Article

Shifting the Balance among the 'Three Rs of Sustainability:' What Motivates Reducing and Reusing?

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Abstract: The "Three Rs of Sustainability—Reduce, Reuse, Recycle," are central tenets of many community waste-management programs promoting responsible use of natural resources and ecosystem services. Over the past few decades, recycling has become widespread, but monetary and energy expenditures required to transport and transform waste materials have led to downsizing of recycling programs globally and in the U.S. This trend increases the need for effective reducing and reusing practices as alternatives to recycling. Using a survey experiment to examine motivations that underlie reducing and reusing behaviors, individuals reported their current reducing, reusing, and recycling practices. Respondents then were provided with three hypothetical scenarios that described (1) an external waste-management threat to public well-being, (2) social/peer pressure from family and friends towards sustainable decision-making, and (3) increased convenience of reusing and reducing practices. These messages reflect previously identified RRR motivations. After the scenarios, the questions regarding recycling, reducing, and reusing behavior were presented again to test for changes in the responses. All three scenarios were effective in increasing intended reducing and reusing behavior. The threat scenario was slightly more effective than the others, particularly among individuals who reported behavior with considerable recycling practices but not as much reducing and reusing.

Keywords: reducing, reusing, recycling; environmental behaviors; sustainability; waste management behavior; socio-environmental

1. Introduction

Poor waste-management practices and the overproduction and excessive packaging of consumer goods are contributing to global environmental crises, which are escalating rapidly [1,2]. People often cite recycling as the solution to this crisis, but in many communities, recycling alone will not perpetuate sustainable waste management systems. In the United States, the first records of recycling can be traced back to Philadelphia in the 1860s, with the establishment of the Rittenhouse Mill that recycled linens and other cotton materials [3]. The current household recycling paradigm—single-receptacle curbside collection—emerged in 1995 [4] and has since spread to most metropolitan communities in high-income nations. In theory, recycling is supposed to minimize energy consumption by reusing or re-purposing the materials used in a would-be waste product. Although recycling is a mainstream practice in most industrialized nations, substantial changes in

policy and legislation have altered recycling and sustainability practices across the United States, impacting the viability of recycling programs. For example, glass recycling has been eliminated in many communities [5], and only a fraction of plastics put into municipal recycling programs are actually kept out of landfills—about 9 percent in the United States prior to 2018 [6].

Currently, a major challenge for North American recycling programs has been China's "National Sword" policy, which was enacted in 2017. The policy bars the import of recyclable materials from foreign countries and has had major consequences for the global recycled materials market, particularly for plastic [7]. Prior to "National Sword," China was processing about half of the world's recyclable waste [6]. Since 2017, cutbacks in recycling programs have been occurring in the United States and globally, as waste management experts seek to strike a balance between efficient use of energy resources and recycling as much material as possible [8]. With excessive amounts of plastics and other recyclable materials going into landfills and incinerators, waste managers are now advocating for more reducing and reusing practices as alternatives to recycling [9].

Sustainability research regarding waste management has expanded in specific disciplines, such as chemical engineering, urban development, and materials science [10]. Antonis A. Zorpas's work has been instrumental in the integration of waste prevention and strategy development, framing waste management as an integral component of sustainability at the local and state level [11]. In contrast, our study focuses on individual waste-management behaviors and what might increase more sustainable individual practices. Stewart Barr [12] introduced a conceptual framework to explain the factors that drive recycling, reducing, and reusing (RRR) behaviors and their association with environmental values. His research indicated that reducing, reusing, and recycling practices were slightly different as far as the level of environmental values associated with each type of behavior and could be explained by different psychological variables. While Barr's work identified the internal motivations of the individual, our research uses applied messaging through hypothetical scenarios to determine what the individual might perceive as external motivations of behavior changes toward more sustainable practices.

Recycling now is more generally considered to be a normative behavior compared to the more robust environmental values of individuals who regularly practice reducing and reusing behaviors. This is because recycling is not "underlain by such fundamental values" as compared to reducing and reusing [12] (p. 467). In many cases, recycling is much more likely with "access to good facilities, awareness of these facilities, and perceptions of convenience," which is somewhat different from the conditions that lead to reducing and reusing behaviors [12] (p. 467). This study seeks to understand the factors that can motivate an individual to increase reducing and reusing behaviors rather than solely recycling ones.

