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Social Preferences and Environmental Behavior: A Comparison of Self-Reported and Observed Behaviors

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Abstract: Faced with the depletion of natural resources and climate change, individuals making the choice to behave in a more environmentally conscious way is increasingly necessary. Rational choice theory suggests that individuals will only behave in pro-environmental ways if they perceive those actions to align with their own self-interests. Others, however, have highlighted instances where individuals act pro-socially or altruistically, deviating from their own self-interests for the benefit of others. The present study examines whether individuals' social preferences are associated with engagement in pro-environmental behaviors. Specifically, drawing on a methodology from behavioral economics, we use dictator and ultimatum game behavior to measure social preferences, and we then evaluate whether heterogeneity in social preferences is associated with self-reported pro-environmental behaviors and observed recycling behavior. The results indicate that individual differences in social preferences have a modest association with self-reported pro-environmental behaviors but no association with observed recycling behavior. Self-reported pro-environmental behavior was not associated with observed recycling behavior. We also find that recycling bin proximity to classroom doors increased participation in recycling. This finding demonstrates that individuals are receptive to the proximate opportunity to recycle. This suggests increasing the ease with which people can engage in pro-environmental behaviors, such as recycling, will promote participation in these practices. Overall, our research indicates that social preferences do not seem to drive individuals to act in environmentally friendly ways. This work also provides new opportunities for future research to integrate economic games into the study of pro-environmental behaviors.

Keywords: environmental behavior; recycling; dictator game; ultimatum game; social preferences; altruism

1. Introduction

The Earth has limited resources; hence, the need to pursue sustainability has become ubiquitous in modern society. The United Nations (UN) World Commission on Environment and Development [1] described sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Many organizations have since recognized the need for, and advocated for, implementing sustainable practices with an interdisciplinary economic, social, and environmental focus. This is evidenced by the United Nations' 2030 Agenda of Sustainable Development Goals [2], the World Bank's Millennium Development Goals [3], and the International Energy Agency's Sustainable Development Scenario [4]. The present study focuses on a key pillar of sustainability: pro-environmental behavior. The desire to "go green" has become embedded into many companies through the development of environmental, social, and governance (ESG) and the corporate social responsibility (CSR) criteria for evaluating business operations, investments, and branding with

some of the focus on sustainability metrics [5,6]. There has similarly been an increasing push for individuals to play a role in achieving these goals [7]. Indeed, a key feature of these organizations' sustainability goals is to increase the pro-environmental behavior of individuals [1]. For example, two of the goals laid out in the United Nations' Sustainable Development Goals directly call for increased participation in recycling [2]. The present study seeks to facilitate these goals by examining the individual-level factors associated with pro-environmental behavior.

Recycling is one of the easiest and widely accepted pro-environmental behaviors, yet it remains a prominent issue across the globe. For example, prior research has shown that plastic is at the center of this issue, with only 9% of all plastics being recycled [8]. Failure to recycle this material has resulted in, among other things, human ingestion of five grams of plastic per week via microplastics found in water, food, and greater ecosystems [9]. Plastic production continues to grow due to the shifting economics of petrochemical companies [10]. Given the continued push for environmental practices among people, organizations, and countries, it is vital to understand the factors that influence people to engage in environmentally conscious behaviors, such as recycling. Despite research efforts that have focused on individual-level correlates of environmental behavior, such as convenience, sex, and age [11–14], relatively few studies have considered individual differences in social preferences as a factor that influences pro-environmental behavior. This is a key aim of the present study.

Classical economic theories of choice assume that individuals are self-interested and behave in a manner that maximizes *their* expected benefits and minimizes *their* expected costs. Recently, scholars have questioned this "pure" self-interest assumption. In doing so, they have highlighted instances where individuals deviate from self-interest in ways that seem to demonstrate sincere concern for the welfare of others or *pro-social preferences* [15,16]. These pro-social preferences have been found to increase the likelihood of individuals engaging in behaviors such as volunteering, participating in community service, and giving to charity (see meta-analysis [17] for a recent review). This emerging evidence also suggests that individual differences in concern for the welfare of others may influence involvement in pro-environmental behaviors such as recycling [18–20]. However, this body of research has not yet applied the dictator and ultimatum games—common methods for measuring social preferences within behavioral economics—to gauge pro-sociality. This is a key gap in the literature not only because these methods are well-regarded for their ability to capture heterogeneity in social preferences [15,16], but also because there is increasing evidence that these "laboratory" games are associated with observable pro-social "field" behavior, such as volunteering with the fire department, abiding by the law, and charitable giving [21–27].

