Article

Recycling bias and reduction neglect

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Waste generation and mismanagement are polluting the planet at accelerating and unsustainable rates. Reducing waste generation is far more sustainable than managing waste after it has been created, which is why 'reduce, reuse, recycle' is ordered the way it is, with reduce first and recycling as a last resort. However, our research finds strong evidence for a recycling bias and reduction neglect. Across two surveys ($N_{\text{Total}} = 1{,}321$), most participants perceived recycling as the most sustainable action to manage waste. This error decreased when different waste destinations were emphasized and when choice options were reduced. When asked in study 2 ($N = 473$), 53.9% of participants recognized that the product design stage offered the greatest potential for mitigating waste and its impacts. However, participants only felt empowered to enact change via their consumption (72.9%) and disposal choices (23.3%). For consumers and producers alike, policies and interventions should motivate source reduction and reuse, which could help correct the misplaced preference for recycling.

Recycling has long been promoted as a sustainable waste management strategy. However, current levels of waste generation are unsustainable and harmful[1-3]. Microplastics, for example, are ubiquitous waste by-products that are now found in the most remote natural environments, in food and in human blood[4]. Beyond problems with plastic waste, the production and mismanagement of goods is a major source of greenhouse gas emissions, a public health concern, in particular for the often-marginalized communities where that waste ends up[1,5]. Waste overgeneration and associated problems are predicted only to accelerate—and in many cases, much faster than they can be mitigated[6].

Public concern about waste-related pollution has surged alongside efforts to regulate and ban wasteful products[7-10]. However, despite growing awareness, per capita waste generation has increased, waste-related pollution has grown and recycling rates remain stagnant[2,3,11]. Understanding what people think are effective solutions to these problems could help address the gap between public concern and persistent and increasing waste issues.

Experts recommend source-reduction strategies that prevent the creation of waste rather than those that focus on managing waste after it already exists. The waste management hierarchy, a framework used by the US Environmental Protection Agency (EPA), ranks different management strategies from most to least environmentally preferred[12,13]. These are, in order, source reduction, reuse, recycling

and composting, energy recovery (that is, incineration with energy capture), and treatment and disposal (that is, landfilling)[12,13]. The widely recognized 'reduce, reuse, recycle' (3Rs) framework also orders waste management actions from most to least preferred[14-16]. Waste disposal behaviours are the end result of an entire system of production, distribution and consumption. Creating items destined to be recycled, while better than creating items destined to be disposed of, is still energy and resource intensive and leads to negative impacts downstream[12,13,17,18]. By contrast, source reduction prevents natural resource depletion and other negative impacts across a product's life cycle.

Despite the greater benefits of minimizing waste generation[12,13,19,20], many organizations and individuals persist in focusing on opt-in recycling by individual consumers to manage waste[21-24]. The misplaced focus on recycling is intentionally encouraged by goods manufacturers, namely, the fossil fuel, beverage and packaging industries, to defer waste disposal responsibilities onto consumers and prevent the disruption of their business models[21-24]. These industries have created anti-litter and pro-recycling organizations, promoted public education to recycle, supported the creation of municipal recycling programmes and lobbied against policies that would regulate the waste they produce[21,22]. In recent years, scientists and journalists have exposed these failures of recycling[24-27]. While recycling can be more sustainable than other disposal-focused waste management strategies

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such as landfilling or incineration, it is currently not diverting a high percentage of waste[11] nor displacing virgin production for certain materials, such as plastics[3]. Given this historical emphasis on recycling and new awareness of limitations, we sought to examine how members of the US public think about recycling compared with other strategies.

In our research, we examined how people living in the United States understand the efficacy of different waste management strategies. We hypothesized that participants would erroneously prefer recycling over more effective reduction and reuse strategies. Given the importance of public participation for recycling to work, we also explore how much our participants know about the recycling system and how efficacious they perceive it to be. Understanding these perceptions and beliefs can help provide guidance on how to engage with the public on issues of waste and to better design systems that support waste reduction.

Results

Choosing the 'most effective' personal action

In study 1, participants ($N = 848$) answered two series of open-ended questions about the most effective thing they and other Americans could personally do to reduce landfill waste and plastic pollution in the oceans (randomized assignment of the series and the questions within the series). The questions included the following: 'What is the single most effective thing YOU [other Americans] can personally do to reduce landfill waste?' and 'What is the single most effective thing YOU [other Americans] can personally do to reduce plastic pollution in the oceans?'