Barr tested his conceptual framework by surveying 673 residents of Exeter, UK, and found that stronger environmental values tended to underlie reduction and reuse behaviors, whereas recycling behaviors are motivated more by social pressures and convenience [10]. We built on Barr's work by examining whether certain motivations are likely to influence reducing, reusing, and recycling by testing which of three imagined scenarios was most effective in changing how people reported their likelihood to take part in reducing and reusing behaviors. These scenarios were presented as part of a survey wherein individuals responded to questions about their current behavior regarding RRR. We then presented respondents with three hypothetical scenarios that described (1) external environmental threats to public well-being, (2) the influence of social/peer pressure from family and friends to accept more sustainable waste management norms, and (3) increased convenience of reusing and reducing practices. The survey repeated the questions about RRR behaviors after each scenario to determine whether the scenarios might induce respondents to change their behavior. Our primary goal was to determine which of the motivations (environmental threat, social/peer pressure, or convenience) was the most effective means of modifying reported behavior of individuals who are primarily "recyclers" to incorporate more reducing and reusing behaviors. In addition, we asked a series of demographic and

political affiliation questions to determine whether RRR activities are related to age, gender, income, political affiliation, civic participation, and geographic location.

Barr pointed out that "the waste problem is one that is likely to be resolved only when policies are implemented that are based on a clear understanding of what factors influence individual intentions and behaviors" [12] (p. 436). The research presented in this paper speaks directly to this need, as our intent is to provide a clearer understanding of the shared environmental values among reducers and reusers and what might induce recyclers or even non-recyclers to practice more sustainable behaviors. We argue that this information is essential for informing the public and waste-managing institutions about realigning waste-management practices to adjust to the current constraints on recycling programs.

2. Materials and Methods

2.1. Survey Design and Participants

The survey was designed specifically to evaluate underlying motivations for sustainability behavior. To make this assessment, the survey first evaluated the degree to which respondents participated in recycling, reducing, and reusing (RRR) behavior. Then, we had respondents read three different hypothetical scenarios that might pertain to waste management in their communities, and we had the survey participants respond to the reducing, reusing, and recycling questions again after exposure to each scenario. Hence, we sought to determine how these hypothetical scenarios changed respondents' propensity to participate in reducing and reusing behavior.

To establish participation levels in RRR activity, we asked for information regarding current participation levels in at-home waste-management behaviors. Specifically, we asked a series of 15 questions, five for each category of environmental behavior (reducing, reusing, and recycling) in random order for each respondent. The questions asked how likely respondents would be to take part in specific activities, with answers formatted as a seven-point Likert scale ranging from "extremely unlikely" (scored as 1) to "extremely likely" (scored as 7). We also asked respondents about their awareness of existing waste-management programs within their communities, such as curbside recycling or privately funded drop-off facilities. We then asked them to select whether they would describe themselves as a reducer, reuser, recycler, or a skeptic (i.e., one who does not reduce, reuse, or recycle often).

This initial set of 15 RRR questions was used to categorize participants into one of three groups: recyclers, reusers/reducers, and skeptics (this categorization was independent of respondents' self-evaluation). Respondents categorized as recyclers scored high on the Likert-type scale for questions pertaining to their propensity to recycle various types of household waste (cans, plastic, paper, cardboard etc.). More specifically, recyclers had a mean score of 4 or higher for all the 15 RRR questions but had a mean score of less than 6 for both reducing and reusing questions. Reducer-reusers had a mean score of 4 or higher for all RRR questions and had a score of 6 or more for either the reducing or reusing question sets, which asked about the frequency of reusing things like glass jars as well as avoiding disposable items like paper towels. Participants with relatively low scores (mean less than 4) on all RRR questions were categorized as skeptics.