We also contribute to the literature by examining both self-reported pro-environmental behavior and observed recycling behavior to evaluate whether findings are consistent across outcomes. In doing so, this research aims to provide further insight into the relationship between "laboratory" game behavior and "field" observed behavior, testing the external generalizability of pro-social game behavior.

Further, as prior research has highlighted proximity—or the ease with which individuals can engage in pro-environmental behaviors because of minimized time or distance—as a possible influence on individual engagement in pro-environmental behaviors [11–14], we use an experimental method to assess whether this is an alternative mechanism explaining involvement in pro-environmental behavior. A key goal of this study is to provide practical implications to increase individual involvement in recycling.

In the sections that follow, we first discuss the applicable empirical literature. We then describe the present study's methodology and test our hypotheses using ordinary least squares regressions. We then present our results and discuss implications of these findings.

2. Literature Review and Study Development

2.1. Pro-Environmental Behavior

Within the context of this study, sustainability is defined as considering the needs of future generations and protecting the sociophysical resources of the planet [14]. Under the umbrella of sustainable behavior lies pro-environmental behavior. Pro-environmental behaviors are actions where individuals consciously seek to minimize their own negative impacts on the natural and built world by minimizing consumption and reducing waste production [28]. Environmental behaviors encompass many specific behaviors, such as recycling, a key focus of this study, and other behaviors like eating less meat, driving less, composting, and conserving energy. Knowledge of environmental practices, knowledge sharing, and basic values, beliefs, and norms are common explanations for engaging in pro-environmental behaviors and the current research builds upon this knowledge [29–33]. Research has also found that specific environmental behaviors, like recycling, are influenced by the proximity or ease of the behavior; the easier a behavior is to engage in, the more likely an individual is to do it [34–37]. While proximity has been shown to have an association with pro-environmental behavior, the present study seeks to examine an additional potential explanation as well—individual differences in pro-social preferences.

2.2. Pro-Social Preferences

Understanding why an individual would deviate from their own self-interest to provide benefits to others is a crucial element in understanding pro-environmental behavior. This is especially true given that acting in environmentally conscious ways can be inconvenient or costly to an individual [38,39]. There is a large body of research suggesting pro-social preferences, or showing concern for the general welfare of others [40], positively influences involvement in pro-social behaviors. These behaviors include organ donation [41], blood donation [42], volunteering [43,44], working in the public health sector [45], paying more for an airline that is socially responsible [6], and compliance with the law [46]. This also includes engaging in environmentally friendly behaviors generally [39,47–50], specific environmental behaviors, such as recycling [18–20,51], and an increased willingness to pay for recycled products [52]. For example, prior research suggests that individuals are more likely to act in an environmentally conscious fashion when the behavior is advertised as morally good rather than financially beneficial [53,54].

This pro-sociality may be explained by the fact that some individuals derive intrinsic benefits or a "warm glow" from this type of behavior [55]. Research has suggested that altruism is an individual difference that reflects caring about other human beings or the environment [56–59]. To be sure, this assumption has historically been outside the scope of rational choice theory, which assumes that all individuals are *purely self-interested*. Behavioral economists have recently begun to question this assumption by developing games to examine individual differences in social preferences. In doing so, they have begun capturing behavioral deviations from pure self-interest.

Two games frequently employed within behavioral economics to assess an individual's social preferences are the ultimatum [15] and the dictator games [16]. Figures A1 and A2 in Appendix A provide illustrations of each of these games. The ultimatum game is a two-player, "one-shot" anonymous game where Player 1 decides what proportion of their money (or "stake") to offer to Player 2. Player 2 must then decide whether to *accept* or *reject* Player 1's offer. If Player 2 chooses to accept Player 1's offer, then the money will be distributed according to Player 1's offer. If, however, Player 2 decides to reject the offer, then both players will walk away with $0.

Classical rational choice theory would expect that Player 1's offer and Player 2's decision to accept or reject would both reflect *self-interest*. Under this assumption, the ultimatum game should reveal that Player 1 offers a 9-to-1 split, since 9 dollars maximizes Player 1's earnings with the expectation that Player 2 will accept a 1-dollar offer as this offer is greater than the alternative (if Player 2 rejects the offer he/she will get nothing). However, prior research finds this prediction is not accurate. In fact, Player 1

offers often exceed expectations, with the mean offer approximately 30 to 40 percent and the median offer at 40 to 50 percent of the stake, likely due to a social preference for fairness and the recognized possibility of smaller offers being rejected [60,61].

The second game is the dictator game. Here, Player 1 assumes the role of the "dictator." Like the ultimatum game, Player 1 anonymously decides how much of the stake to offer Player 2. The key distinction in this game, relative to the ultimatum game, is that Player 2 has no choice to reject Player 1's offer [16,62]. The stake is distributed only according to Player 1's ("the dictator's") offer.

