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This has already been used! A paradigm to measure the point at which people become unwilling to use reusable containers

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ABSTRACT

Reusing packaging and containers can significantly reduce plastic waste, yet little research has considered whether people are willing to reuse containers, especially as they start to show signs of use. The present research developed a novel method for identifying how worn or dirty a container needs to be before people become unwilling to reuse it and demonstrates how this paradigm can be used to investigate factors that might influence people's willingness to reuse that container. Across four studies, we recruited University staff and students or members of the local and online community and asked them to complete a variation of our paradigm designed to measure their willingness to reuse containers, followed by self-report measures of disgust, concerns about disease, and pro-environmental attitudes and behaviors. The findings demonstrate that: (i) the paradigm can identify the point at which people deem a container unacceptable for reuse, (ii) there is substantial variation in people's thresholds, and (iii) variation can be explained, in part, by individual differences (e.g., feelings of disgust) and contextual factors. This paradigm provides the basis for a scientific study of psychological, physical, and environmental factors that are crucial to the success of reuse models and ultimately, reducing plastic waste.

1. Introduction

A world without plastic seems unimaginable today; however, the large-scale production of plastic only began in the 1950s (Thompson, Swan, Moore & vom Saal, 2009). Since then, it is estimated that 8.3 billion tonnes of plastic have been produced, 6.3 billion tonnes of which have already become waste (Geyer et al., 2017). The biggest contributor to plastic waste is packaging, an application that has seen exponential growth as a result of a global shift from durable and reusable containers to single-use, disposable packaging (e.g., Van Overveld et al., 2006). For example, it is estimated that almost half of the plastic waste generated globally is from packaging and, if current trends continue, that 12 billion tonnes of plastic waste will be in landfills or the natural environment by 2050 (Geyer et al., 2017). Research has indicated that reusable and refillable packaging and containers can significantly reduce plastic waste and are more sustainable than single-use alternatives (e.g., Greenwood et al., 2020). However, although we have the technology and materials to produce durable alternatives to single-use plastic packaging, little research has explored how people feel about reusing packaging and containers. Given that individuals' behavior will be central to the success of reuse systems (Ertz et al., 2017), this is an important consideration.

Manufacturing durable containers that are designed to be reused requires significantly more energy and resources than packaging intended for single-use and, therefore, reusable containers must be used multiple times in order to extract sufficient value from the raw resources (Coelho et al., 2020). For example, a recent life cycle assessment (a methodology for quantifying the environmental impact associated with a product over its lifecycle; Finnveden et al., 2009) estimated that a reusable coffee cup would need to be used at least 150 times (i.e., once a week for almost three years) to confer the environmental benefits of a single-use coffee cup (Cottafava et al., 2021). However, containers that are frequently refilled and reused are likely to become worn and discolored over time. Given that the appearance of reusable containers will likely change with use, a fundamental question for the success of initiatives to promote reuse is whether and how changes in the appearance of containers influences people's willingness to use those containers. The aim of the present research, therefore, was to develop a novel method for identifying the point at which people deem a container unacceptable for reuse.

Our approach for measuring the point at which people deem a container unacceptable for reuse was inspired by a paradigm designed to

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assess people's perceptions of how healthy people are based on the appearance of their face (Mirams et al., 2014). Morphing software (Kimball and Mattis, 2013) was used to create images of containers that varied from clean to dirty in subtle intervals in order to mimic changes in appearance over time (e.g., see Fig. 1). People were presented with images of these containers one at a time in a computer-based paradigm and asked to decide whether or not they would be willing to use the container. We then used methods from psychophysics to determine people's thresholds; that is, the point at which they became unwilling to use the container. Psychophysics provides a systematic and precise method for studying the relationship between physical stimuli and the sensations and perceptions that they produce (Gescheider, 1997) and has a number of important advantages over self-report measures, including being less susceptible to response bias (Magalhães et al., 2018).

In addition to developing a method for identifying the point at which people deem a container unacceptable for reuse, the present research also sought to demonstrate how the paradigm can be used to explore factors that are associated with the point at which people deem reuse unacceptable. To this end, we explore a number of contextual, motivational, and individual difference factors that may be associated with people's willingness to reuse.

2. Literature review and hypothesis development

2.1. How might individual differences be associated with willingness to reuse?

Research has indicated that the physical appearance of packaging can influence people's attitudes towards the product and subsequent willingness to use it (White et al., 2016). For example, evidence suggests that 75% of shoppers will not buy a product if the packaging is damaged (George, 2010) and that even superficial damage to a container (e.g., a dented can or a torn label) can act as a contamination cue that activates concerns about the health and safety of the product (White et al., 2016). These findings provide evidence for the "behavioral immune system", which refers to a psychological mechanism that enables people to detect the presence of parasites or pathogens in their environment and prompts them to avoid contact with those objects or individuals (Schaller, 2011). However, as the examples above demonstrate, this system can be over conservative such that people will avoid things even if they are likely to be safe (e.g., where the damage to the packaging is only superficial, White et al., 2016).

The behavioral immune system is driven by people's concerns about the transmission of disease and the extent to which they experience feelings of disgust, both of which differ between individuals (Schaller et al., 2021). That is, people who believe that they are more vulnerable to infection (regardless of whether or not they actually are) and experience greater feelings of disgust have stronger pre-emptive defenses against things that connote disease, than people who are less concerned about the transmission of disease and are less affected by feelings of disgust. Interestingly, research has also shown that concerns about contamination and feelings of disgust can influence sustainable choices, such that people are less willing to buy fruit and vegetables that are not perfectly formed (Powell et al., 2019). In light of these findings, the present research will explore whether perceived vulnerability to disease and feelings of disgust are associated with the extent to which people are willing to reuse containers that show signs of previous use.

The present research will also explore whether (and how) demographics (e.g., age, gender, ethnicity) and pro-environmental attitudes and behaviors are associated with people's willingness to reuse containers. Although we have less firm hypotheses about the nature of these relationships, there is some evidence that culture and gender can influence people's perceptions of cleanliness (Mortimer and Clarke, 2011; Yoo, 2012) and that age and gender can shape people's pro-environmental attitudes and behavior (Mintel, 2018; Yamane and Kaneko, 2021). Given that reusing containers is an example of pro-environmental behavior, it could be that people who see themselves as more environmentally friendly are more willing to eat or drink from dirty containers, either because they see the value in doing so and/or because they already use reusable packaging and so are more accustomed to using containers that appear worn. However, such questions have yet to be explored. Thus, we demonstrate how our paradigm can be used to explore whether people's willingness to reuse varies as a function of demographics (e.g., age, gender, ethnicity) and individual differences, such as how likely people are to feel disgusted, concerns about the transmission of infectious diseases, and pro-environmental attitudes and behaviors.

2.2. How might motivational factors be associated with willingness to reuse?

The present research also considers how the paradigm can be used to investigate whether motivational factors relevant to the reuse context are associated with people's willingness to reuse. For example, Study 1a and Study 1b explore whether people's willingness to drink from a dirty water cooler is associated with how thirsty they are, and Study 2 and Study 3 explore whether people's willingness to eat from a dirty takeaway bowl is influenced by their dietary requirements and how hungry they are. Previous research has shown that feelings of thirst and hunger can influence people's consumption choices. For example, participants who were deprived of food were more willing to consume unpalatable foods than participants who had eaten recently (Hoefling and Strack, 2010). These findings suggest that consumption choices are driven, in part, by physiological needs. This is consistent with Maslow's hierarchy of needs (Maslow, 1954), which states that the biological requirements for human survival, such as air, food, and water will typically take precedence over an individual's need for safety, including protecting

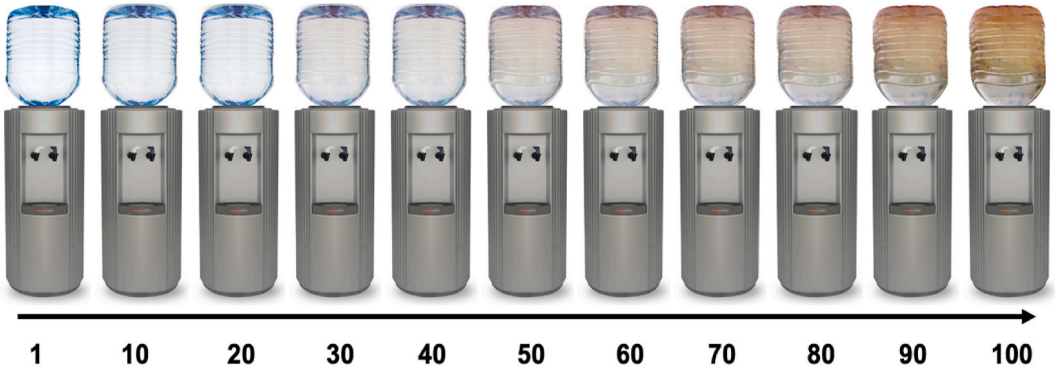

Fig. 1. *Example stimuli from the willingness to reuse paradigm for Study 1a and 1b*
Notes. 100 images of water coolers were created for the Study 1a and 1b study. Here, images of water coolers are shown in units of ten.

themselves against illness and accidents. As such, it is likely that the more thirsty or hungry participants are the more willing they would be to drink or eat from dirty containers, perhaps because their need to satisfy their thirst or hunger outweighs their concerns regarding potential contamination by pathogens.