After establishing initial or baseline levels of RRR activity for each participant, we presented them with three scenarios (in random order) designed to elicit one of the motivating factors for changing waste management behavior. The threat scenario used a threat message modeled after vested interest theory [13–15] regarding individual and community harm from a lack of recycling—specifically, the construction of a landfill in the immediate vicinity. The social pressure scenario attempted to elicit normative behavior motivation by describing a new reduce/reuse initiative in the community in which friends and family participated. The convenience scenario attempted to evaluate the influence of the convenience of RRR behaviors by describing a new, easily accessible grocery store featuring reusable containers and reduced product packaging. Each scenario was followed directly by two comprehension and attention-check questions. The threat scenario also had

a follow-up question about what types of threats were most concerning for the participant (i.e., threats to nature, human health, neighborhood economy, and neighborhood culture). These questions were followed in turn by a repeat of the 15 RRR questions (randomly ordered). These questions were regarded as indices of behavioral intention and were used as a repeated measure in comparison with the first set of RRR questions. Differences between the responses to the initial RRR questions and those following each scenario were regarded as an indication of a participant changing his/her intention to participate in RRR activities.

After all the scenarios were presented, the survey asked participants a standard series of demographic questions to ascertain information about age, gender, race/ethnicity, employment, income, political participation, political affiliation, family status, living situation, and education. We also asked participants whether they thought threats to wellbeing, social pressure, or convenience were more likely to get them to participate in more reducing and reusing behavior. Finally, we asked participants if they considered themselves to be an environmentalist. Personal sustainability motivators have been linked to intrinsic and extrinsic based pressures represented by general concern for the welfare of one's environment and community, social and familial social/peer pressure, as well as personal health and well-being [16]. Our goal for these follow-up questions was to better understand the individual priorities of community sustainability initiatives from the prioritization of recycling to increasing community-wide reducing and reusing behaviors.

This study surveyed individuals within the United States recruited as respondents with Amazon Mechanical Turk, which is an online crowd-source labor force often used in social science to collect survey data [17]. Participants were eligible to participate if they had a 95% approval rating for jobs completed on the platform, a minimum of 10,000 tasks completed, and if they lived in the United States. The survey was created and distributed using Qualtrics [18]. Eight attention-check questions were present in the survey. The survey was conducted between 31 March and 10 April 2020, during the COVID-19 global pandemic. An example of the full survey is available on the Open Science Framework at https://osf.io/t3rj2/, (accessed on 15 June 2020).

2.2. Statistical Analysis

To evaluate the primary question in our study—which external factors (threat, social/peer pressure, or convenience) are most effective in motivating reducing and reusing behavior—we used a repeated-measures experimental survey design wherein we focused on the responses to just the 10 RRR questions about reducing and reusing behaviors that were answered by respondents before and after reading the scenarios. For each respondent, we regarded the first set of reduce and reuse questions as a baseline, and then we calculated the change in these responses associated with each of the three scenarios by subtracting the average baseline response score from the average associated with each scenario. If this difference was a positive value, then the scenario had inspired an increase in intended reducing and reusing behavior.

We used these differences as the dependent variable in a linear mixed model with the type of scenario and the respondent category (reducer/reuser, recycler, or skeptic) as independent variables. Preliminary analyses revealed that the order in which the scenarios were presented appeared to have a small but significant effect on the changes in reduce and reuse responses. Therefore, the final statistical model included scenario, respondent category, and scenario presentation order as independent factors as well as a scenario-type/respondent-category interaction term along with respondent ID as a random factor. As a post-hoc analysis, we calculated estimated marginal means to find pairwise differences in reduce and reuse responses across all three scenarios and respondent categories.

We performed several follow up analyses that were largely aimed at revealing the influences of various demographic and lifestyle parameters (e.g., age, racial or ethnic identification, income, and political affiliation) on (1) the classification of respondents (as reducers/reusers, recyclers, or skeptics); (2) how the different scenarios affected responses to the reduce and reuse questions; and (3) which factors the respondents identified as being

most influential in inducing reducing and reusing behavior. These analyses were a mix of ANOVAs, chi-square tests, and Kruskal–Wallis tests. In general, we employed an ANOVA when dealing with a continuous variable (e.g., age); we used a chi-square test when dealing with a categorical variable (e.g., race); and we used a Kruskal–Wallis test when dealing with ordered categories (e.g., household income range).

