WOULD YOU REALLY VOTE TO MAKE ME DRINK COCKROACH-CONTAMINATED WATER JUST SO YOU COULD EARN MORE MONEY? AN EXPERIMENTAL ANALYSIS OF THE SOCIAL PREFERENCE THEORIES AND THEIR EFFECT ON MAJORITY RULES VOTING.*

DRAFT

Deborah Kerley
Kent D. Messer
William D. Schulze

Several models of social preferences have been proposed that theorize individuals' preferences over differing distributions of payoffs: Charness and Rabin (2002), Fehr and Schmidt (1999), and Bolton and Ockenfels (2000). Each of these theories appears to be able to organize differing amounts of actual data in consistent ways. Given this and the fact that human behavior is extremely complex, preferences are most likely best descried by a combination of these theories all existing simultaneously. However, almost all research has tested to see which one model is the best or is the true explanation of human behavior, many times using simple distribution experiments with undergraduate students. Using staff members from Cornell University who are much more representative of the population as a whole, we test the social preference theories with an emotionally charged commodity, cockroach-contaminated water, using the random price voting mechanism. This allows each of the social preference theories to coexist at the same time using continuous data. We find that social preferences exist with respect to commodities, not just over distributions of money, implying a more general utility framework is appropriate with distributional concerns. We find strong evidence for efficiency motives and for the Fehr and Schmidt model. We also test if individuals with economics and business backgrounds exhibit different types of social preferences than those with other backgrounds and we find no affect from differing backgrounds. Furthermore, when testing to see which individual characteristics are correlated with having any type of preferences other than maximizing one's own payoff, we find that gender plays a significant role, with females being more likely to exhibit preferences over the distribution of payoffs. Additionally, we find that individuals are less likely to incorporate other individuals' payoffs into their own utility function unless they are explicitly told what the payoffs of the other individuals are, even if they have knowledge of the distribution of the possible payoffs of others. Most importantly, since many public goods decisions are determined by majority rules voting, we analyze how individuals voting with these social preferences affect this mechanism. We find that when calculating economic efficiency, incorporating social preferences into the calculation may actually increase economic efficiency. That is, majority rules voting may be more efficient than previously thought when social preferences are considered. We find this both for our data and in simulated groups.

*Kerley and Schulze are from Cornell University. Messer is from the University of Delaware. The corresponding author is Deborah Kerley, drk27@cornell.edu, Cornell University, Uris Hall 4th Floor, Ithaca, NY, 14853. We would like to thank the National Science Foundation for their support of this project. We would also like to thank Catherine Eckel, Glenn Harrison, Brian Wansink, George Jakubson, and the participants of both the 2005 ESA meetings in Tucson, AZ and the 2007 International Meeting on Experimental and Behavioral Economics in Málaga, Spain for their helpful comments. We would like to extend our appreciation to the Laboratory for Experimental Economics and Decision Research at Cornell University assistants for their continued help in all projects. All remaining errors are our own.

I. Introduction

Individuals frequently desire an income distribution that exhibits several characteristics simultaneously. It is commonplace to see people wanting to maximize GDP, while having a welfare system for the worst off individuals and an income distribution that is as equal as possible. These preferences may even spill over to commodities such as a health care or schooling. However, the social preference theories and tests of these theories to this point do not incorporate all of these different preferences, they only consider them individually. Additionally, this research has solely been conducted with games where participants within a group receive differing amounts of money, many times chosen from a set of distributions of payoffs determined by the experimenter.

We investigate social preferences by examining a commodity, cockroach-contaminated water, in a group setting. The use of cockroach-contaminated water is appealing since individuals have strong preferences over whether or not they drink it. We show that social preferences are indeed exhibited with respect to commodities, not just to distributions of money, indicating that social preferences are relevant to more general forms of an individual's utility function. Our analysis is primarily conducted using staff members from Cornell University as opposed to the typical undergraduate business or economics student. We are thus able to parallel the results of our experiments with a broad section of the general population who have differing backgrounds and personal characteristics.

Our study allows individuals to continuously, up to a one-cent increment, choose the price at which they would be willing to have their whole three-person group, to which they are assigned, drink the cockroach-contaminated water. They make this decision after finding out what each group member's own private value for drinking the cockroach-contaminated water is.

This allows us to test several of the various social preference theories that have been proposed. Our study, unlike many previous studies where individuals were asked to choose between different distributions of monetary payoffs chosen by the administrator, lets the decision maker decide on their own optimal payoff distribution. Furthermore, since we have continuous data, this investigation does not put the various social preference measures at odds with each other, but rather sees if any of them may be representative of real world behavior in conjunction with each other. We find evidence for both forms of inequality aversion that Fehr and Schmidt (1999) propose and for the efficiency motives Charness and Rabin (2002) propose.