Within the dictator game, *if one assumes individuals are guided by pure self-interest*, Player 1 would be expected to offer nothing to Player 2. It would appear to be in Player 1's best interest to do so, as he or she faces no costs or possible retribution for doing so, the game is anonymous, and it is played only one time. However, research shows this is not often the case. A meta-analysis of 83 studies revealed that only 40% of dictators offered 0, 5% gave everything, and 16% chose an equal split [62,63]. These findings lend themselves to suggesting that some individuals feel a sense of pro-sociality or altruism, given that offering anything more than 0 shows a deviation from pure self-interest.

These two games have now become common methods for measuring pro-social preferences such as altruism [61,63]. However, only a few known studies have evaluated whether dictator and/or ultimatum game behavior is associated with other pro-social behaviors. In considering the external generalizability of these games, studies have found that game offers predicted volunteering with the fire department and training hours [21], abiding by the law [22] (but see also [23]), returning misdirected mail [24], and allocating time teaching and absenteeism [25], but not sharing food among indigenous individuals in Bolivia [26]. This methodological approach offers the opportunity to further examine pro-social preferences and determine whether they are associated with pro-environmental behaviors. To the best of our knowledge, no studies have examined pro-environmental behaviors in combination with the dictator or ultimatum games, hence the research on pro-environmental behavior will be expanded by this study. Based on findings from prior research, we propose the following hypothesis:

Hypothesis 1 (H1). *Pro-social preferences will be positively associated with pro-environmental behaviors*.

2.3. Measures of Pro-Environmental Behaviors

It is also important to note that a great deal of the prior research considering the association between pro-social preferences and environmentally conscious behaviors has relied on self-report data, rather than capturing actual observed field behaviors of the participants [18–20,47,51]. This is potentially problematic as social desirability bias can influence self-reported measures of pro-environmental behaviors [64–66]. The current research sought to expand this literature by examining both self-reported and observed pro-environmental behavior as outcomes. The self-reported pro-environmental behaviors we consider include recycling, composting, using reusable grocery bags, avoiding plastic water bottles, shopping locally, eating less meat, conserving energy, choosing a fuel-efficient vehicle, avoiding plastic straws, reducing plastic use, and purchasing pro-environmental products (see Appendix A Table A1). Observed pro-environmental behavior focuses on recycling. We propose the following hypothesis (H2) with regard to observed environmental behavior:

Hypothesis 2 (H2). *Pro-social preferences will be positively associated with observed environmental behavior*.

Given that we will observe recycling behavior, this study also offers a unique methodological contribution to the body of literature evaluating the association between "laboratory" game behavior (pro-social preferences) and observed "field" pro-social behavior, given that some have questioned social preference laboratory experiments' external generalizability [67,68].

2.4. Proximity

Previous research has shown how the ease of access, convenience, or proximity influence involvement in pro-environmental behaviors such as recycling [11–13,34–37]. Since the current study examines this specific environmental behavior, it is necessary to also consider the association between the proximity of the recycling bin and the observed recycling behavior, as individuals may simply elect to discard waste into the most proximate bin. In light of this, we propose the following hypothesis:

Hypothesis 3 (H3). *Recycling bin proximity will be positively associated with observed recycling behavior*.

2.5. Objectives of the Study

In summary, the aim of this study is to examine whether social preferences are associated with pro-environmental behavior. The study seeks to increase understanding of this relationship in three ways. First, it examines whether social preferences are associated with self-reported pro-environmental behaviors. Second, it assesses whether social preferences are associated with observable pro-environmental behavior. Third, we consider an alternative mechanism that may explain observed recycling behavior: proximity.

3. Methods

3.1. Sampling Method and Study Design

This study was conducted at a large public university located in the southeastern United States, one that enrolls a racially and ethnically diverse student population. To find study participants, the authors first recruited professors with large classes who were willing to offer 10 extra credit points to their students for participating in the study and allow students to participate during their scheduled class time. This resulted in the participation of students from eight different classes comprising approximately 59 different majors.

Prior to participating in the study, students within each class were randomly assigned to one of four "treatment" conditions and assigned to report to different classrooms (consistent with their treatment condition) where the study was conducted in iterative sessions over two days. Classrooms were either assigned to play the dictator or ultimatum game (2 conditions) and to have the trash or recycling bin located more proximately to the classroom's door (2 conditions), resulting in a 2×2 study design. The randomization of relative bin proximity was important given that prior research has found this to be a key factor influencing pro-environmental behavior [37].