All analyses were done using the program R [19]. To organize and transform data, we used the packages lubridate [20], plyr [21], and tidyr [22]. For linear mixed models, we used the lme() function in the nlme package [23], and the post-hoc analysis with estimated marginal means was done using the emmeans package [24]. ANOVAs, Tukey tests, chi-square tests, and Kruskal–Wallis tests were done using functions in the stats package, which is part of the base R installation. We used the FSA package [25] to run post-hoc tests following Kruskal–Wallis tests. For plotting, we used ggplot2 [26] and ggpubr [27]. All data and R code associated with this manuscript are available on the Open Science Framework at https://osf.io/t3rj2/, (accessed on 15 June 2020).

3. Results

3.1. Sample Characteristics

In the Spring of 2020, 734 surveys were conducted. After removing surveys that were incomplete and those that failed to meet the criteria described above, we had a total of 428 surveys that were used in our analyses. All survey participants were residents within the continental United States. This was a sample of convenience and most easily attainable using the Amazon Mechanical Turk (MTurk) platform for data collection. The completion time averaged 14.6 min with a standard deviation of 6.1 min. The average age of respondents was 40.75 years (SD = 11.79). The sample was slightly male biased, with 53.21% of respondents identifying as male, 45.85% identifying as female, and 0.94% identifying as non-binary. In addition, 77.98% of the respondents identified as white, 5.85% identified as black, 2.64% identified as Hispanic, 7.36% identified as Asian, and other ethnic groups (i.e., groups that individually amounted to less than 2% of the respondent pool) amounted to 7.71% of the sample. Regarding employment, 76.42% of the individuals had a full-time job, 10.00% worked part time, 9.62% were unemployed, 2.83% were retired, and 1.13% were students. From our question about income range, we found that 55.28% of respondents were making less than $60,000 per year. A large majority of the respondents (91.13%) had completed some level of higher education, with 48.11% having completed a four-year degree, 12.4% having completed a two-year degree, and 17.36% with some college experience. Roughly half (51.70%) of respondents described their communities as suburban, with 30.38% and 17.92% in urban and rural communities respectively, and 58.1% were homeowners as opposed to renters (40.75%) or house-less individuals (0.57%). Finally, 21.96% of respondents identified as Republican, 49.30% identified as Democrat, 26.87% identified as Independent, and 1.87% identified as "Something else." Generally speaking, this sample of respondents was representative of the United States but with some skew toward white males, higher incomes, and Democrats, [28,29], which is typical of MTurk samples.

When asked if they considered themselves to be an environmentalist, 64.72% of respondents stated that they somewhat agreed, agreed, or strongly agreed (mean Likert score 4.71). This response could be related to possible self-selection or social desirability bias [30]. Regarding respondents' self-classification as a recycler, reducer, reuser, or skeptic, only 4.21% of respondents self-identified as skeptics; whereas 54.44% and 41.36% of respondents self-identified as recyclers and reducer-reusers, respectively. These self-classifications disagreed with our analysis classifications of respondents based on their answers to the RRR questions and the classification criteria described above. We identified 7.7% of the respondents as skeptics, 25.0% as reducers/reusers, and 67.3% as recyclers. The responses to the question about whether respondents considered themselves to be environmentalists were strongly associated with respondent category (Kruskal–Wallis: chi-square$_2$ = 61.1, *p*-value < 0.001), with an average Likert score of 5.50 $\pm$ 1.08 for reduc-

ers/reusers, 4.58 ± 1.43 for recyclers, and 3.27 ± 1.70 for skeptics. Individual rank-sum comparisons indicated that the Likert scores for these groups were all significantly different from each other ($p < 0.001$).

3.2. Scenario and Respondent Category Effects

Preliminary analyses indicated that there were significant effects of scenario, respondent category, and scenario presentation order on post-scenario changes in responses to reducing and reusing questions. Therefore, we incorporated all these factors into a final linear, mixed-effects model that also included an interaction between scenario and respondent category as well as a random effect of subject. The model results indicated clear effects of all three variables (scenario: $F_{2849} = 203.5$, $p = 0.003$; category: $F_{2424} = 21.2$, $p < 0.001$; order: $F(2849)_{2849} = 38.60$, $p < 0.001$), but the interaction between scenario and category was not significant ($F_{4849} = 1.2$, $p = 0.311$), which suggests that different categories of participants (i.e., recyclers, reducer/reusers, and skeptics) responded in a similar manner to each of the different scenarios.