After analyzing which social preference theories are consistent with individuals' choices, we then analyze what personal characteristics are correlated with having behavior consistent with these preferences. We do not find a difference between individuals with economics and business backgrounds and those with other backgrounds; both groups act consistent with the efficiency preferences of Charness and Rabin (2002) and with the inequality aversion preferences of Fehr and Schmidt (1999). We find that gender is correlated with having preferences over the distribution of payoffs other than maximizing one's own payoff, with females being much more likely to display these preferences. We do not find that other personal characteristics are correlated with exhibiting social preferences, including such variables as age and having a science background. Additionally, we find that individuals are less likely to display behavior that is consistent with preferences over the distribution of payoffs unless they are specifically told what the payoffs of others are, even if the distribution of possible payoffs is given to them.

In all cases we use the random price voting mechanism to elicit individuals' true demand. Imbedded within the random price voting mechanism is majority rules voting, which is known to be an economically inefficient mechanism under many circumstances. Since numerous public goods decisions are decided by majority rules voting and we have strong evidence that individuals actually incorporate their preferences over the distribution of payoffs into their votes, we investigate what the implications of social preferences are on the majority rules mechanism. For the groups in our experiment, we analyze how often the economically efficient outcome, which is whether or not the cockroach-contaminated water should be drunk, occurs. If we assume that individuals vote their own private values, the efficient outcome occurs significantly less often than if we assume individuals' vote take into account their social preferences. That is, majority rules voting is more efficient when individuals' social preferences are considered. To check if this result is just an artifact of the groups the participants saw in our experiments, we generate all of the groups that could have been possible in our experiments. When we assume that individuals' behavior in the generated groups is consistent with the social preferences parameters we previously estimate from their decisions, we find that economic efficiency is still improved when individuals' social preferences are taken into account. This result still holds when we simulate groups using various distributions of private values.

The organization of the rest of the paper is as follows. Section II reviews the relevant literature. Section III presents our experimental design. Section IV tests whether individuals' behavior is simultaneously consistent with any of the social preference models. Section V tests under what conditions are social preferences relevant and who displays social preferences. Section VI shows that when social preferences are incorporated into calculating economic efficiency, majority rules voting actually becomes a more efficient mechanism. Section VII concludes.

II. Previous Literature

Several theories of social preferences have been theorized. Fehr and Schmidt (1999), henceforth F&S, assume that along with utility increasing from one's own individual payoff, individuals dislike payoff differences between themselves and other agents, regardless of whether their payoff is greater than or less than others. Any difference reduces utility, with reductions in utility being greatest from others being ahead of them in the distribution of payoffs. They posit a utility function for individual $i \in [1,n]$ with a payoff of π_i in the form of

$$U_i(\pi_1,...,\pi_n;\beta_{FSA_i},\beta_{FSB_i}) = \pi_i - \beta_{FSA_i} \tfrac{1}{n-1}\sum_{j \neq i} \max\left[\pi_j - \pi_i, 0\right] - \beta_{FSB_i} \tfrac{1}{n-1}\sum_{j \neq i} \max\left[\pi_i - \pi_j, 0\right]$$, where

$\beta_{FSB_i} \leq \beta_{FSA_i}$ and $0 \leq \beta_{FSB_i} < 1$.

Bolton and Ockenfels (2000), henceforth B&O, also assume that individuals' utility increases from an increase in their own payoff and decreases with an increase in inequality, and theorize their *ERC* model. However, in their formulation utility decreases with any difference in relative payoffs from an even split. They model individuals having motivation functions, v_i, and give an example of a motivation function in a two-player game,

$v_i(\pi_i,\sigma_i;\beta_{OWN_i},\beta_{ERC_i}) = \beta_{OWN_i}\pi_i - \frac{\beta_{ERC_i}}{2}(\sigma_i - \frac{1}{2})^2$, where σ_i is player *i*'s share of the total payoff.

Expanding to an n person game, $\sigma_i = \dfrac{\pi_i}{\pi_1 + ... + \pi_n}$ for $\pi_1 + ... + \pi_n > 0$ and $\sigma_i = \dfrac{1}{n}$ for $\pi_1 + ... + \pi_n = 0$. The coefficients β_{OWN_i} and β_{ERC_i} determine the magnitude that individuals care about their own payoff and their relative payoff compared to an equal split of the total payoffs, respectively. In the general form, v_i is twice continuously differentiable, $v_{i1}(\pi_i,\sigma_i) \geq 0, v_{i11}(\pi_i,\sigma_i) \leq 0, v_{i2}(\pi_i,\sigma_i) = 0$ for $\sigma_i = 1/n, v_{i22}(\pi_i,\sigma_i) < 0,$ and for $v_i(\pi_i^1,\sigma) = v_i(\pi_i^2,\sigma)$ with $\pi_i^1 > \pi_i^2$, player *i* chooses payoff π_i^1. We categorize this theory, along with the F&S theory, as inequality aversion models.