Only one student present in class on the day of the study chose not to participate, which resulted in a potential analytic sample of 315 individuals. After accounting for missing data resulting from listwise deletion, the study had a final analytic sample of 282 individuals (89.5% of the potential analytic sample). Data were missing from the following variables, with the frequency of each listed in the parentheses: age (2), GPA (4), offer (2), and recycling observed behavior (25). There were no missing data for the pro-environmental behavior scale, the self-efficacy scale, sex, semesters in college, or race/ethnicity. The sample was 34% males, with ages ranging from 18 to 53 (mean = 20.24; SD = 4.41). Demographics of study participants are largely consistent with the general composition of the university from which the sample was drawn.

3.2. Procedure

The study was approved by the university's institutional review board and consent from each participant was obtained prior to the administration of the survey. The administration of the study took approximately 45 minutes. When entering the classroom, each student was given a questionnaire. Attached to the questionnaire was a pink word-search puzzle and a yellow offer sheet. Each set of documents (instrument, pink word-search puzzle, and yellow offer sheet) had a unique identifying

survey number printed on it. This was done to assist in the linking of survey responses with observed behaviors. Proctors—undergraduate and graduate students—were recruited to assist with the dissemination and collection of the surveys, and they were trained on how to administer these materials.

As students entered the classroom, they were asked to ensure their survey, word-search puzzle, and offer sheet all had a matching survey number. Prior to the students' arrival, the proctor set up one trash bin and one recycling bin next to each other by the classroom's entrance/exit, in a randomized and recorded order (see Figure A3 in Appendix A for an example of bin design and placement). Within each classroom, either the trash or recycling bin was placed more proximate to the classroom's doorway, making it easier for students to discard their materials into the more proximate bin. This randomization was done to ensure that the trash and recycling bins were equally convenient across the study and to properly test if people were recycling based on proximity as previous research has suggested [37]. The trash and recycling bins were clearly distinguishable from one another by both labeling and color. For example, the recycling container was white and green and prominently displayed the universal recycling symbol, whereas the trash bin was predominantly black. It is important to note that this study's use of trash and recycling bins is consistent with the university's and general geographic area's single-stream recycling approach, where it is common for individuals to discard waste into a recycling *or* trash bin, rather than separating recycling materials across various recycling bins.

After entering the classroom, students were instructed to start the questionnaire at the same time. About halfway through the survey, the students were then told to stop and wait for further instructions. Then they all began a brief word-search puzzle (on the separate pink sheet of paper), recorded their time upon finishing and continued to fill out the remaining questionnaire items. While the word search was included to simply give students something to discard, students were led to believe the research team was interested in recording how long it took them to complete the puzzle as a test of their abilities. This method was used to enable the researchers to later assess the association between social preferences and recycling without the participants recognizing a goal of the study—to observe their recycling behavior.

Once participants had reached the final portion of the survey, they were read a series of instructions that described this section as the part of the study that would determine *how many extra credit points they would ultimately receive* for their participation. Each participant was randomly assigned to be Player 1 in the dictator or ultimatum game. Importantly, because they were in separate rooms and aware that many students were participating in the study, students did not know there was not really a "Player 2." In fact, they were led to believe there was, as they were instructed to make an offer on the yellow piece of paper that would be delivered to an anonymous student in another room. During the game portion of the survey, proctors reported students verbally stating that the games were "unfair" and "messed up," adding to the validity of the study in the sense that students believed the games were real and points would be allocated accordingly. This method was used to make the participants believe the game and point allocation was real to ultimately increase the validity of our pro-social preferences measures. Upon completion, each student submitted their questionnaire and yellow offer sheet to the research staff and was told to "discard the pink word-search puzzle on their way out of the classroom." After all students had left the classroom, the proctors collected the materials, including the bags from the recycling and trash bins, and labeled the bags accordingly. The research team also found non-research materials discarded into the bins (e.g., coffee cups, candy wrappers, and food waste). This also adds to study validity in that the students believed the bins were there as trash and recycling bins, nothing more. In study debriefing, students were first asked to tell the principal investigator what they thought the goal of the study was. In no instances did respondents indicate that they had any idea that the recycling or trash bins were a part of the study, further adding to the validity of the study.