We examined the model results further by making pairwise comparisons of marginal means for every possible combination of scenario and respondent type. This analysis amounted to 36 comparisons that were made using the emmeans package [24] in R [19]. This package applies a Tukey adjustment to control for multiple comparisons in calculating *p*-values. On average, all three scenarios had the expected effect of raising the cumulative response score for the reducing and reusing questions, indicating that respondents were claiming that they would do more reducing and reusing activity under the circumstances of each scenario (Figure 1). As expected, this change in the reduce/reuse score was smallest in the respondents classified as reducers-reusers (because they had high reduce/reuse scores initially). Average reduce/reuse score increases were greatest among the skeptic group, but this increase was not statically different from that of the recycler group.
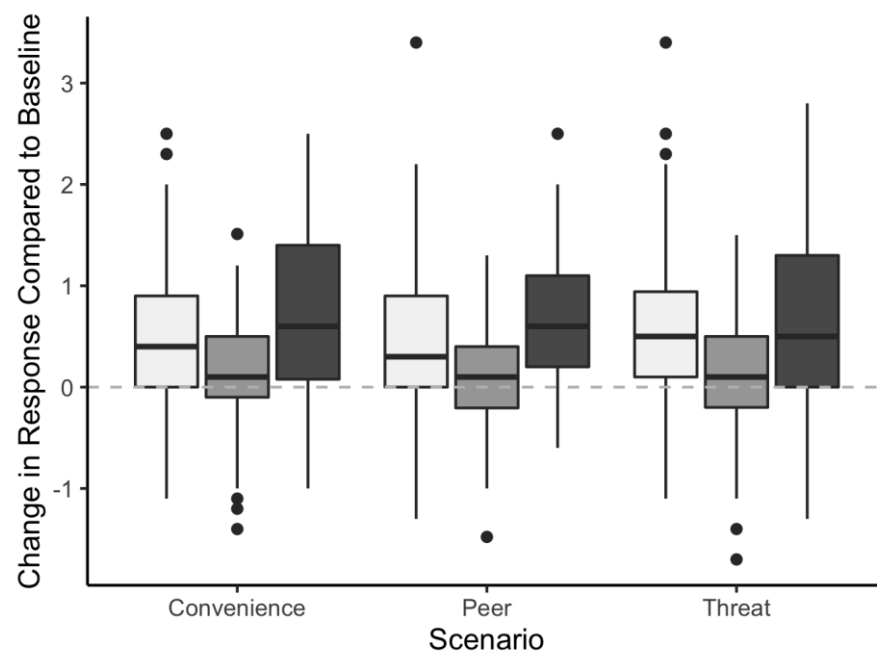

Figure 1. Changes in reducing and reusing answers across respondent groups and scenarios. Box−plots show medians (horizontal bars) surrounded by the high and low 75% quantiles. Error bars indicate 95% quantiles.

Pairwise comparisons confirmed that the reduce/reuse respondent group had consistently lower changes in reduce and reuse responses ($p \leq 0.001$). They also indicated that the effects of the three scenarios were similar within each of the three respondent categories, but the threat scenario did cause a larger increase in reduce/reuse scores among

recyclers than the other two scenarios (convenience for recyclers vs. threat for recyclers: $t_{5849} = -3.875$, $p = 0.004$; social pressure for recyclers vs. threat for recyclers: $t_{5849} = -4.165$, $p = 0.001$). The effects of the social/peer-pressure and convenience scenarios did not differ within respondent groups ($p \geq 0.99$).

As part of the set of questions that followed the presentation of the threat scenario, we asked respondents to rank which specific threats concerned them most (from highest concern to lowest). The options were: "The threat to nature", "The threat to human health", "The economic threat to the neighborhood" and "The threat to your neighborhood's culture". The threat to human health stood out as the option that was most frequently ranked highest (201 rankings from 428 respondents) and as the option with the highest average rank (3.0 of possible 4). The second most concerning threat was the threat to nature (112 top rankings and an average rank of 2.7). Threats to the neighborhood economy and culture had 42 and 73 top rankings and had average ranks of 2.3 and 1.9, respectively.