Table 1 shows the responses of participants regarding the most effective actions they thought they could personally take. There were limited differences between recommendations for 'self' and recommendations for 'other Americans' (see Supplementary Tables 1 and 2 for all responses). When thinking about the most effective action to reduce landfill waste, participants cited recycling more frequently than any other action, demonstrating a harmful preference for recycling (what we term a 'recycling bias') because, in reality, both source reduction and reuse are more effective[12]. When answering the question regarding the most effective thing they could do to reduce ocean plastic pollution, however, participants were more likely to recommend source-reduction strategies, with 40% of participants endorsing using fewer plastic products versus 22.2% recommending recycling. These results more closely align with expert recommendations to reduce waste generation at the source.

In study 2, we posed the following question to participants ($N = 473$): 'Household waste can cause many environmental problems. What is the single most effective thing you can do in your day-to-day life that helps solve this problem?' The modal response from participants was that recycling was the most effective action they could take (Table 1), again demonstrating a recycling bias.

Ranking waste management strategies

To explore how people understand the efficacy of different strategies in relation to each other, participants in study 2 completed two ranking tasks. In the first task, participants ($N = 473$) ranked the different strategies listed in the waste management hierarchy of the EPA from most to least environmentally preferred (Fig. 1a). Overall, participants demonstrated a poor understanding of which of these strategies was most effective: 78.4% failed to place them in the correct order. Participants thought that source reduction and reuse were roughly equivalent to recycling and composting in terms of environmental impact: while 39.7% of all participants correctly placed reduction and reuse in the top position, 35.9% incorrectly placed recycling and composting there. A significant majority of participants (90.3%) correctly placed treatment and disposal (landfill) in last place. In the second task, which asked participants to rank the 3Rs (Fig. 1b), a majority (53.9%) placed the phrase in the correct order of most to least environmentally preferred. Still, nearly half of the participants misordered the 3Rs.

Table 1 | Perceptions of the 'most effective thing'

Activity	Source reduction or disposal	Study 1		Study 2
		Reduce landfill waste	**Reduce ocean plastic**	**Solve problems caused by waste**
		Self (%)		
Recycle	Disposal	44.9	22.4	46.9
Use fewer plastic products	Source reduction	7.4	40.0	5.1
Reuse items and buy reusable products	Source reduction	9.1	10.1	10.6
Reduce consumption and buy less	Source reduction	7.1	2.5	9.6
Unspecific (for example, 'avoid waste')	–	6.3	3.1	0.8
Compost	Disposal	4.5	–	5.9
Seek out items with less or sustainable packaging	Source reduction	4.0	3.9	3.8
Reduce food waste	Source reduction	3.7	–	5.1
Mindful purchasing	Source reduction	2.9	0.7	3.8
Separate waste and dispose of it 'properly'	Disposal	0.7	1.1	3.0
Advocate for systemic change	–	1.5	4.7	0.6
Do not litter	Disposal	0.5	5.0	0.4
Beach clean-ups	Disposal	0.1	2.9	–

Participant responses regarding the most effective actions they could personally take to reduce landfill waste, solve environmental problems associated with household waste and reduce ocean plastic pollution. Rows that do not have a single category adding up to at least 2% of responses were removed from the table. For all questions, some responses defied binary categorization between disposal and source reduction. Full tables including responses to recommendations for 'self' versus 'other' are available in Supplementary Tables 1 and 2.

Finally, we asked participants to choose between two actions in terms of which is better for the environment generally: recycling waste and reducing waste. On a 5-point scale from 1 ('recycling waste is much better') to 5 ('preventing waste is much better'), on average, participants understood that preventing waste is better for the environment (mean (M) = 4.18, s.e. = 0.05). A majority of participants (81.6%) indicated that preventing waste was somewhat or much better, compared with just 13.1% who thought recycling was somewhat or much better for the environment; the remaining 5.3% were neutral between the two options.

How participants sort waste

The recycling system requires active, informed consumer participation to effectively recover recyclable materials[28,29]. The act of 'wish recycling', or wishcycling, which refers to placing contaminants into the recycling stream, creates additional costs and difficulty for recyclers[30,31]. In study 2, participants sorted common consumer goods into virtual recycling, compost and rubbish bins, and indicated how certain they were about their choice (Fig. 2). In this task, several common recycling contaminants, including plastic bags, disposable coffee cups and light bulbs, were erroneously placed in the virtual recycling bin by more than 25% of participants. Wishcyclers who erroneously placed coffee cups and plastic bags in the recycling bin were significantly more confident than participants who correctly placed these contaminants in the rubbish bin (Supplementary Section 3b).