3.3. Measures

Demographic information capturing race (*white* = 1, nonwhite = 0), ethnicity (*Hispanic* = 1; non-Hispanic = 0), *Age*, sex (*male* = 1, female = 0), grade point average (GPA), and the number of *semesters* a student had been enrolled at the university were collected from respondents. The study also controlled for the possibility that respondents would be generous purely because they were doing well in the course. Therefore, academic *self-efficacy* [69] was also measured. Respondents were asked to rate 10 items, such as "Compared with other students in this class I expect to do well" and "I think I will receive a good grade in this class" on a scale of strongly disagree (= 1) to strongly agree (= 5). Exploratory factor analysis indicated that all 10 items could be maintained with factor loadings above 0.30. A summated average scale was then established with high internal reliability (Cronbach's alpha = 0.88), where higher scores indicated increased self-efficacy. Appendix A Table A1 provides a list of all items included in the scale and their respective descriptive statistics. The questionnaire also included Likert-scale items inquiring about pro-environmental behaviors, past behavior, and a final section where students were prompted to play the dictator or ultimatum game.

Our first outcome, self-reported *pro-environmental behavior*, was intended to be measured by 14 items designed by the research team to capture self-reported acts of environmental behavior that were based on the United Nations' call for society to incorporate the Sustainable Development Goals [2]. Each item was measured on a five-point Likert scale ranging from strongly disagree (= 1) to strongly agree (= 5) and included items such as "I recycle if I have the opportunity" and "I try to reduce the amount of plastic I use." Exploratory factor analysis indicated that all items loaded as a single factor. All items were maintained if factor loadings were 0.30 or higher, resulting in 11 items with strong internal reliability (Cronbach's alpha = 0.81). A summated average scale was then created, where high values indicate increased self-reported pro-environmental behavior. Appendix A Table A1 provides all items included in the scale and their respective descriptive statistics.

Our second outcome, *recycling*, is a dichotomous measure indicating whether the participant discarded their pink word search into the recycling bin (= 1) or trash bin (= 0) on their way out of the classroom. Unlike the above self-reported pro-environmental behaviors scale, which may be influenced by social desirability bias [64–66], this measure captures actual observed behavior.

To control for the randomized *proximity* of bin placement, we also include a variable which indicates that the recycling bin was located more proximately to the door relative to the trash bin (proximity = 1). When the trash bin was located more closely to the door, proximity was assigned a value of 0.

To capture pro-social preferences, ultimatum and dictator game *offers* were utilized. During the study, students recorded (on the yellow sheet of paper) how much of their stake (10 extra credit points) they were willing to offer another anonymous student in a separate room. These offers were recorded and then recoded as categorical ordered dummy variables (0,1–4,5,6–9, and 10) because we believed an offer within certain intervals may be theoretically similar. For example, a participant who gave half of their points may be qualitatively different from a participant who gave less than half but greater than zero, or a participant who offered nothing may be qualitatively different from someone who gave a small (less than half) value (see Jaynes and Loughran [23] for a recent example of this methodology).

3.4. Data Analysis

Data analysis was completed in three stages. The first stage considers descriptive statistics for the key variables of interest. The second stage evaluates pro-environmental behavior as a self-report continuous scale outcome and is analyzed using ordinary least squares linear regressions. In the final third stage, observed recycling behavior (a dichotomous outcome) is analyzed using a linear probability model. A logistic regression was not used because there was not enough variation within recycling to compare effects between all social preference offer categories and the reference category. However, Appendix A Table A2 provides the results of a logistic regression where offer is measured continuously. These findings are substantively consistent with our third stage results. Within stages 2

and 3, variables are included iteratively to demonstrate the association between social preferences and pro-environmental behaviors with and without the control variables and the competing explanation for pro-environmental behavior (i.e., proximity of the recycling bin).

4. Results and Discussion

The following section discusses our results. Table 1 shows the univariate statistics of the variables used in the study. These results reveal that offering half of the stake was the modal category, with 59% of respondents making this offer. Notably, only 3% of the sample offered no extra credit points to the second player.

Table 1. Univariate statistics.

	Mean	SD	Min.	Max.
Self-report pro-environmental behavior	3.17	0.71	1.09	4.91
Recycling behavior	0.85	-	0	1
Male	0.34	-	0	1
Age	20.24	4.41	18	53
GPA	3.45	0.51	1.05	4
Semesters	2.19	1.04	1	4
White	0.63	-	0	1
Hispanic	0.28	-	0	1
Self-efficacy	3.98	0.56	1	5
Offer 0	0.03	0.17	0	1
Offer 1–4	0.07	0.26	0	1
Offer 5	0.59	0.49	0	1
Offer 6–9	0.05	0.22	0	1
Offer 10	0.26	0.44	0	1
Proximity	0.44	-	0	1

Notes: N = 282.

These results also show that, on average, the sample reported pro-environmental behavior with the highest item mean, suggesting that they recycle if given the opportunity to do so. Then, when they were actually given the opportunity to do so, they acted on their self-report behaviors, given that 85% of respondents were observed recycling. This behavior was captured through the aforementioned dichotomous *recycling* variable.