The survey also included a question that followed the scenario sections wherein we asked respondents directly: "Which of these is most likely to increase your likelihood to reduce and reuse as opposed to recycling or throwing things away?" The options were: "Convenience of engaging in reducing and reusing", "Pressure from my friends, family, and neighbors", "Threats to my well-being" and "Other". Most of the respondents indicated that convenience was most influential motivator (Figure 2). Interestingly, the responses to this question (Question 28) did not agree with the scores for the reduce/reuse questions associated with each of the three scenarios. Based on the changes in the post-scenario reduce/reuse scores, respondents were more strongly influenced by the threat scenario than the other two (Figure 1). Fourteen respondents chose "Other" as their answer to Question 28, which prompted a request for them to type in their own answer. These answers included several claims that concern for the environment was a strong motivator. There were also some references to legal and monetary incentives, and two expressed that their behavior would not be influenced by "social/peer" or "outside" pressure.
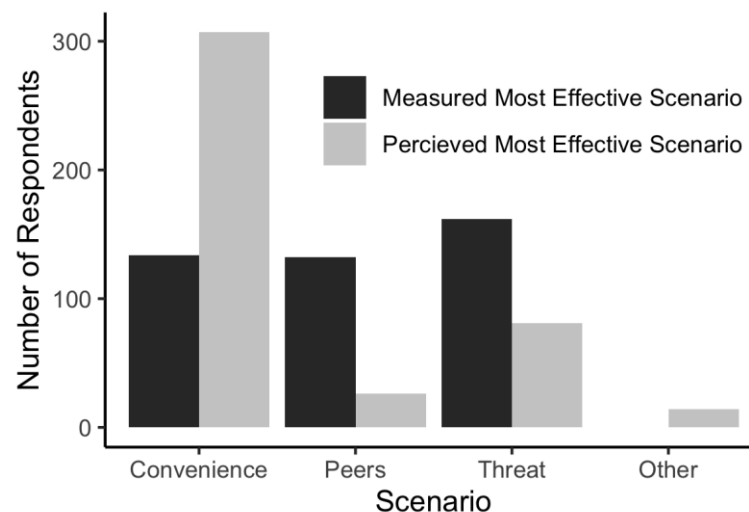

Figure 2. Comparison of the most effective scenarios to motivate change in responses (i.e., the scenarios that induced the largest increase in selecting reducing and reusing behaviors) as perceived by respondents in question 28 (gray bars) and as measured by our survey outcomes (black bars).

3.3. Demographic Correlations

Age was not related to respondent type (reducer/reuser, recycler, or skeptic) (ANOVA: $F_{2425} = 1.52$, $p = 0.22$), nor was it related to which scenario had the strongest positive effect on reduce/reuse scores (ANOVA: $F_{2425} = 0.33$, $p = 0.72$). However, age did seem to matter regarding responses to Question 28 (Q28) (ANOVA: $F_{3424} = 5.71$, $p < 0.001$). More specifically, younger respondents tended to indicate that social pressure was most likely to increase their likelihood of engaging in reducing and reusing behaviors (Tukey HSD:

$p \leq 0.02$). The average age of respondents who selected social pressure as the answer to Q28 was 35.8 ± 12.6 ($\pm$SD), whereas the average age associated with the other answers was 42.2 ± 11.8.

Gender was not related to participant type (chi-square$_4$ = 4.9, n = 428, p = 0.30), although more women were reducers-reusers (60) than men (46), which is consistent with Barr's findings [12] (p. 470). There was no clear influence of racial or ethnic identification on the survey results. Racial or ethnic identification was not related to the post-scenario changes in reduce/reuse scores (chi-square$_{12}$ = 10.2, n = 428, p = 0.60) nor the factors selected by participants as most likely to increase reduce and reuse behaviors (i.e., Question 28; chi-square$_{18}$ = 44.6, n = 428, p = 0.69). We note that because our sample lacked adequate representation from many racial and ethnic groups, we can offer nothing definitive in relation to racial or ethnic identification having a correlation to reducing and reusing tendencies. There was also no correlation between community type (urban, suburban, or rural) on the respondent type (chi-square$_4$ = 7.0, n = 428, p = 0.14), scenario effect (chi-square$_4$ = 3.6, n = 428, p = 0.46), and Question 28 (chi-square$_6$ = 11.0, n = 428, p = 0.09).