While people may default to recycling when considering sustainable waste management, participants were not confident in the efficacy of their preferred strategy. We asked participants in study
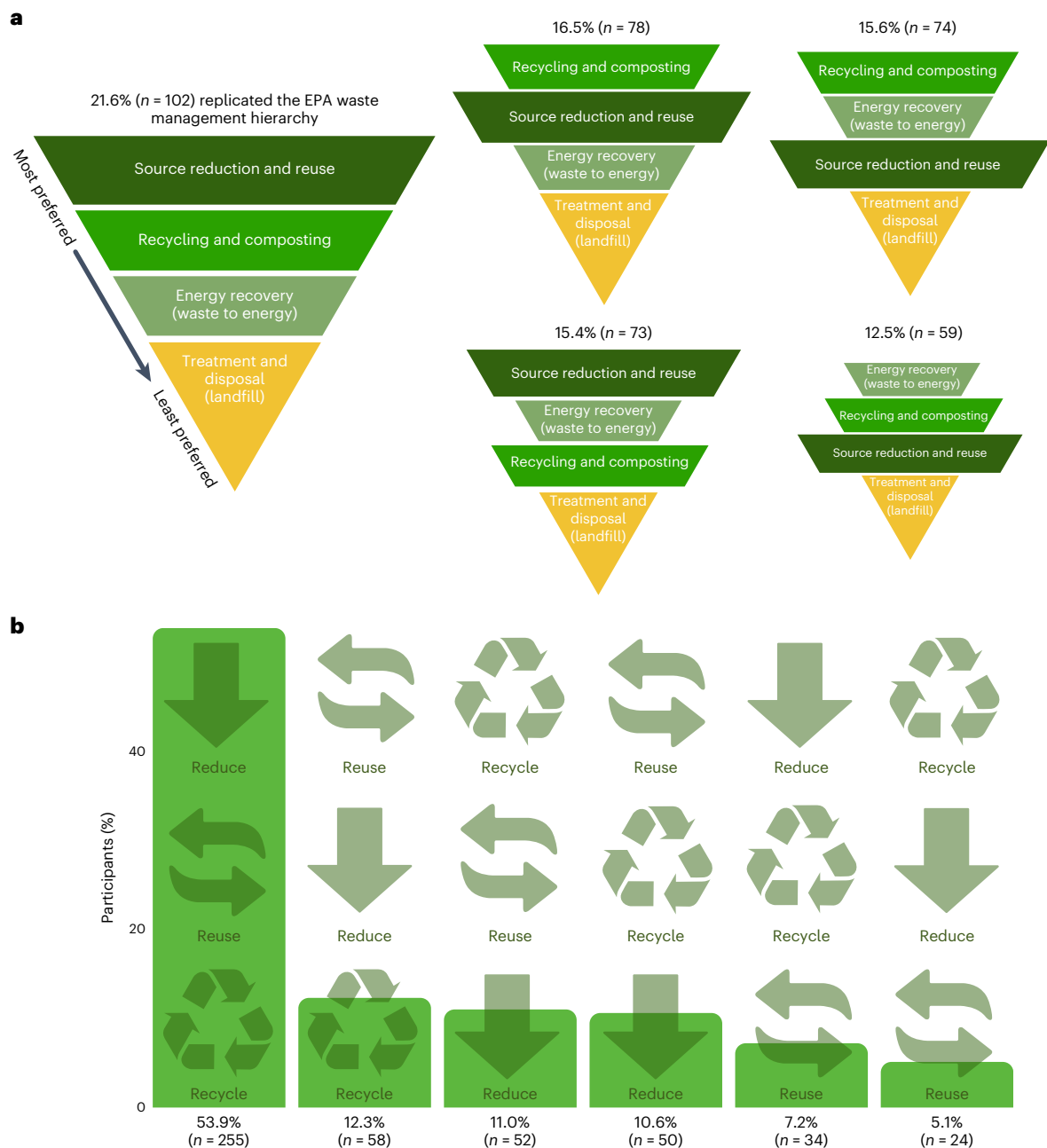
Fig. 1 | Perceptions of waste management strategies. a, The five most common waste management hierarchies created by participants in order of frequency. The majority of participants did not correctly replicate the waste management hierarchy of the EPA. Note that the EPA hierarchy groups reduction and reuse together and recycling and composting together. **b**, Slightly more than half of the participants correctly ordered the 3Rs from most to least environmentally preferred. We also found that 33.9% of participants placed reduce or reuse at the bottom position as the least environmentally preferred option. Data are shown here in order of frequency. Credit: icons in **b**, uxwing.com.