2.3. How might contextual factors be associated with willingness to reuse?

It is also likely that people's willingness to reuse will depend on situational and contextual factors, and so we show how the paradigm can be used to investigate the effect of contextual variables on people's willingness to reuse containers. For example, a key difference between models of reuse is who owns the container (e.g., refill models where the consumer owns their own container and takes it to the retailer to be refilled vs. return models where the retailer owns the container and 'loans' it to the consumer, asking them to return it after use). Research has shown that people's evaluations of a product, and their subsequent intentions to purchase that product, are significantly lower if they think that the product has been touched by another person (Argo et al., 2006). Similarly, research on contaminated interactions (Baxter et al., 2016) has suggested that people are less willing to use objects or items that belong – or have belonged – to someone else because they are considered contaminated (e.g., second-hand goods may be viewed as carrying the 'essence' of the previous user). Thus, it is possible that the appearance of a container will interact with ownership to influence people's willingness to reuse. For example, people may be willing to use their own dirty or worn coffee cup, but not willing to use a dirty or worn coffee cup that belongs to a stranger. We also explore whether people's willingness to reuse containers differs according to their perspective or role. For example, thresholds might be expected to differ between consumers who will be using the container and food service staff who are serving food in that container. Although consumers might be willing to eat from a bowl that appears worn, food service staff might be unwilling to serve consumers in a bowl that appears worn, perhaps as they are concerned about the reputation of the establishment in which they work. Indeed, research has shown that the appearance of containers for takeaway food is associated with the perceived quality of the restaurant (Collis et al., in prep).

3. Research methodology

3.1. Development of a method for measuring the point people become unwilling to reuse

A computer-based paradigm was developed using techniques borrowed from psychophysics to investigate how changes in the appearance of a container over time influence participants' willingness to use the container. We created two different scenarios based on a water cooler in an office and getting lunch in a reusable takeaway bowl. A total of 100 images of these containers were created using morphing software (e.g., Adobe Photoshop) that varied from clean to dirty in order to mimic changes in appearance over time. Participants were presented with images of these containers one at a time and asked to decide whether or not they would be willing to eat or drink from the container by pressing a key on their computer keyboard (e.g., "*Y*" to indicate that 'yes, they would be willing eat or drink from the container' or "*N*" to indicate that 'no, they would not be willing to eat or drink from the container'). Their responses were used to determine their 50% thresholds; that is, the point at which participants became unwilling to drink or eat from the container.

The selection of the container to present on each trial was made using Parameter Estimation by Sequential Testing (PEST; Taylor and Creelman, 1967), which is a method that is used to efficiently estimate psychophysical parameters. The PEST procedure began by presenting either a noticeably clean or a noticeably dirty container (e.g., images 10 and 90 in Fig. 1, respectively). The sequential likelihood-ratio test (Wald, 1947) was then used to determine which version of the container should be presented next to converge toward participants' 50% thresholds (i.e., the version of the container for which participants responded yes and no equally often). Below, we outline the rules for the paradigm when a dirty version of the container was shown first; however, the same rules also applied when a clean version of the container was shown first but in the opposite direction. These rules provide what is known as an 'adaptive staircase' as illustrated in Fig. 2.

1. The paradigm begins by presenting participants with a noticeably dirty container (i.e., image 90).
2. If participants provide two responses in the same direction (i.e., provide two 'no' responses), then a cleaner version of the container is shown in a step of two (i.e., image 88).
3. If participants provide two further responses in the same direction, then an increasingly cleaner version of the container is shown again in a step of two (i.e., image 86).
4. If participants continue to respond in the same direction (i.e., 'no' responses), then the step size is doubled such that a cleaner version of the container is shown in a step of four (i.e., image 82). Subsequent responses in the same direction will continue to double the step size with the maximum step size set to eight steps.
5. If there is a reversal in participants' responses (i.e., participants' responses change from 'no' to 'yes'), then the step size is halved, and participants are shown a dirtier version of the container. However, if the change in response follows a four-step change, then there is no change to the step size.
6. The paradigm terminates when the minimum step size is reached (i.e., step of one)

To maintain variability and to prevent the task from becoming too difficult, the adaptive staircase trials (75%) were mixed with dummy trials (25%) on which a random image of a container was presented.

3.2. How the paradigm was used

Having developed a paradigm, we conducted four studies which used the paradigm to measure participants' willingness to reuse containers in different scenarios and the extent to which willingness to reuse containers was associated with individual differences, as well as motivational and contextual factors, such as who owns the container. In each study, participants were told that the research investigated people's perceptions of how the appearance of products change over time and were asked to read an information sheet and complete a consent form. Participants then provided demographic information, including their age, gender, and ethnicity, country of origin, employment status, and level of education. Finally, participants were then asked to complete the paradigm designed to measure their willingness to reuse, followed by a questionnaire.

3.3. Self-report measures

The questionnaire was presented using the survey software, Qualtrics (https://www.qualtrics.com). Below we provide details of all the measures used in the present research; however, a slightly different subset of measures was used in each study (see Appendix A for an overview of the measures used in each study). Details of these measures, with reasons, are provided within the procedure section for the corresponding study. In each study, the order of presentation was randomized, and scale scores were computed by averaging the items for the respective measure, unless otherwise stated. The full list of items associated with these measures can be found in Appendix A.

3.3.1. Disgust propensity and sensitivity

Participants' disgust propensity (i.e., how easily they are disgusted) and disgust sensitivity (i.e., how unpleasant the experience of disgust is

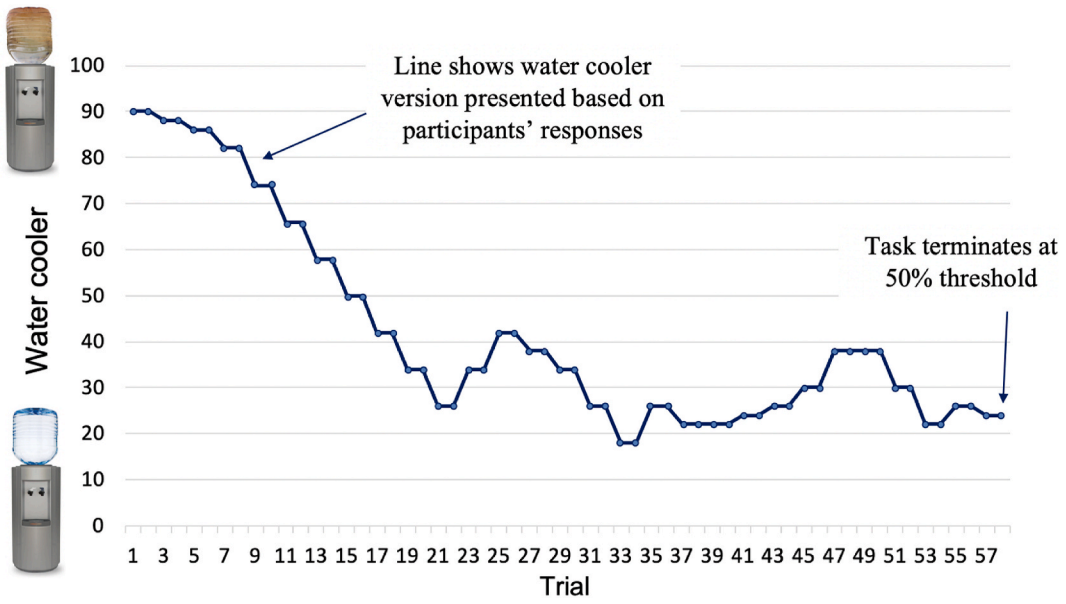

Fig. 2. An example of how the adaptive staircase procedure is used to identify a participant's 50% threshold
Notes. A step down on the graph indicates a 'no' response, whereas a step up on the graph indicates a 'yes' response.

to them) were measured using the 12-item Disgust Propensity and Sensitivity Scale-Revised (DPSS-R; van Overveld et al., 2006).[1] The scale contains six items measuring propensity to disgust (e.g., "I become disgusted more easily than other people") and six items measuring sensitivity to disgust (e.g., "It scares me when I feel nauseous"). Participants responded to each item on a 5-point scale with endpoints labelled "never" and "always", with higher scores indicating greater propensity and sensitivity to feelings of disgust.

3.3.2. *Disgust towards food*

The short version of the Food Disgust Scale (FDS-short; Hartmann and Siegrist, 2018) was used to measure participant's sensitivity to potentially disgusting food-related stimuli (e.g., eating animal flesh and cartilage, mould on food, human contamination). Participants were asked to rate how disgusting they would find eight scenarios, such as, "Finding a little snail in the salad that I wanted to eat", "Putting animal cartilage in my mouth" and "Eating with dirty silverware in a restaurant". Participants responded to items on 6-point scales ranging from "not disgusting at all" to "extremely disgusting", with higher scores indicating greater sensitivity to food-related disgust.

3.3.3. *Perceived vulnerability to disease*

The Perceived Vulnerability to Disease Scale (Duncan et al., 2009) was used to assess participants' concerns about the transmission of infectious diseases. This is a 15-item measure with two subscales. One subscale assesses respondents' beliefs about their susceptibility to infectious diseases (termed 'Perceived infectability'; e.g., "In general, I am very susceptible to colds, flu and other infectious diseases"); the other assesses emotional discomfort in contexts that indicate high potential for disease transmission (termed 'Germ aversion'; e.g., "I prefer to wash my hands pretty soon after shaking someone's hand"). Participants responded to each item on a 5-point scale with endpoints labelled "strongly disagree" and "strongly agree", with higher scores indicating greater perceived vulnerability to disease.

3.3.4. *Ecological worldview*

The revised version of Dunlap and Van Liere's (1978) New Ecological Paradigm (NEP; see Dunlap et al., 2000) was used to assess the degree to which participants endorsed an ecological worldview (i.e., the belief that human beings are part of nature rather than separate from it). Participants were asked to respond to 15 statements relating to human–environment interactions (e.g., "We are approaching the limit of the number of people the earth can support") on a 5-point scale anchored by "strongly disagree" and "strongly agree", with higher scores reflecting a stronger ecological worldview.