Education level was assessed by asking respondents to choose their education level from a list of seven options ranging from "Less than High School" up to "Doctorate." Each respondent's selection was coded as a number 1 to 7, and we applied Kruskal–Wallis tests to determine whether education level was related to the respondent type, the scenario that had the greatest positive effect on reduce/reuse score, and the answer to Question 28. However, none of these tests indicated a significant relationship. There was no correlation with the employment type of respondents (full-time, part-time, unemployed seeking work, and unemployed not seeking work) and their self-selected reason for what would cause a change in their waste-management behaviors (convenience, social/peer pressure, or threat; chi-square$_{12}$ = 20.2, n = 428, p = 0.06). There was also no scenario effect (chi-square$_{12}$ = 14.1, n = 428, p = 0.29) or a correlation with employment and Question 28 (chi-square$_{18}$ = 20.6, n = 428, p = 0.30). Contrasting only employed (full or part time) and unemployed (i.e., excluding student, retired, and disabled) still left us with no indication of a relationship regarding employment and Question 28 (chi-square$_2$ = 2.5, n = 399, p = 0.28).

Income level was strongly associated with the self-identified categories for level of environmental waste-management behaviors. Individuals who categorized themselves as skeptics were largely from low-income households. Based on the available household income choices in the survey ($5000, $15,000, $25,000, $35,000, $45,000, $55,000, $65,000, $75,000, $85,000 $95,000, $125,000, and $175,000), the average income for skeptics was $46,515, whereas recyclers and reducers-reusers had incomes of $66,562 and $58,084, respectively. However, income level was not related to scenario effect (Kruskal–Wallis chi-square = 0.94, df = 2, n = 428, p = 0.63) or the response to Question 28 (Kruskal–Wallis chi-square = 1.97, df = 3, p = 0.5781).

Respondents were asked about their marital status and could respond with "married," "never married," "divorced," or "widowed." There was no relationship between marital status and respondent category (chi-square$_6$ = 6.6, n = 427, p = 0.36), the most effective scenario (chi-square$_6$ = 8.2, n = 427, p = 0.23), or the response to Question 28 (chi-square$_9$ = 5.8, n = 427, p = 0.76). Similarly, having children in the household did not affect any of the same factors (respondent type: chi-dquare$_2$ = 1.2, n = 428, p = 0.54; scenario effect: chi-square$_2$ = 0.9, n = 428, p = 0.63; Question 28: chi-square$_3$ = 1.5, n = 428, p = 0.67).

We asked respondents about their political affiliation with options: "Democrat," "Republican," "Independent," or "Something else." There was no effect of reported political affiliation on respondent classification (chi-square$_6$ = 1.48, n = 427, p = 0.96), the most effective scenario, (chi-square$_6$ = 9.1, n = 427, p = 0.17) or the response to Question 28 (chi-square$_9$ = 15.4, n = 427, p = 0.08). We also asked respondents to rank themselves on a scale ranging from liberal (1) to conservative (7). Again, the responses indicated no effect on how respondents were categorized (respondent classification: chi-square$_2$ = 0.98, p = 0.61; most effective scenario: chi-square$_2$ = 1.75, p = 0.42; Question 28: chi-square$_2$ = 2.15, p = 0.54). We investigated respondents' levels of political participation by asking them

to select activities they may have participated in (e.g., attending a rally, voting, or signing a petition). People classified as skeptics had lower political-participation scores than reducer-reusers (ANOVA, F_{2425} = 4.115, p = 0.017, Tukey post-hoc test, p = 0.027), but there were no other differences among these classifications (Tukey post-hoc test, $p \geq 0.07$). There were no significant relationships regarding the most effective scenario and political participation (ANOVA, F_{2425} = 0.007, p = 0.99), but there was a relationship with respect to responses to question 28 (ANOVA, F_{2425} = 4.227, $p < 0.01$). Individuals who selected "Other," for Question 28 tended to have higher political-participation scores (Tukey post-hoc test, $p < 0.01$). In the write-in window that opened in response to selecting "Other", these respondents tended to cite environmental concerns as the primary motivation for reducing and reusing behavior.