Charness and Rabin (2002), henceforth C&R, model what is known as "quasi-maximin preferences." They posit that individuals' utility is increasing in their own payoff, the total sum of the payoffs across the relevant group members, and the payoff of the lowest person in the group, the latter two measures being known as efficiency[1] and maximin, respectively. They model player *i*'s preferences as

$$U_i(\pi_i,...,\pi_n;\beta_{OWN},\beta_{MAXIMIN},\beta_{EFF}) = \beta_{OWN} * \pi_i + \beta_{MAXIMIN} * \min_i(\pi_i,...,\pi_n) + \beta_{EFF} * (\pi_i + ... + \pi_n),$$

where $\beta_{OWN} \in [0,1]$, and $\beta_{MAXIMIN} = (1-\beta_{OWN}) * \delta$, and $\beta_{EFF} = (1-\beta_{OWN}) * (1-\delta)$ where $\delta \in (0,1)$.[2]

Several studies have compared and tested the C&R, F&S, and B&O theories for their applicability when real incentives are involved, all of which have primarily focused on varying distributions of money and typically have put the separate models at odds with each other to declare which one is the true model of real world behavior. Thus far, the results have been mixed. Kritikos and Bolle (2001) using binary-choice dictator games find evidence supporting efficiency concerns and against equity motives, specifically the parameterization used by F&S. However, other papers have found the opposite result favoring the models of inequality aversion over models with efficiency concerns.

Bereby-Meyer and Niederle (2005) find that rejection rates do not vary with rejection payoffs in three-person ultimatum games, contrary to C&R. They find, after controlling for who receives the rejection payoff and how large it is, that rejection rates decrease with the size of the offer, indicating some form of inequality aversion. Güth, Kliemt, and Ockenfels (2003) examine gift giving games and find that fairness concerns outweigh efficiency concerns in favor of the F&S and B&O models. Chmura, Kube, Pitz, and Puppe (2005) also find evidence of inequality-aversion over efficiency concerns in coordination games. They find this inequality-aversion appears to come from people's belief that others have such a preference. Riedl and Vyrastekova

(2003) study 3 person ultimatum games where the payoffs for the two responders vary between treatments using the strategy method and find varying results. About one half of their participants care about the distribution of payoffs when deciding when to reject and only one individual accepted every possible outcome, a strategy consistent with efficiency. Furthermore, proposers most often propose an even share of the payoffs. However, less than ten percent of the individuals required a fair split of the payoffs.

Engelmann and Strobel (2004), using simple distribution experiments, test under what circumstances individuals will choose a distribution of payoffs amongst group members that has the above three social preference theories at odds with each other. They find evidence that people choose distributions of payoffs consistent with efficiency and maximin preferences. They also find that while F&S does better than B&O in describing the distributions individuals choose, this is most likely because F&S preferences are in line with maximin preferences. We find the opposite results. Engelmann and Strobel also claim that F&S and B&O cannot explain important findings in the data. Fehr, Naef, and Schmidt (2006) argue that Engelmann and Strobel's results are a consequence of using economics students, who even in their first semester classes learn that efficiency is an important factor in decision-making. They replicate Engelmann and Strobel's experiment and find that equity concerns are far more prevalent than efficiency concerns when subjects other than economists are used. Engelmann and Strobel (2007) in an internet experiment do not find the Fehr, Schmidt, and Naef results. We additionally do not find a difference between the preferences of individuals who have backgrounds in economics and business and those who do not.

Other papers have found that the distribution of payoffs, specifically inequality concerns, seem to matter while not necessarily attempting to test one of the theories against another.

Bolton, Brandts, and Ockenfels (1998) find evidence for reciprocity, however they find that this evidence can be completely attributed to distributional preferences rather than intensions using simple dilemma games. Bolton, Katok, and Zwick (1998) investigate dictator games and find that giving cannot be attributed to individuals' preferences for giving. They hypothesize that the giving above a 0 level they find must be attributed to some form of preferences for a fair distribution. Okada and Riedl (2005) study coalition formation games where after coalitions are formed responders can reject a proposer's split of the payoffs resulting in everyone in the coalition receiving a monetary payoff of 0. They find that many inefficient outcomes occur, especially when responders are acting with reciprocity and prospers are trying to maximize their monetary gain. However, they find evidence in favor of both B&O and F&S in the rejection and proposal behavior.

