained 55% of the variance in policy support intentions. The strongest predictor was personal norms (H2a), followed by sufficiency orientation (H4a). Thus, the willingness to support policy regulations was driven by a moral conviction and a belief that reducing resource consumption is important for protecting nature and the climate. The emotional component of this moral conviction might be particularly relevant as concern for the environment has been found to be a good predictor of policy support in previous studies (Wang et al., 2018). Collective efficacy (H3a) was also a significant predictor but had the smallest power to predict policy support intentions. This at least partially fit with the results of a study by Brick and Lai (2018), who found that explicitly self-identifying as an environmentalist also supported equivalent policies. With regard to *TPB* variables (H1a), perceived behavioural control was negatively related to policy support intentions such that people who perceived few opportunities to make plastic-free purchases were more willing to support policies to take appropriate action. Attitude and social norms were not significant predictors, which again might be due to the limited content overlap between perceived behavioural control and policy support intentions. *TPB* variables have usually been explored with respect to private behaviour in the past, whereas public behaviour, such as protesting, has only recently been studied. For instance, Wang and colleagues (2018) found that emotions play a significant role in public engagement. Furthermore, mechanisms behind group identification (e.g. collective efficacy, trust in the government) play a more important role in public engagement than *TPB* components or moral concerns do (Thaker et al., 2019). Again, gender, but not age, had a unique effect on policy support

intentions. As gender had the same effect on the other two intentions, women appear to be more willing to tackle the plastic problem than men – independent of the type of intention.

4.4 Prediction of behaviour

In this study, activism intentions were an important predictor of behaviour. In a failure to support hypothesis H1b, policy support intentions and purchasing intentions were not significant predictors. Age and sufficiency orientation (H4b) had an additional impact. Overall, 52% of the variance in people's choice of incentive was explained. Even though the choice between a conventional shopping voucher and a plastic-free option does not directly correspond to the measured intentions, this result indicates the content validity of the intentions. As boycotting can be interpreted as a form of activism, it is plausible that activism intentions reduced the probability that participants would accept a conventional shopping voucher instead of an ecological choice. Therefore, it is not surprising that the impacts of purchasing intentions with a focus on concrete packaging choices and policy support intentions addressing policy measures have remained behind the impact of activism intentions on this choice. The strong impact of sufficiency orientation confirmed the inherent motivation as a clear stance against overconsumption.

Contrary to theoretical assumptions (H1b, H2b, H3b), perceived behavioural control, personal norms, and collective efficacy were not direct predictors of behaviour. However, these results are in line with empirical evidence that personal norms and perceived behavioural control have only indirect impacts on behaviour via intentions, rather than predicting behaviour directly when intentions are included in the model (e.g. Bamberg et al., 2007). Furthermore, the choice of incentive was not directly linked to the content of perceived behavioural control that referred to plastic-free purchases. There was no barrier to choosing one of the incentives. Hence, perceived behavioural control was irrelevant.

4.5 Limitations

The sample in this study was large but not representative. The majority of participants were women and were highly educated. Thus, conclusions should be considered carefully when transferred to other groups. In particular, when considering research on gender biases in the environmental domain which we also argued upon, a more diverse sample should be investigated (Bloodhart & Swim, 2020; Zelezny et al., 2000).

Participants were recruited in summer 2017 when plastic was at the top of the agenda in the German media. The general willingness to become active against plastic pollution was quite large and socially desirable (European Commission, 2017) which might have also increased effects in our sample. In addition, the results presented here do not allow causal inferences to be drawn because the parameters in the path models were based only on cross-sectional correlations. Moreover, the conceptualisation and measurement of the outcome variables were in line with Stern's behavioural categorisation (Stern, 2000). However, the factor structure of the items did not fully match Stern's model. We propose that our three-factor structure needs to be replicated by running additional studies with more heterogeneous samples and groups with lower pro-environmental awareness. Future research should also explore directional influences between the factors in longitudinal designs.

Referring to the explained variance in this study, purchasing intentions were predicted best by the measured variables. This finding might be due in part to a lack of symmetry in

content between intentions (the criteria) and the predictors. For example, the content of the perceived behavioural control items was more precisely related to the content of purchasing intentions than to the content of activism intentions or policy support intentions. 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 more broadly defined construct with the smallest amount of overlap in content with intentions, had a rather strong effect on behavioural choice. Thus, similarity in content and specificity alone cannot explain the pattern of effects in the path model. Apart from the specific formulation of the items, we suggest to add important constructs (e.g. self-identity, Fielding et al., 2008; Rees & Bamberg, 2014; positive and negative emotions, Hamann & Reese, 2020; Rees et al., 2015; Rees & Bamberg, 2014) in future studies that seek to model lower plastic consumption.