3.3.5. *Pro-environmental identity and concern*

The extent to which people believe that acting in a pro-environmental way is part of their self-identity was measured with four items from Whitmarsh and O'Neill's (2010) Green Identity Scale: (i) "I think of myself as someone who is very concerned with environmental issues", (ii) "I think of myself as an environmentally friendly consumer", (iii) "I would not want my family or friends to think of me as someone who is concerned about environmental issues", and (iv) "I would be embarrassed to be seen as having an environmentally friendly lifestyle".

Participants concerns about the environment was assessed using a four-item measure developed by Ellen (1994): (i) "Compared to other things in my life, environmental problems are not that important to me"; (ii) "Environmental problems are of great concern to me personally", (iii) "Environmental problems are not that serious because in the long-term things will balance out", and (iv) "I can think of many things I'd rather do than work toward improving the environment". Participants responded to each item on a 5-point scale anchored by "strongly disagree" and "strongly agree", with higher scores indicating greater pro-environmental identity and concern.

3.3.6. *Knowledge regarding plastic pollution*

Participants' knowledge regarding the issue of plastic pollution was assessed using 14 questions collated from various online quizzes (e.g., Earth Day Network, https://www.earthday.org/oceans-plastic-pollution-quiz). Example questions included: "What happens to plastic waste?", "Which industrial sector generates the most plastic waste?", and "By what year do scientists predict that plastic will outweigh fish in the ocean, pound for pound?" All of the questions were multiple-choice, and the number of correct responses were summed so that higher scores

[1] Participants' propensity and sensitivity to disgust was measured using the 16-item scale; however, analyses were conducted using the 12-item solution as this version has been recommended due to cross-loadings on four of the items from the 16-item scale (Fergus and Valentiner, 2009).

indicated greater knowledge about plastic pollution.

3.3.7. Attitudes toward using reusable products

Attitudes toward using reusable products were measured with the stem "For me, using reusable products (e.g., a reusable coffee cup or shopping bag) is …" followed by 5-point response scales anchored by: foolish – wise, bad – good, harmful – beneficial, unenjoyable – enjoyable, unpleasant – pleasant, unfavourable – favourable, and negative – positive. These adjectives were derived from Ertz et al. (2017), who adapted these items from Sparks and Shepherd (1992). Higher scores indicated more positive attitudes toward using reusable products.

3.3.8. Reuse behavior

The extent to which participants currently use reusable containers was measured using nine items adapted from Ertz et al. (2017). Example items included: "I do not purchase disposable water bottles", "I bring reusable shopping bags every time I go shopping" and "I bring a reusable coffee cup every time that I buy a takeaway hot drink". Participants were asked to respond to each item on a 5-point scale with endpoints labelled "never" and "always", with higher scores indicating greater use of reusable containers.

3.3.9. Creative reuse

The Creative Reuse subscale of Price and Ridgeway's (1983) three-dimensional 'Use Innovativeness Scale' was used to assess the extent to which participants creatively reuse and find multiple uses for their products. This subscale contains 10 items; for example, "I never throw something away that I think I might use later" and "After the useful life of a product, I can often think of ways to use the parts of it for other purposes". Participants were asked to respond to each item on a 5-point scale with endpoints labelled "strongly disagree" and "strongly agree", with higher scores indicating greater creative reuse.

4. Study 1a

Study 1a sought to provide an initial test of the paradigm based on a scenario describing a water cooler in an office. A total of 100 images of water coolers were created that varied from clean to dirty in order to mimic potential changes in appearance over time (Fig. 1). Participants were asked whether they would be willing to have a drink of water from the water cooler presented on the screen. We also designed two versions of the paradigm; one in which a dirty image of a water cooler was shown first, and one in which a clean image of a water cooler was shown first.

4.1. Method

4.1.1. Participants

One hundred and eighty-three staff and students at a large University in the UK and members of the wider local community were recruited through email and online adverts. Participants were aged between 18 and 70 years old ($M_{age} = 25.28$; $SD_{age} = 10.07$) and were predominantly female (69.5%), white (78.7%), and of British origin (71.6%). A sensitivity power analysis (G*Power 3.1; Faul et al., 2009) based on a significance level of $\alpha = 0.05$ and power set at 80% indicated that the sample was sufficient to detect a small-sized relationship ($r = 0.18$) between thresholds and other measures, such as the level of thirst. Psychology students were provided with two course credits for their participation and other participants were given the option of being entered into a prize draw to win one of three £20 shopping vouchers.

4.1.2. Procedure

Participants were invited into a lab to complete the paradigm designed to measure their willingness to reuse, followed by a questionnaire. Study 1a included the 12-item Disgust Propensity and Sensitivity Scale-Revised (Van Overveld et al., 2006), the Perceived Vulnerability to Disease Scale (Duncan et al., 2009), the revised version of the New Ecological Paradigm (Dunlap et al., 2000), measures of pro-environmental identity (Whitmarsh and O'Neill, 2010) and concern (Ellen, 1994), knowledge about plastic waste, and attitudes and behaviors with respect to reuse (Ertz et al., 2017; Price and Ridgway, 1983). Prior to starting the task, participants were also asked to indicate (i) how thirsty they were on a scale ranging from 0 (not thirsty at all) to 10 (extremely thirsty) and (ii) how long (in hours) it had been since they last had a drink.

4.1.3. Approach to analysis

The aim of Study 1a was to develop a method for identifying the point at which people deem a container unacceptable for reuse. We started by checking that (i) there was variability in participants responses (e.g., that different participants had different thresholds for reuse), and (ii) thresholds had appropriate psychometric properties (e.g., were normally distributed). Subsequent analyses investigated whether willingness to reuse was correlated with individual differences (e.g., in environmental concern, sensitivity to disgust), motivational variables (e.g., thirst), and contextual variables (e.g., whether participants were first shown a dirty or a clean water cooler). All of the analyses were conducted using SPSS, version 25.0, and the anonymized data and syntax relating to the analyses can be found online (https://osf.io/5tnmb/).

4.2. Results

4.2.1. At what point did participants become unwilling to use the water cooler?

There were no outliers in participants' thresholds (i.e., all thresholds were within ± 3 *SDs* from the mean). However, there were outliers ($N = 9$) when considering the number of trials that participants completed before the paradigm identified their threshold. The number of trials that participants complete is potentially important because the paradigm requires that participants respond consistently in order to quickly and efficiently determine their 50% threshold. Therefore, a relatively large number of trials relative to the average number of trials may indicate that participants were responding randomly. As such, these participants were removed from subsequent analyses. After removing outliers, the number of trials presented to participants ranged from 16 to 160 ($M = 48.54$, 95% CI = [44.10, 52.98]).[2]

Fig. 3 presents the distribution of participants' 50% thresholds. Tests of normality confirmed that thresholds were normally distributed (skew = 0.31, kurtosis = −0.63). Thresholds ranged from 10 to 88 ($M = 39.80$, 95% CI = [37.35, 42.26]; see Table 1), indicating that there was substantial variation in the point at which participants deemed the water cooler unacceptable for reuse.

4.2.2. Factors associated with participants' thresholds

(a) **Contextual variables.** To show how the paradigm can be used to investigate whether and how contextual variables influence thresholds, we devised two versions of the paradigm; one in which a dirty water cooler was shown first (i.e., water cooler version 90) and one in which a clean water cooler was shown first (i.e., water cooler version 10). Participants' 50% thresholds were lower when they were presented with a clean water cooler first ($M = 33.15$, 95% CI = [30.06, 36.24]), compared to when participants saw a dirty water cooler first ($M = 44.85$, 95% CI = [41.51, 48.19]; $t(171.42) = -5.11$, $p < .001$, $d = 0.76$). Given that the version of the paradigm influenced participants' 50% thresholds, and this was manipulated between-participants, we controlled for the version of the paradigm in subsequent analyses.

[2] Prior to removing outliers, the number of trials presented to participants ranged from 4 to 210 ($M = 50.66$, *95% CI* = [45.25, 56.06]).