Table 2 displays the models that examine the effect of social preferences on self-reported pro-environmental behaviors. The results show that, relative to those who gave half of their stake (the reference group), those who gave 0 points (the most self-interested) were less likely to exhibit pro-environmental behavior. However, no differences were observed between those who gave half of their stake and those who gave 1–4 points, 6–9 points, or the entirety of their stake (10 points). These results are not sensitive to including a game indicator (dictator or ultimatum game) or running the model by game condition. In terms of demographic controls, the only other variable to have a significant association with self-reported pro-environmental behavior was sex; males were significantly less likely to state they act in environmentally conscious ways. Substantively, these findings indicate that social preferences have modest effects on self-reported environmental behaviors.

Table 3 displays the models examining possible influences on the observed recycling behavior of individuals. These results show that social preferences are not significantly associated with observed pro-environmental behavior. This is a key finding as this study uses dictator and ultimatum game behavior to test the theoretical connection between pro-social preferences, individuals' reported environmental behaviors, and individuals' actual observed recycling behavior. In light of our findings, there is little consistent evidence that social preferences are associated with pro-environmental behavior. This lack of support for an association between pro-social preferences and pro-environmental behavior

is contrary to some previous research that found an association between pro-social or altruistic behaviors and environmental behaviors [18–20,29,39,47–52]. This lack of association may be attributable to perceptions of weak collective efficacy (unmeasured), with respondents being skeptical of other students' or the community's willingness to recycle or engage in other pro-environmental behaviors [29].

Table 2. Effect of social preferences on self-reported pro-environmental behavior.

	Model 1	**Model 2**
	Coef. (SE)	Coef. (SE)
Male	- (-)	−0.32 *** (0.09)
Age	- (-)	−0.02 (0.01)
GPA	- (-)	−0.10 (0.09)
Semesters in college	- (-)	−0.06 (0.05)
White	- (-)	−0.07 (0.10)
Hispanic	- (-)	−0.08 (0.11)
Self-efficacy	- (-)	0.13 (0.07)
Offer 0	−0.63 * (0.25)	−0.65 ** (0.25)
Offer 1–4	−0.25 (0.17)	−0.18 (0.16)
Offer 6–9	−0.07 (0.19)	0.01 (0.19)
Offer 10	−0.19 (0.10)	−0.09 (0.10)
Constant	3.26 *** (0.05)	3.68 *** (0.48)

Notes: N = 282, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$, and all hypothesis tests are two-tailed.

Table 3. Effect of social preferences, self-reported pro-environmental behavior, and proximity on observed recycling behavior.

	Model 1	**Model 2**	**Model 3**
	Coef. (SE)	Coef. (SE)	Coef. (SE)
Male	- (-)	0.06 (0.05)	0.07 (0.05)
Age	- (-)	0.00 (0.01)	0.00 (0.01)
GPA	- (-)	0.01 (0.05)	0.01 (0.05)
Semesters in college	- (-)	0.00 (0.03)	0.01 (0.03)
White	- (-)	0.04 (0.05)	0.04 (0.05)
Hispanic	- (-)	0.01 (0.06)	0.02 (0.06)
Self-efficacy	- (-)	0.02 (0.04)	0.00 (0.04)
Offer 0	0.15 (0.13)	0.13 (0.13)	0.19 (0.13)
Offer 1–4	0.10 (0.08)	0.10 (0.09)	0.11 (0.09)
Offer 6–9	0.02 (0.10)	0.03 (0.10)	0.03 (0.10)
Offer 10	−0.04 (0.05)	−0.04 (0.05)	−0.03 (0.05)
Self-reported Pro-environmental behavior	- (-)	- (-)	0.03 (0.03)
Proximity	- (-)	- (-)	0.10 * (0.04)
Constant	0.85 *** (0.03)	0.74 ** (0.25)	0.64 * (0.28)

Notes: N = 282, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$, and all hypothesis tests are two-tailed.

The lack of association between social preferences and observed behavior also provides insights regarding the external validity of "laboratory" game behavior [67,68], as our findings comport with prior studies, which found an inconsistent association between general game behavior (not restricted to the dictator and ultimatum games) and natural field observations [21,26,27,70] (but also see [24,25,71–74]).