1 (*N* = 848) to estimate the all-time percentage of plastic that has been recycled. Participants greatly overestimated the percentage of plastic recycled (*M* = 25.2%, s.e. = 0.70) when compared with expert estimates of 9% from the literature[3] (mean difference (MD) = 16.2, *t*[847] = 23.19, *P* < 0.001, *d* = 0.80). However, they correctly estimated that the majority of plastics have ended up in landfills and the natural environment (*M* = 70.62%, s.e. = 1.35), although they reasoned that significantly less plastic had this fate compared with expert estimates[3] (MD = −8.4%, *t*[847] = −6.210, *P* < 0.001, *d* = −0.21). When asked how certain they were that items put in recycling bins actually get recycled, participants in study 2 (*N* = 473) reported a mean certainty of 53.4% (s.e. = 1.22).

Choosing the 'most important stage' for action

Household waste is the end result of a long supply chain, with environmental impacts at every stage. Products that eventually become waste are designed, manufactured and distributed by companies, yet responsibility for this waste often falls on consumers[21,32]. To probe how participants understand the system that creates waste and their perceptions about effective interventions, we asked participants in study 2 (*N* = 473) two systems-thinking questions. The production, consumption and disposal system was depicted visually, and participants were prompted to select one stage where change would have the most impact and where in the cycle they felt they could have the most impact as individuals (Fig. 3). While over half of participants felt that the design
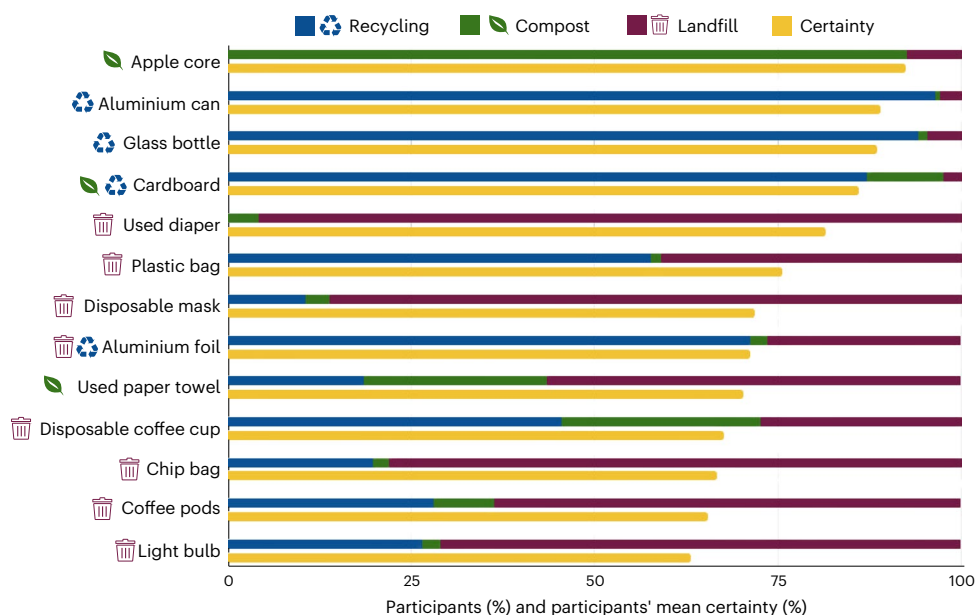
Fig. 2 | Sorting-waste task and associated certainty in responses.
Participants were asked to sort common consumer items into online recycling, compost and rubbish bins, and then indicate how certain they were about their choice on a 0–100 slider bar. The blue, green and maroon bars indicate the percentage of participants who placed items in each category. The yellow bar represents the mean certainty of participants across our sample in their choice. The correct category is indicated by the icon placed to the left of each item. For some items, more than one category is correct. For example, clean cardboard can be recycled or composted. For other items, such as aluminium foil, recyclability varies significantly. Items are placed in descending order in terms of how confident participants were, on average, about their sorting choice. Note: there is variation in the recycling system across the United States. We cross-referenced several recycling industry websites and municipality recommendations to determine these categories of what is typically recyclable and compostable in most programmes and what items contaminate these streams. Credit: icons, uxwing.com.

stage was most important to mitigate the impact of household waste overall (53.9%), participants overwhelmingly indicated that the only two stages they felt empowered to enact change were through their consumption (72.9%) and disposal behaviours (23.3%).

In follow-up open-ended responses, participants wrote about their thought process, explaining why they selected the stages they did. Some participants believed that consumer demand drove all the other stages by introducing feedback and promoting upstream change through market signals. One participant captured this sentiment clearly: "Consumers have the largest impact on the market. If demand decreases, supply follows." Another wrote, "Ultimately the stuff will not be made if there is not a demand for it, so if I don't consume, there is no need for all the steps that come before it (or disposal, for that matter)."