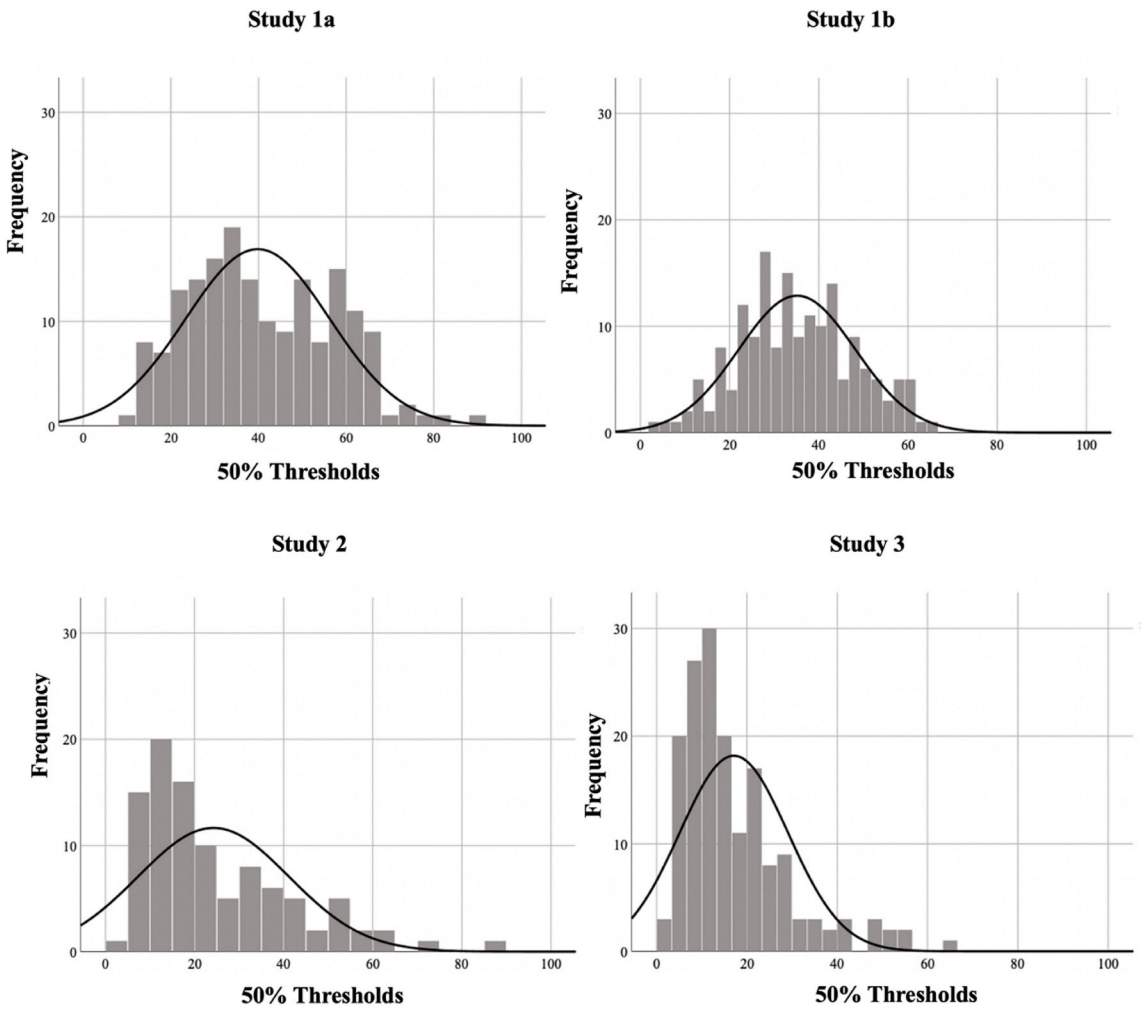

Fig. 3. *Distribution of thresholds on the willingness to reuse paradigm.*

(b) **Motivational variables.** To show how the paradigm can be used to investigate whether and how motivational variables are associated with thresholds, we asked participants to rate how thirsty they were and to state how long it had been since they last had a drink. The thirstier that participants were, and the longer it had been since they had last had a drink, the more willing they were to drink from a dirtier water cooler ($r = 0.08$, $p = .294$ and $r = 0.12$, $p = .124$ respectively); however, these correlations were small in magnitude (Cohen, 1992).

(c) **Individual differences.** An analysis of covariance (ANCOVA) did not identify differences in participants' thresholds according to their gender, $F(1, 163) = 1.00$, $p = .318$, $\eta_p^2 = 0.01$, ethnicity, $F(1, 163) = 0.34$, $p = .562$, $\eta_p^2 = 0.00$, or nationality, $F(1, 163) = 0.42$, $p = .519$, $\eta_p^2 = 0.00$. Similarly there were no differences in thresholds according participants' employment status, $F(2, 163) = 2.49$, $p = .086$, $\eta_p^2 = 0.03$, or level of education, $F(2, 163) = 0.06$, $p = .944$, $\eta_p^2 = 0.00$, and there was no relationship between participants' age and thresholds ($r = -0.04$, $p = .587$).

Table 2 presents the correlations between participants' thresholds and individual differences. Positive correlations were observed between reuse thresholds and pro-environmental identity ($r = 0.17$, $p = .084$), pro-environmental concern ($r = 0.13$, $p = .218$), and creative reuse ($r = 0.12$, $p = .129$), suggesting that people who were more concerned about the environment and tended to find creative ways to reuse products and containers were more willing to drink from a dirtier water cooler; however, these relationships were small. Participants' reuse thresholds

Table 1
Descriptive statistics (means and 95% confidence intervals) and internal reliability (Cronbach's α) of variables in Study 1a (N = 174) and Study 1b (N = 169).

	Study 1a			Study 1b		
Variable	*Mean*	*95% CI*	α	*Mean*	*95%CI*	α
1. 50% thresholds	39.80	37.35, 42.26	–	35.12	33.14, 37.11	–
2. Disgust propensity	2.94	2.86, 3.02	.76	2.98	2.89, 3.07	.76
3. Disgust sensitivity	2.34	2.23, 2.44	.77	2.52	2.41, 2.63	.76
4. Perceived infectability	2.64	2.51, 2.77	.91	2.82	2.69, 2.94	.87
5. Germ aversion	2.87	2.76, 2.99	.76	3.25	3.16, 3.35	.62
6. Ecological worldview	3.87	3.81, 3.94	.73	3.82	3.74, 3.90	.81
7. Pro-env. identity	4.07	3.96, 4.18	.58	3.95	3.86, 4.05	.65
8. Pro-env. concern	3.79	3.65, 3.94	.73	3.73	3.61, 3.85	.77
9. Knowledge	7.43	7.17, 7.68	–	7.74	7.46, 8.03	–
10. Attitudes towards reuse	4.45	4.33, 4.58	.89	4.52	4.42, 4.61	.90
11. Reuse behavior	3.29	3.19, 3.38	.71	3.29	3.19, 3.39	.71
12. Creative reuse	3.08	2.97, 3.19	.84	3.35	3.24, 3.47	.86

Notes. 95% CI = 95% confidence intervals. All self-report measures were rated on 5-point scales, with the exception of the measure assessing participants' knowledge about plastic waste (where scores could range from 0 to 14).

Table 2
Correlations between 50% thresholds and individual difference measures in Study 1a and Study 1b.

	Correlations											
Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. 50% thresholds		-.09	-.08	-.07	-.14	-.08	.17	.13	-.10	.04	-.06	.12
2. Disgust propensity	.02		.41***	.23**	.34***	.07	.04	.04	-.03	.00	.05	.04
3. Disgust sensitivity	-.05	.43***		.30***	.28***	.09	.08	.06	.02	.05	.10	.07
4. Perceived infectability	.08	.25**	.35***		.19*	.17*	.20*	.14	.03	.03	.23**	.03
5. Germ aversion	-.12	.32***	.26**	.28***		-.03	-.08	-.02	.01	.04	.00	-.04
6. Ecological worldview	.05	.13	.05	.16*	.02		.44***	.47***	.28***	.22*	.26**	.10
7. Pro-env. Identity	-.13	.19*	.01	.06	.05	.44***		.72***	.06	.32**	.55***	.32**
8. Pro-env. concern	-.04	.18*	.09	.04	.03	.55***	.71***		.22*	.29**	.41***	.36***
9. Knowledge	-.19*	.06	.02	-.14	.14	.11	.12	.13		-.01	-.01	.02
10. Attitudes towards reuse	-.08	.04	-.03	.09	-.02	.27***	.39***	.35***	.01		.27**	.10
11. Reuse behavior	-.06	.03	-.04	-.05	.08	.22**	.39***	.38***	.12	.17*		.32***
12. Creative reuse	-.05	.01	-.01	-.01	-.00	-.00	.20*	.20**	.14	.07	.37***	

Notes. Correlations above the diagonal are partial correlations (controlling for whether participants were shown a dirty or clean version of the water cooler first) from Study1a. Correlations below the diagonal are bivariate correlations from Study1b. *$p < .05$, **$p < .01$, ***$p < .001$.

were not associated with feelings of disgust, but there was a small, negative correlation with germ aversion ($r = -0.14$, $p = .072$) suggesting that people who were more concerned about the transmission of germs were marginally less willing to drink from a dirtier water cooler.

4.3. Discussion

The findings from Study 1a suggest that the paradigm that we developed to assess people's willingness to reuse containers has potential – as expected, there were substantial variations in the point at which people deemed the container unacceptable for reuse (i.e., there were no floor or ceiling effects) and thresholds were normally distributed. Thresholds were also related to contextual variables, such as whether participants saw a dirty or a clean water cooler first – participants were willing to drink from dirtier water coolers when they saw a dirty, rather than clean, water cooler first. This is consistent with previous research that suggests that initial exposure to an image or information can serve as a reference point that influences subsequent judgements (known as the anchoring and adjustment heuristic; Tversky and Kahneman, 1974). Thresholds were not found to be associated with sample demographics (e.g., age, gender, ethnicity) nor individual differences (i.e., feelings of disgust, concerns about the transmission of infectious diseases, pro-environmental attitudes and behaviors).

5. Study 1b

Study 1b sought to extend Study 1a in two ways. First, the paradigm was reprogrammed in PsychoPy (https://www.psychopy.org/), an open-source software package that uses the programming language, Python, and enables researchers to conduct experiments online. Online experiments have a number of advantages over lab-based studies, such as enabling access to large and more diverse samples, efficient data collection, and less burden on participants (Finley and Penningroth, 2015). Using a platform that is open source also allows members of the research community to use and adapt the paradigm for future research. Second, given that Study 1a found that the version of the water cooler that participants saw first influenced thresholds, we adapted the staircase procedure to run two interleaved staircases concurrently to reduce any 'anchoring' effects of the initial starting point.

5.1. Method

5.1.1. Participants

Participants ($N = 182$) were recruited through Prolific (https://www.prolific.co/), an online participant recruitment platform for scientific research. Participants were aged between 18 and 70 years old ($M_{age} = 29.26$; $SD_{age} = 11.83$) and were predominantly female (62.1%), white (70.9%), and of British origin (73.1%). Participants were paid £2.50 for taking part.