The substantive difference in our findings across self-reported (Table 2) and observed (Table 3) environmental outcomes, as well as the lack of association between self-reported and observed environmental behavior (Table 3), together suggest that self-reported pro-environmental behavior scales may be susceptible to social desirability bias [64–66]. This is in line with the fact that a majority of the prior research that found an association between social preferences and environmental behavior measured only self-reported, rather than observed, environmental behavior [18–20,47–51]. This is

important because it suggests that there is little association between what individuals *say* they do and what they *actually* do with respect to environmental behavior. However, researchers recently developed a recycling behavior transition (RBT) procedure to improve environmental sorting [75]. This procedure includes identifying hurdles to recycling by interviewing participants. This is a fruitful avenue for future policy interested in changing observed behavior. Perhaps if we had interviewed participants after the study, we could have identified ways to further facilitate their recycling, such as providing more information on the benefits of doing so.

Finally, although we did not find a consistent association between social preferences and environmental behavior, within Table 3 we found that the recycling bin's relative proximity was associated with observed recycling behavior. This demonstrates that individuals are receptive to the opportunity to recycle with only a minor nudge [76] as notably only a small increase in the ease of access to a recycling bin was found to influence this pro-environmental behavior, consistent with prior research [37]. It should also be noted that the increase in physical "convenience" within our study was minor—making the recycling bin (relative to the trash bin) more proximate to the door—a less than one-meter shift. This offers a relatively simple and cost-effective implication for those deciding on the placement of waste and recycling containers as they may consider intentionally choosing to make the recycling bin relatively more proximate, especially in locations where a high volume of recyclable material is expected to be consumed (e.g., university campuses).

Limitations and Further Developments

Of course, the present study is not without limitations. First, we analyzed a university sample of young adults in the US and acknowledge that findings may not generalize outside of this age cohort and location. To that end, future research should strive to replicate these findings amongst alternative samples. Second, the recycling and trash bins were placed inside the classrooms to ensure a high rate of study compliance (to minimize missing data). Future studies should consider other locations for placements of the recycling and trash bins. This study also only assessed a single observed environmental behavior: recycling. This research should be extended to studying additional observed environmental behaviors like using reusable water bottles, grocery bags, and other means of reducing waste. It is also possible that inquiring about respondents' environmental behavior within the study's survey influenced their later observed recycling behavior by priming them to think about the environment as some research has shown [77]. However, a recent review suggests that evidence of priming effects is mixed when examining environmental behaviors [78]. Our findings may also be sensitive to the design of the recycling and trash bins [11]. The potential for both priming and study design effects should be key inquiries for future research. Finally, it is possible our lack of association between dictator and ultimatum game pro-social behavior and observed "field" recycling may be due to contextual aspects of the game design [27]. Evaluating whether findings are sensitive to variation in game context—direct or indirect interactions with other participants, type of stake offered, or the potential recipient of the offer—is a fruitful area for future consideration.

5. Conclusions

A number of prominent individuals, organizations, and governments have pushed for greater participation in sustainable behaviors over the past three decades, with a key focus on environmental behavior [1–7]. Because of this, a growing body of research has sought to understand individual involvement in pro-environmental activities, such as recycling. The current study used a large sample of young adults from a university in the southeastern United States to examine the factors associated with pro-environmental behaviors. The study specifically assessed whether there is an association between pro-social preferences and these behaviors. It did so using a novel methodology that combined self-reported and experimentally observed pro-environmental behaviors, and measures of social preferences commonly used within behavioral economics: dictator and ultimatum games [15,16].

Overall, this study provided insight into a pressing modern problem—environmental sustainability. It is imperative to continue examining what drives people to act in environmentally friendly ways, especially as the UN and other organizations push to achieve their sustainability goals [1–5]. Although we did not find strong or consistent associations between social preferences and pro-environmental behavior, our findings did indicate that increasing the ease with which people can engage in environmental behaviors (i.e., altering bin proximity to room entrances/exits) will promote participation in pro-environmental practices such as recycling. We encourage policymakers and practitioners to seek out ways to improve accessibility to recycling and to coordinate their environmental sustainability efforts with the research that has been conducted in this field. This study suggests that even minor improvements in proximity may help to improve individual-level environmental efforts.

Author Contributions: The three authors listed each contributed to this research throughout the conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, review and editing, and visualization. Z.O. prepared the original draft, with C.M.J. and R.K.M.J. heavily involved in this process. All authors have read and agree to the published version of the manuscript.