Many other participants exhibited a sentiment that production was inevitable, so their role was to minimize the negative impact created by producers. One participant wrote, "I am a strong believer in preventing a problem before it happens, so a lot of the responsibility lies with the manufacturers, who make the decisions in regards to packaging, materials, ingredients, and how much waste is produced in the creation of these products. As a consumer, it is my responsibility to decide, before bringing an item home, if there is an option available to me that will not leave behind as much waste." One participant expressed this sentiment more strongly: "Companies … can destroy entire ecosytems [sic]. Individuals cannot do much but they can help with how it is consumed and disposed of."

Discussion

Across several measures, participants exhibited a 'recycling bias', the mistaken perception that recycling is the most sustainable action when it comes to consumer waste, and 'reduction neglect', insufficient attention to reduction and reuse. Recycling bias and reduction neglect are harmful and problematic because producing items intended to be disposed of, even if they are recycled, is incredibly resource and energy intensive[2].

The belief that recycling is the most effective strategy was not static. When presented with fewer options, different end destinations for waste and a systems diagram, participant responses moved towards reduction and reuse. Our results provide insight into when and why individuals default to disposal strategies. The explanation lies in how they believe the problem should be solved, feelings of agency and the number of options with which they are presented. When asked what they as individuals can do, participants default to recycling. However, when asked what should be done 'in general', participants acknowledged that preventing waste is much better. When given fewer options, participants understood solutions to these problems, but may not feel empowered to influence the system.

Dealing with waste is a systems-level problem that has often been positioned as a consumer-choice problem rather than a political one[21,22]. As pollution from post-consumer waste (a term that places culpability on the consumer rather than the producer) has become a more visible issue and the efficacy of recycling has been questioned[23,25,26,33], the petrochemical industry has not reduced plastic production[34]. Instead, corporations have continued to blame consumers, embrace new recycling schemes and push for internal recycled content standards to stave off regulation[34]. Advocating for systems changes that promote source reduction at scale (for example, bans on wasteful products, formalized reuse programmes) and engaging in source-reduction behaviours (for example, buying less, reusing) are arguably the most effective actions that individuals can undertake to tackle these problems. However, our participants overwhelmingly cited downstream, individual actions that maintain the status quo. Participants reported that they felt most empowered (and disempowered) as consumers or 'shoptivists'[35] and disposers, rather than as citizens, voters or activists. Recycling, in contrast to reducing consumption of goods, does not represent a threat to dominant business interests—producers can
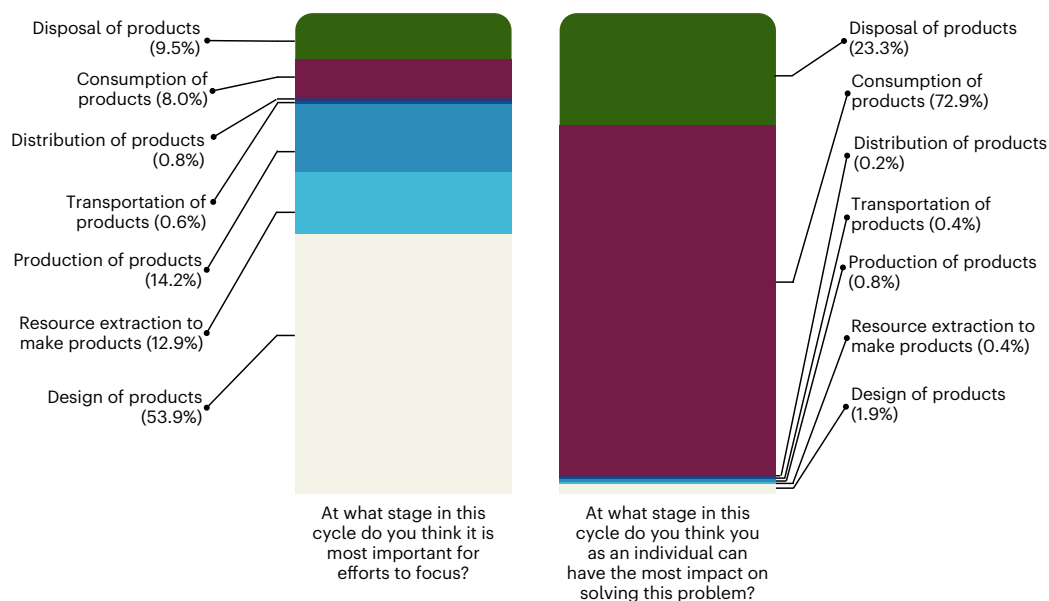
Fig. 3 | Perceptions of what matters most for intervention and impact.
Results of system-level questions on what stage to focus on to solve the problem of household waste. Participants were told, 'Household waste can cause many environmental problems. There is a long process for products that eventually become waste, beginning with resource extraction and ending with disposal.' See 'Study 2 survey text' in Supplementary Information for visuals that accompanied the questions.