5.1.2. Procedure

The stimuli, instructions, and self-report measures were identical to Study 1a (see Table 1 for the means, 95% CIs, and Cronbach's alpha for the self-report measures). The procedure remained the same, although participants completed the study online rather than in-person. To enable the paradigm to be conducted online, the paradigm was programmed using PsychoPy (version 3.0; https://www.psychopy.org/) and was hosted by Pavlovia (https://pavlovia.org). The only difference from Study 1a was the changes made to the adaptive staircase procedure described above. Specifically, rather than participants being presented with a single staircase that started with either a clean or a dirty water cooler and became increasingly dirty or clean, participants completed both staircase procedures concurrently (as illustrated in Fig. 4). The procedure for calculating the step size remained the same, and the order for presenting trials from the different staircase procedures was randomized. Data were analyzed in the same way as the data from Study 1a; however, without controlling for the version of the watercooler that was presented first.

5.2. Results

5.2.1. Participants' thresholds on the willingness to reuse paradigm

The interleaved staircase procedure used in Study 1b produced two thresholds for each participant; the threshold corresponding to the ascending staircase (i.e., where trials started with a clean water cooler) and the threshold corresponding to the descending staircase (i.e., where trials started with a dirty water cooler). An analysis of outliers revealed that there was an outlying threshold on both the ascending and descending staircase (i.e., two of the participants' thresholds were greater than ± 3 *SD*s from the mean). There were also outliers when examining the number of trials that participants completed ($N = 6$ on the ascending staircase and $N = 6$ on the descending staircase). As such, 13 participants (7.14%) were removed from subsequent analyses. After removing outliers, the number of trials presented to participants ranged from 10 to 287 ($M = 103.42$, 95% CI = [95.64, 111.20]) for the ascending staircase and 13 to 257 ($M = 94.81$, 95% CI = [87.54, 102.09]) for the descending staircase.

Thresholds for the ascending staircase trials ranged from 3 to 71 ($M = 35.12$, 95% CI = [33.09, 37.16]) and thresholds for the descending staircase trials ranged from 1 to 67 ($M = 35.12$, 95% CI = [33.09,

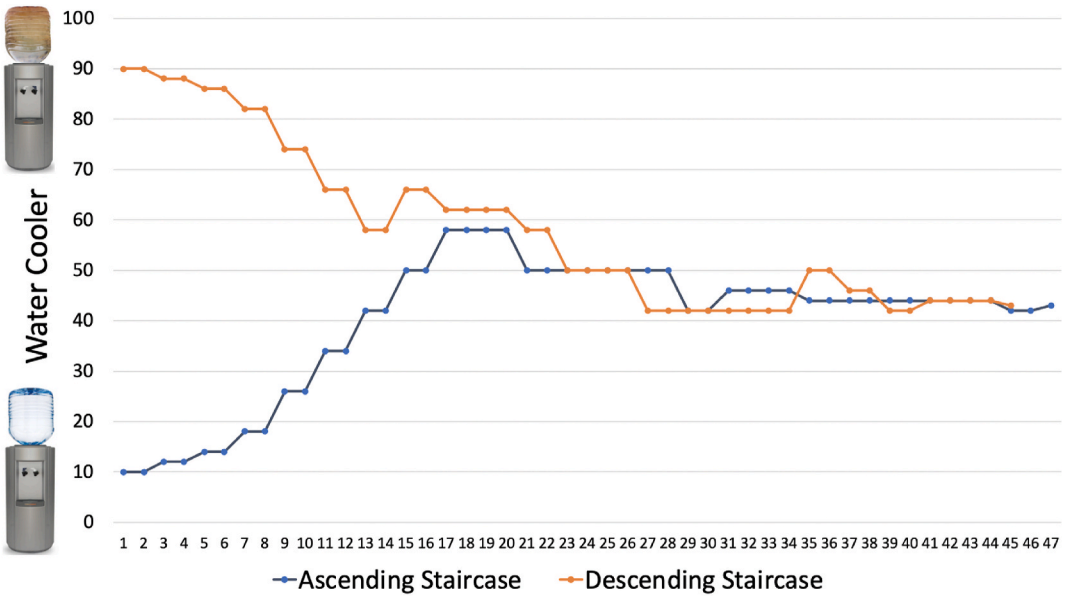

Fig. 4. An example of how the interleaved adaptive staircase procedure is used to identify a participant's 50% threshold
Notes. A step down on the graph indicates a 'no' response, whereas a step up on the graph indicates a 'yes' response.

37.16].[3] There was no difference in participants' thresholds according to the ascending or descending staircase procedure, $t(168) = 0.00$, $p = 1.00$, $d = 0.00$), suggesting that the interleaved staircase procedure removed the anchor effect that was observed in Study 1a. Thus, we computed participants' average threshold across the ascending and descending staircase trials for use in subsequent analyses.

Fig. 3 presents the distribution of participants' average 50% thresholds. Tests of normality confirmed that thresholds were normally distributed (skew = 0.08, kurtosis = −0.45). Average 50% thresholds ranged from 3 to 66 ($M = 35.12$, 95% CI = [33.14, 37.11]), indicating that there was substantial variation in the point at which participants deemed the water cooler unacceptable for reuse.

5.2.2. *Factors associated with participants' thresholds*

Participants' thresholds were not associated with how thirsty they were nor how long it had been since they had last had a drink ($r = 0.08$, $p = .278$ and $r = 0.01$, $p = .949$, respectively). An ANOVA did not identify any differences in participants' thresholds according to their gender, $F(1, 157) = 3.75$, $p = .055$, $\eta_p^2 = 0.02$, ethnicity, $F(1, 157) = 1.49$, $p = .224$, $\eta_p^2 = 0.01$, nationality, $F(1, 157) = 1.52$, $p = .220$, $\eta_p^2 = 0.01$, employment status, $F(3, 157) = 0.20$, $p = .896$, $\eta_p^2 = 0.00$, or level of education, $F(2, 157) = 0.69$, $p = .504$, $\eta_p^2 = 0.01$, and there was no relationship between reuse thresholds and participant's age ($r = -.12$, $p = .110$). As can be seen in Table 2, there was a negative correlation between participants' knowledge about plastic waste and reuse thresholds ($r = -0.19$, $p = .016$), suggesting that participants who had greater knowledge about plastic waste were less willing to drink from a dirtier water cooler. Thresholds were not associated with feelings of disgust, pro-environmental concern, attitudes towards reuse, or reuse in other domains ($ps > .05$).

[3] Prior to removing outliers, the number of trials presented to participants ranged from 2 to 517 ($M = 111.71$, 95% CI = [100.61, 122.82]) for the ascending staircase and 13 to 381 ($M = 103.22$, 95% CI = [93.75, 112.69]) for the descending staircase. Thresholds ranged from 3 to 91 ($M = 36.06$, 95% CI = [33.90, 38.22]) for the ascending staircase and 1 to 80 ($M = 35.47$, 95% CI = [33.45, 37.49]) for the descending staircase.

5.3. *Discussion*

The findings from Study 1b largely replicated the findings from Study 1a, in that there was substantial variation in the point at which people deemed the water cooler unacceptable for reuse and, on the whole, thresholds were not found to be associated with demographic characteristics nor individual differences. There was also evidence that the interleaved staircase procedure prevented the anchor effect that was observed in Study 1a. That is, there were no differences in participants' 50% thresholds on the ascending or descending staircase trials. Eliminating this effect via the interleaved staircase procedure is beneficial for future research because it means that subsequent studies do not need to manipulate (nor control for) the version of the paradigm presented to participants, thereby increasing the statistical power of subsequent analyses.

Study 1b found a negative correlation between participants' thresholds and their knowledge about plastic waste, suggesting that the more knowledge that people had about plastic waste the less willing they were to drink from a dirtier water cooler. One possible explanation for this finding is that one of the questions related to people's knowledge about microplastics (i.e., small fragments of plastic that can leach into food and drink). It could be that greater knowledge of this issue meant that people were more concerned about containers that appeared worn as they may be more likely to transfer microplastics to the product within (Garcia-Vazquez and Garcia-Ael, 2021).

6. Study 2

Study 2 used a different set of stimuli in order to investigate whether the paradigm could be used to investigate people's willingness to reuse containers for food, rather than water as in Studies 1a and 1b. If so, then it would suggest that the paradigm might be adapted to other contexts as well. Study 2 investigated people's willingness to reuse bowls for takeaway food, as a reuse system in this context could have a significant impact. For example, lunches bought 'on-the-go' (i.e., while away from home) generate approximately 10.7 billion items of packaging waste each year in the UK alone; replacing just half of this single-use packaging with reusable alternatives could significantly reduce waste (Hubbub, 2019). Thus, Study 2 adopted the same paradigm as Study 1b, but used images of reusable bowls for takeaway food rather than images of water

coolers.

6.1. Method

6.1.1. Participants

One hundred and six participants were recruited through Prolific (https://www prolific. co/) and paid £2.50 for taking part. A sensitivity power analysis (G*Power 3.1; Faul et al., 2009) indicated that 106 participants provided 80% power to detect a small-to-medium sized relationship ($r = 0.24$) between thresholds and other self-report measures, with $\alpha = 0.05$. Participants were aged between 18 and 75 years old ($M_{age} = 32.66$; $SD_{age} = 11.51$) and were predominantly female (67.9%), white (79.2%), and of British origin (72.6%).

6.1.2. Procedure

(a) **Stimuli.** 100 images of bowls that varied from clean to dirty were created using Adobe Photoshop. An image of a clean bowl (i.e., version 1) and an image of a dirty bowl (i.e., version 100) were superimposed, placing the dirty bowl on top of the clean bowl. A range of images were then created by adjusting the transparency of the image of the dirty bowl from 100% (i.e., not at all transparent) to 0% (i.e., fully transparent) in units of 1% to gradually morph the images together. Fig. 5 provides examples of the resultant stimuli.