4. Discussion

The focus of our research was to determine which of three external motivators (threat, social/peer pressure, or convenience) was most influential in compelling individuals to practice more sustainable waste management behaviors (i.e., reducing and reusing practices). We found that after respondents were exposed to a series of scenarios representing threat of environmental or community degradation, social/peer pressure, or convenience, the threat scenario had the greatest effect regarding motivating people who were primarily recyclers to shift their intended behavior towards reducing and reusing. This aligns with previous research wherein individuals responded strongly to perceived environmental problems that they regarded as a "threat to well-being and health," [12] (p. 441), Ref. [31]. More specifically, "personal environmental threat" was found to be a "better predictor of overall environmental practices than are demographic variables and political factors" [31] (p. 602). Our results reinforce the argument that a threat to human welfare is highly influential with regard to changing individual intentions towards more sustainable behaviors as a means of potentially alleviating these threats to self and society [12].

Interestingly, although threat was measured as the most effective motivation for shifting towards reducing and reusing behaviors, our survey respondents overwhelmingly selected convenience as what they perceived would cause them to shift their waste management behaviors. Convenience has been identified as an important motivating factor psychologically and is associated with higher recycling efforts related to both intention and behavior itself [12]. Developing more convenient ways to participate in reducing and reusing practices is tied to "innovative policy making" incorporating these convenience strategies [12,32,33] and could offer the psychological motivation necessary to change sustainability behaviors prior to the occurrence of external threats.

Although social pressure did not stand out significantly compared to the threat or convenience scenarios, both based on our analysis of post-scenario responses or in terms of what respondents regarded as the most influential motivator, we did see that young people tended to be influenced more by social or peer pressure than older people. This result also coincides with the increase in environmental movements led primarily by young individuals regarding sustainability and climate action. For example, Greta Thunberg's activism on the global climate crisis response [34] and the Sunrise Movement in the U.S. [35] have informed national and international policy and are led primarily by young people with strong environmental values.

5. Conclusions and Limitations

Reduction of waste products is often associated with progressive or liberal thinking [36,37], but in our study, there was no indication that individuals' self-classification as liberal or conservative related to their RRR behaviors. However, we did find that respondents' degrees of political participation were important regarding waste-management practices. People who were more engaged in political activities tended to be reducer-reusers, whereas skeptics tended to be less politically engaged. Our survey did not attempt to explore underlying motivations for political participation, but there is an intuitive link between

engagement in one's community and concern for waste-management practices. It may also be that political estrangement or exclusion can have consequences for waste management and other forms of environmental stewardship that require voluntary participation.

We recognize that there are certain limitations regarding the use of survey data to determine changes in behavior patterns and that individuals' perceived intended behavior could differ from their actual behavior [38]. There is a similar limitation related to "the conceptual restrictions placed on interpreting reported behavioral data" rather than solely collecting observable behavioral data [12] (p. 449) [39,40]. "Self-report methodology" can be justified by articulating the "clear conceptual distinction" between "what people state they do and what they are willing to do" [12] (p. 453). If this distinction and awareness of such is apparent, survey data can offer deeper understandings for both individuals' perceptions of their behavior and what can motivate changes in these perceptions. The paper is also limited by its focus on English-speaking countries, but for convenience and access, our paper remains limited to the United States. Future work should expand this to a more international context and also explore changes in waste-management behaviors during the COVID-19 pandemic.

Poor waste-management practices are exacerbating the climate crisis and creating equally detrimental waste-disposal crises [1,2,41]. To counter these trends, it is essential to find ways to motivate reducing and reusing behaviors. It is unfortunate that the threat scenario was highly influential in motivating intended reduce and reuse behaviors, as it is better to avoid a crisis than to respond to one. However, convenience was almost as influential, and social/peer pressure was important for younger respondents. If possible, public awareness campaigns should probably draw on all three of these external motivators that we studied—and potentially others—when emphasizing the need for more reducing and reusing initiatives in our waste-management practices. These shifts are essential to create more sustainable waste-management systems.

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