4.6 Implications and future directions

4.6.1 Implications for future research

First, this study confirmed the relevance of psychological factors grounded in rational choice and normative theories (*TPB, NAM*) in the field of plastic consumption. It raises awareness of various predictors of diverse plastic-free activities in the private and public spheres that can each be addressed in detail by future studies. Likewise, one might follow up by implementing interventions based on these constructs and assessing behaviour change in the field of plastic reduction (e.g. Heidbreder & Schmitt, 2020).

Second, broadening the scope of this kind of research to public-sphere intentions (i.e. activism, policy support) rather than simply focussing on private-sphere intentions (i.e. purchasing) is promising as it may inspire collective action and drive changes in infrastructures (Amel et al., 2017). Furthermore, this study provides initial evidence that different behavioural intentions in the field of plastic consumption were predicted by different variables (see Stern, 2000). Thus, future studies should consider and carefully model the target behaviour. Ways to increase the effectiveness of psychological drivers for less plastic consumption (see Reese & Junge, 2017, on efficacy beliefs) should be researched further.

Third, sufficiency orientation was a relevant predictor of plastic-free purchasing and donation behaviour. These findings indicate that increasing people's beliefs in consuming less as a way to counter environmental degradation has the power to close the gap between good intentions to protect nature and a lack of actual concrete behaviour (Moser & Kleinhückelkotten, 2017; Verfuerth et al., 2019). Future studies should better incorporate interdisciplinary approaches and address the interrelations between the topics of sufficiency-oriented production and consumption (Bengtsson et al., 2018; Milad et al., 2020).

Fourth, the integrated model adds value beyond addressing single constructs. People's actions are based not only on rational considerations but also on moral ones (see Joanes et al., 2020). Likewise, for activism intentions and policy support intentions, the role of collective action is important. Thus, future studies should consider an integrated framework to strengthen pro-environmental behaviour within the field of plastic consumption.

4.6.2 Practical implications

Considering the main predictors of plastic-reduction-oriented intentions, purchasing intentions were primarily predicted by perceived behavioural control, indicating a lack

of infrastructures and perceived opportunities to avoid single-use plastic. To tackle this structural barriers to increase perceived behavioural control, more convenient alternatives for single-use plastic, such as suitable shopping concepts coupled with information about these alternatives, need to be offered and could be supported by local trade and business initiatives.

A positive attitude towards plastic packaging was a barrier for purchasing and activism intentions. In general, two different ways to change people's attitudes have been discussed: persuasive information and social influence (Wood, 2000). However, only a few studies have addressed the impact of environmental communication in the context of plastic, such as media communication about microplastic (Schallhorn et al., 2019) or role models in reports about plastic pollution in the media (Arlt et al., 2012). Future studies should build on and evaluate interventions in this area.

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 between individual behaviours and their consequences in the environmental domain (van Lange et al., 2018) should be considered. To raise awareness and a feeling of responsibility, it is crucial to overcome this distance. Presenting photographs of plastic litter from consumer products might be an approach that can make the link between people's consumption and its consequences more visible (Pahl et al., 2017).

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

As sufficiency orientation was a strong predictor of behaviour in the plastic domain, it could be key with respect to a more comprehensive shift towards resource conservation. Although people may be reluctant to use the term sufficiency in everyday practise (Reese, Drews, & Tröger, 2019), the goal here is to outline its potential as a 'mindset of enoughness' (Spangenberg & Lorek, 2019, p. 1071).

To solve the anthropogenic plastic crisis, all members of society need to promote the more conscious handling of plastic. This study highlights the potential of the general public as consumers, activists, and policy supporters within a representative democracy. While natural science perspectives work on detecting risks and finding material replacement or recycling strategies for plastics (Milad et al., 2020), the social sciences can explain why and when people use plastic and shape the discourse on how to limit plastic pollution. Motivating action against plastic pollution needs to consider decision-making processes and drivers of reduction behaviour. The current study presented such psychological insights.

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