continue to create single-use goods without consumer guilt because they get 'recycled'. Participants in our study demonstrated misguided beliefs about practices of recycling that limit its efficacy, including miscategorizing contaminants as recyclable. Contamination can lead to collected material being thrown out and excluded from recycling streams, further limiting the effectiveness of recycling. Results suggest efforts aimed at promoting recycling have failed to educate consumers to be effective recyclers, only serving to make recycling the most salient or accessible waste management strategy.

Participants did demonstrate awareness of at least some problems associated with recycling—on average, they estimated low recycling rates of plastic and low confidence in the recycling system—yet they still perceived it to be their most effective option. If participants fail to consider source-reduction actions, they may erroneously see recycling as their best option. Notably, our findings reveal that the magnitude of this recycling bias is context dependent. When the ocean was specified as an end destination for waste, participants became more likely to cite expert-recommended source-reduction strategies. In this case, the long-standing focus on recycling may be getting balanced out by the increasing scientific, media and political focus on ocean plastic pollution. More generally, making the environmental impact of different end destinations for waste more salient may be one way to flip mental defaults from disposal actions to source-reduction actions, which future experimental research could explore.

The misplaced focus on disposal shifted when participants were presented with a systems diagram. Rather than default to disposal, the majority of participants chose consumption as the stage in which they could have the most impact. But even this result is not as straightforward as it might seem: many participants said that companies can have the most impact by creating recyclable goods and that customers can have the most impact by consuming recyclable products. In other words, it may not be about consuming less but shifting consumption to items that can be 'sustainably disposed of'. One participant summed it up this way: "For the first one, I figured that its [sic] up to the manufacturers to think about what components they are using to make their products. Are they recyclable or not. For the consumer, it's at the consumption level because that is when we make decision about how and what we consume which will then have to be recycled."

Engaging in source-reduction behaviours on the individual level—such as buying fewer goods, purchasing second-hand or selecting more durable products[19,36–39]—is not easy. Some barriers to these behaviours include access to alternatives, poor product designs, and lack of convenience, time and purchasing power. Even buying less is challenging because it requires individuals to resist consumer culture and cognitive shortcuts[40]. In addition, acquiring goods and their subsequent disposal strategies are tangible, feel-good actions (for example, recycling, composting)[41] whereas source-reduction strategies are often actions in absence (for example, choosing to 'not' purchase something). It seems that opting out of the dominant consumer culture may feel so inaccessible as to not even occur to our participants, who therefore perceive recycling as their least-worst option within the existing system. Interventions focused on empowering citizens to influence the system may be one way to address the gap between what people believe should happen and how they behave.

Our research had several limitations. Participants were not compensated for greater accuracy, and our samples are not completely representative of the US population, which indicates selection bias. It is also possible that the framing of some questions presupposes the existence of waste, which may have prompted participants to consider disposal rather than source reduction. Perceptions of individual agency as they pertain to solving environmental problems are a rich area for future exploration.

Our results add to the growing evidence that limiting the production of disposable items could have a much larger impact than focusing on individual actions for sustainable waste outcomes. Rather than continuing to emphasize recycling as the best waste management strategy, interventions should motivate behaviours that avoid the creation of waste, including reusing, buying second-hand goods and sharing goods[19,20,36–39]. Policies should promote source reduction at scale through reuse, repair and refill programmes as well as through extended producer responsibility legislation. Limits on the production of wasteful products should also be considered as an alternative to the current status quo that makes disposable goods and saddles consumers with the responsibility of the end product. Recycling is a tool to be used when waste cannot be avoided, not a panacea for the overgeneration of waste.

Methods

Study 1

Participants were recruited and completed a Qualtrics survey via Amazon Mechanical Turk (MTurk, www.mturk.com) in October 2019 (*N* = 995). Informed consent was obtained from all participants before the survey via an online declaration. Participants' responses were excluded if there was evidence the survey was being filled in by a bot, responses indicated a lack of proficiency in English or it was evident that a participant took the survey more than once from different accounts. After the exclusions, 848 participants remained in our sample. Participants were compensated US$4 in their MTurk accounts. The median age was 35.0 years and 46.1% of participants were female. The median income was between US$50,000 and US$79,999, and the majority of participants had a college degree or higher (65.3%). According to census data, our participants had a greater proportion of males and were slightly younger and more educated than the US population as a whole[42]. Politically, 48.9% self-identified as liberal (sum of very liberal, liberal and slightly liberal categories), 20.5% indicated they were politically moderate and 30.6% indicated they were conservative (sum of very conservative, conservative and slightly conservative categories).