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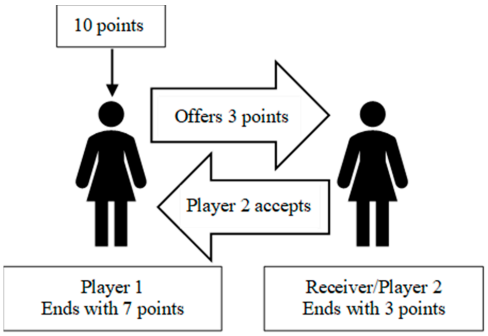
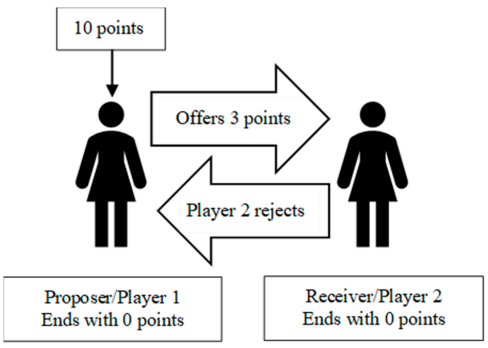
Appendix A



(a)

Or



(b)

Figure A1. Ultimatum game (**a**)—Player 2 accept Player 1's offer or (**b**)—Player 2 reject Player 1's offer.

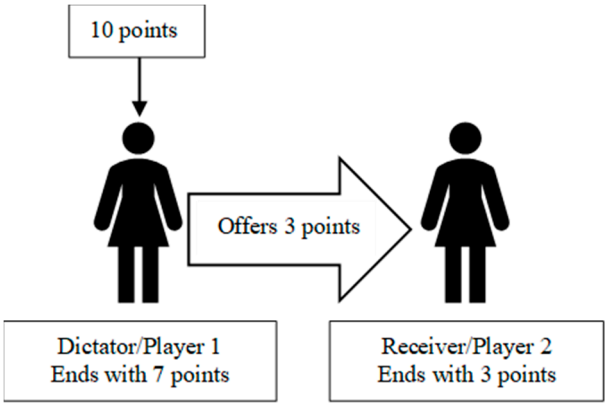


Figure A2. Dictator game.

Figure A3. Picture of recycling and trash bins.

Table A1. Description of study scales.

Self-Report Sustainable Behaviors **(alpha = 0.81)**	**Mean**	**SD**
1. I recycle if I have the opportunity.	4.25	0.83
2. I compost if I have the opportunity.	2.74	1.14
3. I use reusable grocery bags.	3.39	1.35
4. I do not buy plastic water bottles to reduce my impact on the environment.	2.50	1.33
5. I shop locally to reduce my impact on the environment.	2.95	1.17
6. I eat less meat to lower my impact on the environment.	2.06	1.28
7. I conserve energy at home to reduce my impact on the environment.	3.47	1.22
8. If I was able to purchase a fuel-efficient vehicle to reduce my impact on the environment, I would.	3.91	1.17
9. I avoid using plastic straws.	3.00	1.40
10. I try to reduce the amount of plastic I use.	3.32	1.19
11. I try to buy products that are better for the environment.	3.30	1.08
Self-Report Self-Efficacy **(alpha = 0.88)**		
1. Compared with other students in this class I expect to do well.	4.02	0.77
2. I am certain I can understand the ideas taught to me in this class.	4.21	0.78
3. I expect to do very well in this class.	4.23	0.76
4. Compared with others in this class, I think I am a good student.	4.10	0.81
5. I am sure that I can do an excellent job on the problem and tasks assigned for this class.	4.29	0.70
6. I think I will receive a good grade in this class.	4.32	0.71
7. My study skills are excellent compared with others in this class.	3.02	0.95
8. Compared with other students in this class, I think I know a great deal about the subject.	3.20	0.86
9. I know that I will be able to learn the material for this class.	4.26	0.70
10. I work hard to get a good grade even when I do not like a class.	4.11	0.98

Table A2. Logistic regression of recycling behavior with *offer* as continuous.

	Model 1	**Model 2**	**Model 3**
	OR (SE)	OR (SE)	OR (SE)
Male	- (-)	1.80 (0.70)	1.97 (0.80)
Age	- (-)	0.99 (0.04)	0.98 (0.04)
GPA	- (-)	1.08 (0.40)	1.10 (0.41)
Semesters in college	- (-)	0.96 (0.19)	1.03 (0.21)
White	- (-)	1.23 (0.50)	1.22 (0.51)
Hispanic	- (-)	1.06 (0.46)	1.16 (0.51)
Self-efficacy	- (-)	1.23 (0.37)	1.06 (0.33)
Offer	0.89 (0.06)	0.89 (0.06)	0.88 (0.06)
Self-reported environmental behavior	- (-)	- (-)	1.22 (0.30)
Convenience	- (-)	- (-)	2.17 * (0.83)
Constant	12.13 *** (5.59)	4.26 (8.27)	2.68 (5.77)

Notes: N = 282, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$, and all hypothesis tests are two-tailed. Coefficients are odds ratios (OR) calculated e^B.

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