(b) **Task instructions.** Participants were asked to imagine that they were getting lunch "to go" in their local town center, and that the restaurant that they had chosen had replaced their single-use bowls with reusable bowls. Participants were told that they would be shown images of different bowls and asked to decide whether or not they would be willing to eat from the bowl displayed on the screen (indicating "Y" for 'yes, they would be willing to eat from the bowl', and "N" for 'no, they would not be willing to eat from the bowl'). The paradigm followed the same interleaved-staircase procedure reported in Study 1b.

(c) **Self-report measures.** Following the paradigm designed to measure participants willingness to reuse bowls for takeaway food, participants completed a questionnaire containing the measures of pro-environmental identity and concern (Whitmarsh and O'Neill, 2010), and attitudes towards reuse and engaging in reuse in other domains (Ertz et al., 2017) as used in Study 1a and 1b. However, instead of the general measure of disgust used in previous studies, Study 2 employed a domain specific measure of disgust. Specifically, the short version of the Food Disgust Scale (FDS-short; Hartmann and Siegrist, 2018) was used to measure participants' sensitivity to potentially disgusting food-related stimuli. Participants were also asked to indicate whether they followed a specific diet (e.g., vegan, vegetarian, pescatarian, or omnivorous) and whether they had any food allergies. Table 3 reports the means, 95% CIs, and internal reliability of the self-report measures.

6.2. Results

6.2.1. Participants' thresholds on the willingness to reuse paradigm

Four participants had outlying thresholds on both the ascending and descending staircases, and a further three participants had outliers regarding the number of trials that they completed on both the ascending and descending staircase. Thus, a total of 7 participants (6.60%) were removed from subsequent analyses. After removing outliers, the number of trials presented to participants ranged from 5 to 155 ($M = 52.56$, 95% CI = [47.39, 57.72]) for the ascending staircase and 5 to 109 ($M = 30.31$, 95% CI = [25.62, 35.01]) for the descending staircase. Thresholds for the ascending staircase trials ranged from 4 to 94 ($M = 25.67$, 95% CI = [21.89, 29.44]) and thresholds for the descending staircase trials ranged from 4 to 84 ($M = 22.81$, 95% CI = [19.61, 26.01]).[4] Fig. 3 presents the distribution of participants' average 50% thresholds. Thresholds ranged from 4 to 87.50 ($M = 24.24$, 95% CI = [20.86, 27.62]) and were normally distributed (skew = 1.26, kurtosis = 1.41).

6.2.2. Factors associated with participants' thresholds

There was no difference in thresholds according to whether or not participants had food allergies, $t(97) = -0.41$, $p = .683$, $d = 0.19$ or specific dietary requirements, $F(3, 95) = 0.53$, $p = .662$, $\eta_p^2 = 0.02$. Similarly, there was no difference in participants' thresholds according to nationality, $F(1, 89) = 0.01$, $p = .929$, $\eta_p^2 = 0.00$, employment status, $F(3, 89) = 0.34$, $p = .797$, $\eta_p^2 = 0.01$, or their level of education, $F(2, 89) = 0.15$, $p = .863$, $\eta_p^2 = 0.00$, and there was no relationship between thresholds and participants' age ($r = -0.13$, $p = .185$). There was, however, a difference in participant's thresholds according to gender, $F(1, 89) = 5.34$, $p = .023$, $\eta_p^2 = 0.06$, and ethnicity, $F(1, 89) = 6.76$, $p = .011$, $\eta_p^2 = 0.07$. Inspection of the means revealed that female participants were willing to eat from dirtier bowls ($M = 23.06$, *95% CI* [17.74, 28.39]) than male participants ($M = 14.03$, 95% CI [6.61, 21.44]), and that participants who identified as being white were willing to eat from dirtier bowls ($M = 25.09$, *95% CI* [20.33, 29.84]) than participants who did not identify as being white ($M = 12.01$, *95% CI* [3.04, 20.97]).

Table 3 presents the correlations between participants' thresholds and the other measures of individual differences. There was a negative correlation between reuse thresholds and disgust sensitivity towards food ($r = -0.23$, $p = .025$), suggesting that people who tended to be more disgusted in food contexts were less willing to eat from dirtier bowls. There were positive correlations between reuse thresholds and pro-environmental identity ($r = 0.24$, $p = .019$) and pro-environmental concern ($r = 0.26$, $p = .009$), suggesting that people who were more concerned about the environment were willing to eat from dirtier bowls.

6.3. Discussion

Study 2 provided evidence that the paradigm can be adapted to measure people's willingness to reuse containers other than a water cooler – here, for example, bowls for takeaway food. As before, there were substantial variations in the point at which people deemed the bowls unacceptable for reuse (i.e., there were no floor or ceiling effects) and thresholds were normally distributed. Study 2 also demonstrated how the paradigm could be used to investigate whether individual differences are associated with willingness to engage with reuse systems. For example, Study 2 found that disgust sensitivity towards food was associated with participant's willingness to reuse, such that participants who were not easily disgusted within food contexts, were willing to eat from dirtier bowls. This is consistent with previous research that has shown that feelings of disgust can influence sustainable choices (Powell et al., 2019). Our findings also support research which suggests that feelings of disgust are domain specific (Olatunji et al., 2005), such that a general propensity to feel disgust in different domains (e.g., moral, body

[4] Prior to removing outliers, the number of trials presented to participants ranged from 5 to 517 ($M = 82.00$, 95% CI = [60.03, 103.97]) for the ascending staircase and 5 to 520 ($M = 61.43$, 95% CI = [38.36, 84.51]) for the descending staircase. Thresholds ranged from 1 to 100 ($M = 27.77$, 95% CI = [23.23, 32.32]) for the ascending staircase and 1 to 100 ($M = 25.10$, 95% CI = [20.91, 29.30]) for the descending staircase.

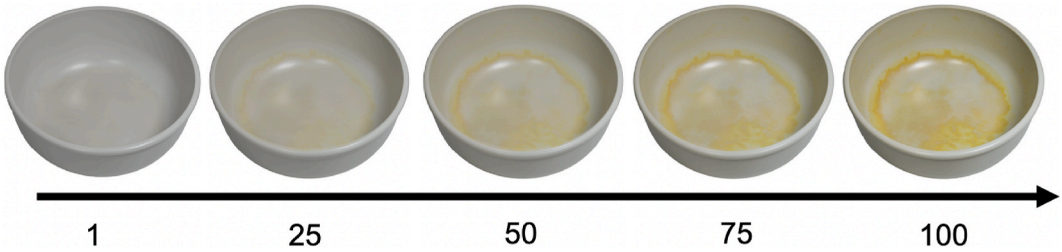

Fig. 5. Example stimuli from the willingness to reuse paradigm for Study 2 and Study 3
Notes. 100 images of takeaway bowls were created for Study 2 and Study 3. Here, images of takeaway bowls are shown in units of 25.

Table 3
Descriptive statistics and bivariate correlations between average 50% thresholds and individual difference measures in Study 2 (N = 99).

Variables	*Mean*	*95% CI*	α	2.	3.	4.	5.	6.
1. Average 50% thresholds	24.24	20.85, 27.62	–	-.23*	.24*	.26*	.18	.12
2. Food disgust	3.42	3.23, 3.60	.76		-.21*	-.24*	-.15	-.29**
3. Pro-environmental identity	4.05	3.93, 4.16	.59			.75**	.29**	.46**
4. Pro-environmental concern	3.85	3.70, 3.99	.75				.23*	.46**
5. Attitudes towards reuse	4.43	4.29, 4.57	.93					.39**
6. Reuse behavior	3.23	3.09, 3.36	.76					

Notes. $*p < .05$, $**p < .01$, $***p < .001$.

hygiene, sexual) was not associated with people's willingness to eat or drink from dirty containers, but feelings of disgust towards food-related stimuli was related to people's willingness to eat or drink from dirty containers.

We also found participants who were more concerned about the environment were willing to eat from dirtier bowls, providing support for the idea that people who are more environmentally friendly are more willing to make sacrifices in order to reduce their impact on the environment (e.g., Miafodzyeva and Brandt, 2013). Study 2 also provided some evidence that gender and cultural differences may be associated with the extent to which people are willing to reuse containers, such that females and people who identified as being white were willing to eat from dirtier bowls. This is in contrast to previous research that has shown that females typically rate cleanliness as more important than men (Mortimer and Clarke, 2011), but is consistent with research which suggests that females are more committed to maintaining an eco-friendly lifestyle than men (Mintel, 2018). It should be noted, however, that the sample was biased towards females (~70% of the sample) and people who were white British (~80% of the sample), so these findings warrant further exploration.

7. Study 3

Study 3 sought to further investigate whether the paradigm is sensitive to factors that might be expected to influence willingness to reuse containers. Specifically, Study 3 used the paradigm in an experimental design in order to explore whether and how the ownership of a container (e.g., owned by oneself vs. owned by another) and the role of the individual (e.g., consumer vs. food service staff) influences people's willingness to reuse containers as they become increasingly worn.

7.1. Method

7.1.1. Participants

A priori power analysis (G*Power 3.1; Faul et al., 2009) indicated that 180 participants would provide 80% power to detect a medium-sized difference ($f = 0.25$, equating to $d = 0.50$) between four conditions, based on a significance level of $\alpha = 0.05$. One hundred and seventy-five participants were recruited through Prolific (https://www prolific. co/) and paid £2.50 for taking part. Participants were aged between 18 and 68 years old ($M_{age} = 28.17$; $SD_{age} = 10.63$) and were predominantly female (73.7%), white (78.3%), and of British origin (72.6%).