This survey was modelled after a study investigating individual perceptions of water use[43] and another study on energy goals[44]. At the beginning of the survey, participants answered two series of open-ended questions about the most effective thing they and other Americans could personally do to reduce landfill waste and plastic pollution in the oceans (randomized assignment of the series and the questions within the series). Responses were judged by two researchers who reviewed the first 100 survey responses together and then independently coded the remaining responses. Interrater agreement was very high for all four questions, $\kappa > 0.8$. Each action was then classified as either a disposal (for example, recycling) or source-reduction behaviour (for example, buy less).

Participants then completed a series of estimations, including personal and average waste behaviours, recycling times and end destinations for plastic waste. Participants indicated how much they (and the average American) know about recycling on a Likert scale from 1 ('none at all') to 5 ('a great deal').

To assess actual recycling knowledge, participants then indicated whether they thought a series of 18 items were 'recyclable at almost all recycling facilities', 'recyclable, but only at select recycling facilities' or 'not recyclable anywhere'. Participants indicated how often they (and the average American) put something in the recycling that they are not sure is recyclable. To assess beliefs about contamination behaviours, we asked participants to indicate the extent to which they agreed with a series of questions.

Participants also responded to questions assessing whether they considered waste when making purchasing decisions. Participants were also asked whether they buy products specifically because they are made out of recycled materials and, if so, what kinds of products they buy for this reason. Lastly, participants responded to standard demographic questions. The exact wording of each survey question can be found in Supplementary Sections 4 and 5.

This research was approved by the University of Virginia Internal Review Board and pre-registered through the Open Science Foundation (osf.io).

Study 2

A representative sample of participants (*N* = 473, based on simplified US census data and balanced on sex, age and ethnicity) was recruited via Prolific (www.prolific.com) and completed a Qualtrics survey in March 2022. Informed consent was obtained from all participants before the survey via an online declaration. All participant responses met inclusion criteria and passed attention checks. Participants were compensated US$2 in their Prolific accounts. The median age was 46.0 years and 51.2% (242) of participants were female. The median

income was between US$50,000 and US$79,999, and the majority of participants (59.4%) had a college degree or higher. Politically, 58.1% self-identified as liberal (sum of very liberal, liberal and slightly liberal categories), 17.1% as moderate and 24.7% as conservative (sum of very conservative, conservative and slightly conservative categories).

Participants first responded to standard demographic questions. They were then told, 'Household waste can cause many environmental problems', and asked an open-ended question about the most effective thing they could do to help solve this problem. Next, participants were presented with the four waste management strategies present in the waste management hierarchy of the US EPA and asked to rank the choices in order of 1 (best for the environment) to 4 (worst for the environment). Participants then completed the same ranking task for the 3Rs and indicated the frequency with which they do each action.

Participants were then asked to sort common products into virtually represented recycling, compost and rubbish bins and indicate how certain they were about their choice. Participants also rated their certainty about whether the items they place in the recycling bins actually get recycled. Participants were then asked to choose between recycling waste and preventing waste in terms of environmental efficacy, which they did more frequently and which was easier.

We then presented participants with two systems-thinking questions. Participants were told, 'Household waste can cause many environmental problems. There is a long process for products that eventually become waste, beginning with resource extraction and ending with disposal.' Alongside this description was a graphic depicting these different stages. Participants were asked at which stage they thought efforts should focus on in general and which stage they thought they could have the most impact.

Participants then responded to hypothetical scenarios regarding their consumption and disposal behaviours, and a reduced-consumption measure and materialism measure[45], as well as a series of questions about recycling heuristics. The exact wording of each survey question can be found in Supplementary Section 5.

This research was approved by the Indiana University Internal Review Board and the University of Virginia Internal Review Board.

All data analysis was done in SPSS version 28.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

Data for study 1 are not available to anyone other than the research team due to language included on the consent form; therefore, requests for study 1 data cannot be fulfilled. Data for study 2 are publicly available at openICPSR (https://www.openicpsr.org/openicpsr/project/181063/version/V1/view). All survey materials are included in Supplementary Sections 4 and 5. Source data are provided with this paper.

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Author contributions

M.J.B., P.I.H. and S.Z.A. designed the research with support from L.E.K. M.J.B. and P.I.H. analysed the data with support from S.Z.A. M.J.B., P.I.H., L.E.K. and S.Z.A. wrote the paper.

Competing interests

Additional information

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Software and code

Policy information about availability of computer code

Data collection	For Study 1, we used Qualtrics version October 2019, a web-based service for creating surveys and collecting data. We used Mechanical Turk (version October 2019) for subject recruitment. For Study 2, we used Qualtrics version March 2022 for survey deployment and data collection. Participants for Study 2 were recruited from Prolific in March 2022.
Data analysis	All data analysis was done in SPSS version 28

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Data for Study 1 is not available to anyone other than the research team due to language included on the consent form, therefore requests for Study 1 data cannot

Human research participants

Policy information about studies involving human research participants and Sex and Gender in Research.

Reporting on sex and gender	Sex and gender were not considered in the study design. Participants were asked to self-report their gender for both studies. We include two correlation matrices in supplementary information on individual relationships between sociodemographic variables and recycling bias, which include gender as a variable.
Population characteristics	Study 1: After exclusions, 848 participants remained in our sample. Median age was 35.0 years and 46.1% of participants were female. Median income was between $50,000 − $79,999 and the majority of participants had a college degree or higher (65.3%). Politically, 48.9% self-identified as liberal (sum of very liberal, liberal, and slightly liberal categories), 20.5% indicated they were politically moderate, and 30.6% indicated they were conservative (sum of very conservative, conservative, and slightly conservative categories).
	Study 2: Study 2 was comprised of a representative sample of participants (N = 473, based on simplified U.S. census data and balanced on sex, age, and ethnicity). Median age was 46.0 years and 51.2% (242) of participants were female. Median income was between $50,000 − $79,999 and the majority of participants (59.4%) had a college degree or higher. Politically, 58.1% self-identified as liberal (sum of very liberal, liberal, and slightly liberal categories), 17.1% as moderate, and 24.7% as conservative (sum of very conservative, conservative, and slightly conservative categories).
Recruitment	For Study 1, Participants were recruited and completed a Qualtrics survey via Amazon Mechanical Turk (MTurk, www.mturk.com) in October of 2019 (N = 995). Recruitment was limited to self-selecting participants on the platform, which may cause some selection bias. However, participant pool was sufficiently large to account for such bias. For Study 2, a representative sample of participants (N = 473, based on simplified U.S. census data and balanced on sex, age, and ethnicity) was recruited via Prolific (www.prolific.com) and completed a Qualtrics survey in March of 2022. This sample was limited to active users on Prolific and therefore may cause some selection bias, however the sample was sufficiently large to account for such bias.
Ethics oversight	Study 1: This research was approved by the University of Virginia's Internal Review board and pre-registered through the Open Science Foundation (osf.io). Study 2: This research was approved by Indiana University's Internal Review Board and the University of Virginia's Internal Review board. Informed consent was received from all participants.

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Study description	Mixed methods (qualitative and quantitative descriptive).
Research sample	Our research includes two separate studies. Study 1 is not representative and is a sample of convenience. Study 2 is a representative sample based on simplified U.S. census data and balanced on sex, age, and ethnicity. We used a sample of convenience for Study 1 as it is more exploratory in nature. We use a representative sample in Study 2 to confirm our Study 1 results and to investigate other interesting relationships in the data. In the Methods, we compare our sample to the US population, and report some biases: our sample for Study 1 and Study 2 is more educated and more liberal than the adult US population.
Sampling strategy	Study 1 was a convenience sample. Study 2 was based on simplified US census data and balanced on sex, age and ethnicity. Both studies used sample sizes informed by target sample sizes from past work (Attari et al., 2010 which used 505 participants).
Data collection	Participants completed surveys for both Study 1 and Study 2 online using Qualtrics, a web-based survey tool. Researchers and participants were not present with each other in-person, as participants took surveys online. Participants were not divided into experimental groups as this was a descriptive study, and researchers were not blind to study hypothesis.
Timing	Data for Study 1 was collected in October 2019. Data for Study 2 was collected in March of 2022.
Data exclusions	For Study 1, participants' responses were excluded if there was evidence the survey was being filled in by a bot, responses indicated a lack of proficiency in English, or it was evident that a participant took the survey more than once from different accounts. After

	exclusions, 848 participants remained in our sample. For Study 2, all participant responses met inclusion criteria and passed attention checks.
Non-participation	Participants self-selected to participate online. We cannot know how many potential participants viewed the online recruitment but chose not to respond.
Randomization	Participants were not allocated into random groups as this was a descriptive study. Open-ended questions for Study 1 were presented in random order to control for framing effects.

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☒	☐ ChIP-seq
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