7.1.2. Procedure

The stimuli and self-report measures were identical to those used in Study 2 and Table 5 provides the means, 95% CIs, and internal reliability of the measures. The key difference between Study 2 and Study 3 is that Study 3 recruited two groups of participants: (i) participants who are currently working in the food service industry (e.g., as a chef, waiter, manager, front of house) and (ii) participants who do not work in food services (i.e., consumers). We also randomly allocated participants to two different scenarios that differed in who owned the container (e.g., bowl owned by consumer vs. bowl owned by restaurant).

Consumers were asked to imagine that they were ordering takeaway food from a restaurant. In the restaurant-owned bowl condition, participants were asked to imagine that the restaurant provided a reusable bowl. In the consumer-owned bowl condition, participants were asked to imagine that they had brought their own reusable bowl to use. Participants in both conditions were asked to indicate whether or not they would be willing to eat their food from the bowl shown (indicating "Y" for 'yes, they would be willing to eat from the bowl', and "N" for 'no, they would not be willing to eat from the bowl').

Participants who indicated that they worked in the food service industry were asked to imagine that they were serving a customer takeaway food from their restaurant. In the restaurant-owned bowl condition, participants were asked to imagine that they were selecting a takeaway bowl owned by the restaurant in which to serve the customer. In the consumer-owned bowl condition, participants were asked to imagine that the customer had brought in their own bowl for them to

Table 4
Reuse thresholds according to role and ownership (Study 3).

	Own bowl (N = 85)		Shared bowl (N = 79)		Total (N = 164)	
Role	*M*	*95% CI*	*M*	*95% CI*	*M*	*95% CI*
Consumer (N = 83)	14.40	11.00, 17.80	15.61	11.91, 19.30	15.00	12.49, 17.51
Food service staff (N = 81)	23.41	19.81, 27.02	15.27	11.71, 18.83	19.34	16.81, 21.87
Total (N = 164)	18.91	16.43, 21.38	15.44	12.87, 18.00	–	–

Table 5
Descriptive statistics and bivariate correlations between average 50% thresholds and individual difference measures in Study 3 (N = 164).

Variables	*Mean*	*95% CI*	α	2.	3.	4.	5.	6.	7.	8.
1. Average 50% thresholds	14.95	12.97, 16.93	–	.09	.09	-.11	.10	.02	.09	.08
2. Hunger	4.54	4.01, 5.07	–		.20	.20	-.06	-.13	-.19	-.08
3. Time since last ate	2.74	1.77, 3.71	–			.08	-.04	-.12	-.10	.01
4. Food disgust	3.42	3.42, 3.20	.77				-.14	-.16*	.03	-.13
5. Pro-environmental identity	4.11	3.97, 4.24	.59					.70**	.41**	.38**
6. Pro-environmental concern	4.03	3.87, 4.19	.71						.37**	.33**
7. Attitudes towards reuse	4.58	4.48, 4.68	.86							.38**
8. Reuse behavior	3.35	3.22, 3.49	.63							

Notes. N = 83 for variable representing how hungry participants were.
*$p < .05$, **$p < .01$, ***$p < .001$.

serve the food in. In both conditions, participants were asked to indicate whether or not they would be willing to serve their food in the bowl shown (indicating "Y" for 'yes, they would be willing to serve their food in the bowl, and "N" for 'no, they would not be willing to serve their food in the bowl').

7.2. Results

Five participants had outlying thresholds on the ascending staircase and two participants had outlying thresholds on both the ascending and descending staircase. A further three participants had outliers regarding the number of trials that they completed on the ascending staircase and another participant was considered an outlier regarding the number of trials that they completed on the descending staircase. As such, a total of 11 participants (6.29%) were removed from subsequent analyses.[5] Fig. 3 presents the distribution of participants' average 50% thresholds (skew = 1.53, kurtosis = 2.36). Average 50% thresholds across the whole sample ranged from 2 to 64.50 ($M = 17.09$, 95% CI = [15.24, 18.94]).

A 2 between (role: consumer vs. food service staff) by 2 between (ownership: bowl owned by self vs. bowl owned by restaurant) ANOVA revealed a main effect of role, $F(1, 160) = 5.77$, $p = .017$, $\eta_p^2 = 0.04$, but no effect of ownership, $F(1, 160) = 3.69$, $p = .056$, $\eta_p^2 = 0.02$. Inspection of the means (see Table 4 and Fig. 6) indicates that food service staff were willing to serve food in dirtier bowls than consumers were willing to eat from. This main effect was qualified by an interaction between participants' role and ownership of the container, $F(1, 160) = 6.70$, $p = .011$, $\eta_p^2 = 0.04$. As can be seen from Fig. 7, there was no difference in thresholds between consumers and food service staff when the restaurant owned the bowl, $t(82) = 1.47$, $p = .147$, but there was a significant difference in thresholds between consumers and food service staff when the consumer owned the bowl, $t(89) = -3.56$, $p = .001$, such that food service staff were willing to serve food in dirtier bowls than consumers were willing to eat from, if the consumer owned the bowl.[6]

[5] Prior to removing outliers, the number of trials presented to participants ranged from 5 to 523 ($M = 53.93$, 95% CI = [46.53, 61.32]) for the ascending staircase and 5 to 477 ($M = 34.31$, 95% CI = [26.37, 42.26]) for the descending staircase. Thresholds ranged from 1 to 95 ($M = 21.26$, 95% CI = [18.15, 24.37]) for the ascending staircase and 1 to 99 ($M = 18.76$, 95% CI = [16.38, 21.14]) for the descending staircase. After removing outliers, and across the sample as a whole, the number of trials presented to participants ranged from 27 to 199 ($M = 48.96$, 95% CI = [45.78, 52.15]) for the ascending staircase and 5 to 149 ($M = 26.91$, 95% CI = [22.96, 30.87]) for the descending staircase. Thresholds for the ascending staircase trials ranged from 2 to 67 ($M = 17.52$, 95% CI = [15.58, 19.46]) and thresholds for the descending staircase trials ranged from 2 to 62 ($M = 16.66$, 95% CI = [14.84, 18.49].

[6] The focus of Study 3 was to explore differences in thresholds according to participants' role and ownership of the bowl, and so the bivariate correlations between thresholds and self-report measures are presented in Table 5 for information.

7.3. Discussion

The findings from Study 3 demonstrate how the paradigm that we have developed can be used to investigate whether and how people's willingness to reuse differs according to the context (e.g., whether people are eating food from, or serving food in, the container and the nature of the reuse system – e.g., private vs. shared ownership). We found that food service staff were willing to serve food in dirtier bowls than consumers were willing to eat from, but only when the bowl belonged to the consumer. It is perhaps not surprising that members of staff were willing to serve food in a dirtier bowl that belonged to the consumer because (i) they were not required to eat from the bowl, and (ii) the appearance of the bowl does not harm the reputation of the restaurant because the bowl belonged to the consumer. Contrary to past research (e.g., Argo et al., 2006; Baxter et al., 2016), we did not find that people were more willing to reuse their own dirty or worn food container than a dirty container that belongs to a stranger; however, the paradigm provides the basis and tools for additional tests of these and other hypotheses in the future.

8. General discussion

Reusing packaging and containers can significantly reduce plastic waste and is more sustainable than single-use alternatives. However, implementing a successful model of reuse relies on people being willing to use packaging and containers multiple times and, therefore, on scientists and practitioners being able to understand the factors that influence such decisions. The present research sought to develop a method to identify how willing people are to reuse containers that can be used to build an understanding of how individual, motivational, and contextual variables influence willingness. To this end, a computer-based paradigm was developed using techniques borrowed from psychophysics to investigate how changes in the appearance of a container over time influence participants' willingness to use the container. To illustrate the potential of the method, we created two different scenarios based on a water cooler in an office and getting lunch in a reusable takeaway bowl. A total of 100 images of these containers were created that varied from clean to dirty in order to mimic changes in appearance over time and participants were asked whether or not they would be willing to drink or eat from the container presented on the screen. Their responses were used to determine their 50% thresholds; that is, the point at which participants became unwilling to drink or eat from the container.

8.1. Overview of findings

Four studies demonstrated how the paradigm can be used to measure the point at which people become unwilling to use a reusable container. In each study, we found substantial variations in the point at which people deemed a product or container unacceptable for reuse (e.g., thresholds ranged from 1 to 94 across the four studies), found no evidence of floor or ceiling effects, and found that thresholds were normally distributed. Identifying thresholds was quick and efficient – it took (on

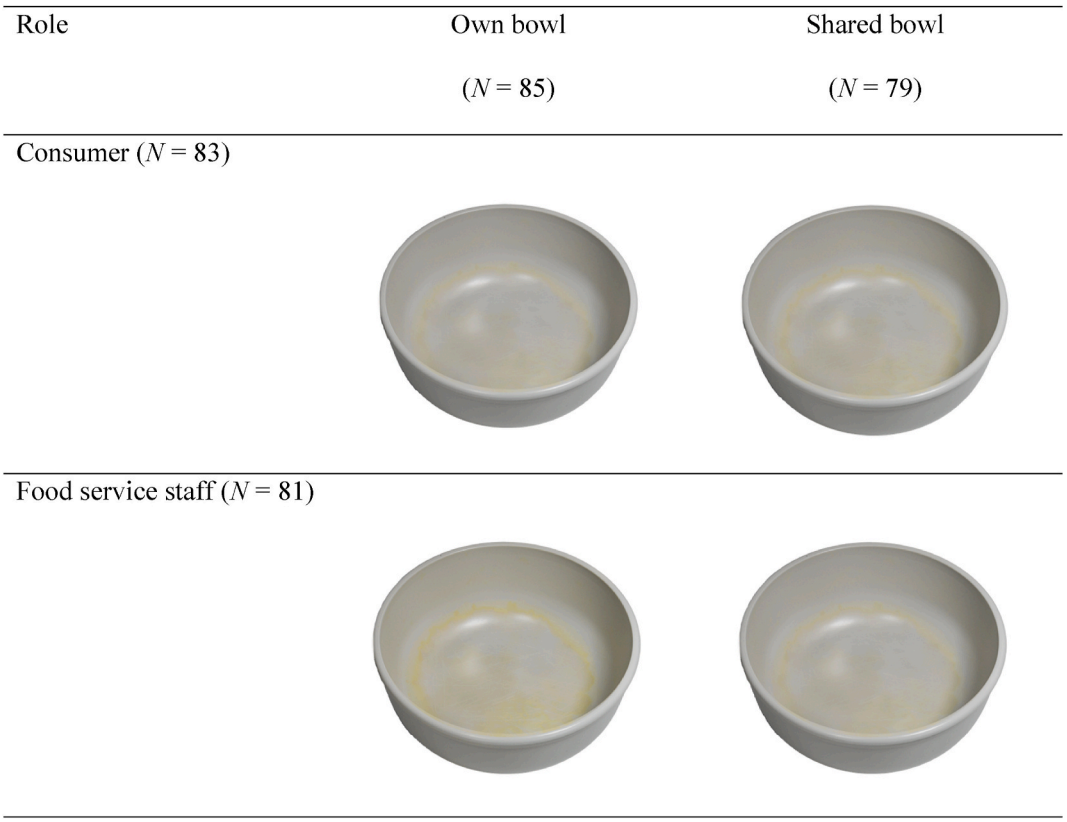

Fig. 6. Bowls representing participants' average thresholds according to role and ownership in Study 3.

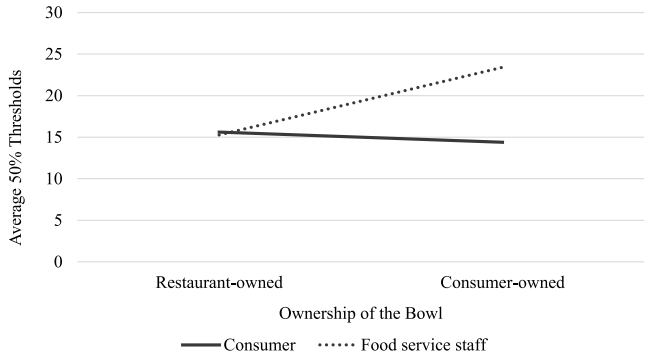

Fig. 7. Average 50% thresholds according to role and ownership of the bowl (Study 3).

average) 58 trials to identify participants' thresholds, which typically took less than 10 min to complete. We also demonstrated how the paradigm can be used to identify factors that may influence people's thresholds. For example, we showed that the paradigm is sensitive to contextual factors, such as whether participants are presented with a clean or dirty container first (Study 1a) and the role or perspective of the individual (e.g., whether they are a consumer eating from the bowl, or a member of staff serving food in the bowl; Study 3). We also showed that the paradigm is sensitive to individual differences, such that thresholds were associated with people's sensitivity to food-related disgust (Study 2). These findings are not intended to be definitive – rather, they provide the basis and the tools to further explore the factors that influence the point at which people deem a container unacceptable for reuse.

8.2. Strengths, limitations and future directions

Despite consumer behavior being key to the success of reuse models, this is the first study to our knowledge that has explored people's willingness to (re)use containers, particularly as they start to show signs of wear or previous use. To achieve this aim, we developed a novel paradigm that can be used in future research to assess a range of factors that may be essential for the success of reuse models. The paradigm is versatile and could be adapted to explore willingness to reuse in other settings and with respect to different types of packaging and containers. For example, the scenarios presented in the current research were based around people consuming water or food from different containers. However, future research could explore people's willingness to reuse containers that do not hold products that are ingested (e.g., in the case of household products or cosmetics). Furthermore, the images of the containers used in the present versions of the paradigm varied according to the amount of discoloration that was present. The paradigm could also be used to investigate the effects of other changes in appearance, such as dents, scratches, or abrasions, that may occur when packaging is reused (e.g., as it is repeatedly cleaned and transported), and different interventions that may influence willingness, such as what people are told about the cleaning process (e.g., telling people that the container has been cleaned using very high temperatures).

The visual nature of the paradigm also means that it is well-suited to cross-cultural research and there was some evidence in Study 2 of cultural differences in the extent to which people are willing to reuse containers that warrants further exploration. Given that people's perceptions of what is considered dirty may differ across different countries and cultures (e.g., Yoo, 2012), it could be that culture provides a naturally occurring anchor that influences people's willingness to reuse. The paradigm could be used to test this hypothesis. In short, the paradigm provides the basis for a scientific study of the factors (e.g., psychological, physical, environmental) that are crucial to the success of reuse models

and therefore inform efforts to make reuse, rather than single use, the default.

The findings that would accumulate as a result of such investigations could inform considerations with respect to reuse systems by other scientific disciplines and manufacturers, retailers, brand owners, and waste processors. For example, life cycle assessments that quantify the environmental impact associated with a product over its life cycle typically identify the number of times that a container must be used before it is considered more environmentally friendly than single-use alternatives (referred to as the environmental break-even point; Cottafava et al., 2021). However, while life cycle assessments often account for potential damage to the packaging in the analyses, they do not account for whether and how the appearance of a container that is repeatedly used influences whether or not it is reused (WRAP, 2010). This is important because, if people are not willing to use a container that has already been used 50 times, but the life cycle assessment indicates that the container should be used at least 100 times before it is more environmentally friendly than a single-use alternative, then individuals' behavior may prevent reusable packaging from having the intended benefit. Given that life-cycle assessments are now considered an influential tool for directing companies on how to make changes to their packaging to promote sustainability (e.g., Sim et al., 2016), considering whether and how behavioral factors (e.g., willingness to reuse) interact with environmental markers (e.g., number of uses) is important for informing where and when reusable packaging is beneficial.

There are some limitations to the present research that could be addressed in future studies. First, the present research measured people's willingness to reuse containers as opposed to actual reuse. That said, research in other contexts has suggested that willingness to consume is strongly associated with actual consumption. For example, Hartmann and Siegrist (2016) asked participants to rate the extent to which they would be willing to eat insect-based products (e.g., deep-fried crickets). Participants were then presented with a tortilla chip that was made using cricket flour and asked to eat it. The findings suggested that self-reported willingness was strongly correlated with whether or not participants ate the tortilla chip. Future studies could, however, measure people's actual use of worn or dirty looking containers. For example, participants could be invited into a lab where they are offered food or drink in a dirty looking container (e.g., under the pretense of a taste test) to observe whether or not participants actually eat or drink from the container presented to them.

Second, while there are a number of advantages to conducting studies online (e.g., the ability to recruit large, diverse, and more representative samples), there are also limitations, especially for research that involves presenting images to participants. For example, it is difficult to control the exact presentation of the stimuli due to differences in the size and resolution of participants' screen and the brightness of their computer display (Woods et al., 2015). We sought to address some of these concerns in the present research by replicating the findings of Study 1a (a lab-based study) with the findings from Study 1b (an online study) and by randomly allocating participants to different conditions in Study 3, such that any differences in display characteristics should be randomly distributed across the groups. However, there are a number of strategies that could be applied in future research in order to help control for these differences. For example, Yung et al. (2015) have created a protocol that guides participants to calibrate their computer displays before beginning the study. This protocol includes asking participants to adjust the brightness of their screen until they can distinguish between 12 bars that vary along a black-to-white gradient, and by asking participants to adjust the size of their screen to match the size of a physical object such as a credit card (the latter of which can be achieved in Pavlovia using the following code: https://pavlovia.org/Wake/screenscale). Future research using our paradigm may want to consider adopting a similar approach.

9. Conclusion

Reusing packaging and containers has been identified as a key strategy for reducing plastic waste. However, research is needed to understand what people are willing to reuse, how, and why. The present research developed a novel method to identify the point at which people become unwilling to reuse different containers and demonstrated how this method can be used to identify factors that influence people's willingness to reuse. In general, the findings suggested that people were relatively unwilling to reuse containers that showed signs of previous use. However, there were substantial variations in the point at which people deemed a product or container unacceptable for reuse and willingness depended on contextual factors, such as whether participants are presented with a clean or dirty container first, the role or perspective of the individual (e.g., whether they are a consumer eating from the bowl, or a member of staff serving food in the bowl) and individual differences, such as people's sensitivity to food-related disgust. This research has implications for behavioral scientists, industry, policymakers, and the public as the method provides a versatile tool that can be used to address a wide range of questions central to the success of reuse systems and inform strategies for promoting reuse and, ultimately, reducing plastic waste. For example, interventions designed to promote reuse may need to alleviate concerns regarding the appearance of reusable containers (e.g., by providing information that the container is clean and safe) or by designing containers that do not show signs of wear. The present research offers a paradigm that can be used to test the efficacy of different approaches.

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Conflicts of interest/competing interests

The authors have no conflicts of interest to declare that are relevant to the content of this article.

Ethics approval

All studies were conducted in line with the principles of the Declaration of Helsinki. Approval was granted by the Research Ethics Committee in the Department of Psychology at the University of Sheffield, UK.

CRediT authorship contribution statement

Harriet M. Baird: Conceptualization, Methodology, Software, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Visualization, Funding acquisition. **Keelan Meade:** Conceptualization, Methodology, Software, Formal analysis, Investigation, Resources, Visualization. **Thomas L. Webb:** Conceptualization, Methodology, Visualization, Writing – review & editing, Supervision, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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