Kagel and Wolfe (2001) find the opposite result. They test both the F&S and B&O models using three person ultimatum games with one responder. They then allow a person completely unrelated to the process of proposing and responding to receive a consolation prize if the responder rejects the split. They find rejection rates do not vary with the introduction of the prize, in contradiction to both F&S and B&O.

Herreiner and Puppe (2006) find evidence that may suggest individuals have preferences in line with several of the theories. They analyze bargaining games and find that agents operate as if they were following the "Conditional Pareto Improvement from Equal Split (CPIES)" rule. That is, when individuals are bargaining, they first figure out what is the most equal distribution of payoffs, choosing Pareto optimal ones. If there is a Pareto improvement, they only choose it as long as the inequality does not become too large, giving evidence that supports C&R, B&O, and F&S. These results hold for both the case where the individuals know the cardinal ranking of the payoffs and where the individuals only know the ordinal ranking of payoffs, where the evidence is weaker, showing that precise payoff knowledge is not necessarily needed for these models.

Using a commodity, cockroach-contaminated water, which individuals have strong preferences over whether or not they consume, we are able to test the social preference theories simultaneously. The use of a commodity allows us to show that social preferences should be used to model more general forms of utility, not just utility over differences in pecuniary payoffs. It also makes individuals' choices much more salient. Instead of choosing between small differences in pecuniary payoffs across group members, individuals must choose if they will force other individuals to drink cockroach-contaminated water. Our method allows us to collect individuals' optimal distribution of payoffs amongst individuals of their group in a continuous fashion. Therefore, our results are not biased by the experimenter deciding the possible distributions of monetary payoffs from which the subjects must choose their most preferred. From this, we find evidence for efficiency and the inequality aversion motives modeled in F&S. Moreover, we find that not all individuals display the same social preferences. Individuals are less likely to exhibit social preferences unless they are explicitly told what the payoffs of others are. If they only know their actions affect others, but do not know precisely how, they are less likely to do anything other than maximizing their own payoff. Additionally, we find that females are far more likely to have preferences over the distribution of payoffs than males.

III. Experimental Design

All experiments took place in the Laboratory for Experimental Economics and Decision Research at Cornell University using Visual Basic Software. 6 sessions with 24 participants each were conducted: three in the late August and September of 2005, Group 1; and three more in early December 2005, Group 2. All experiments were approved by the Office of Human Subjects at Cornell University and lasted approximately an hour and a half. The average earnings from Group 1 were $52.80, and the average earnings from Group 2 were $55.46. Slight modifications to the experimental procedures to check for robustness were made between Groups 1 and 2. The results are robust to these modifications. Full sample instructions for both groups can be found in Appendix A.

Participants were recruited from Cornell University staff members through the staff newspaper, PawPrint. The newspaper sends out periodic announcements to staff members through an e-mail list, which was the medium of communication we used. Participants then signed up for the sessions through web-based software. If a session did not fill up from staff members, we allowed students to participate. In Group 1 we had one student and in Group 2 we had 17 students. If a staff member showed up without signing up, we let them be seated before any extra students. Therefore, we had a couple repeat participants. We have omitted their second data-point from the dataset[3]. The sample of participants came from a wide variety of backgrounds, which included individuals who had a household income of less than $20,000 per year to over $150,000 per year. The education varied from those who had only a high school education to those who had earned their Ph.D. Therefore, we believe our sample is relatively representative of the population, helping to make our results more representative of the population as a whole.

In all experiments, participants were randomly assigned computer terminals with privacy shields. Each computer terminal had Poland Spring Water on it that the participants were encouraged to drink. They were told they could drink as much as they wanted, and if they needed more just to raise their hand. This was done to ensure that the marginal benefit/cost of an additional small amount of water would be equal to zero later on in the experiment since this feature controlled for thirst. The administrators were also drinking the same water to show safety. Group 1 of the experiment was given water in plastic glasses poured from a jug of Poland Spring Water and Group 2 participants were given individual bottles of Poland Spring Water. After filling out Human Subjects forms, the participants were informed they would earn a $20 participation fee and the participants were given written instructions of Part A to read, which was followed by a PowerPoint presentation of the instructions. Each successive part of the experiment was conducted in the same manner.

In Part A, participants were told they would participate in an unknown number of rounds where they would either be in a group of size one or in a group of size three with other members of the experiment, and in each round they would receive ten experimental dollars. Each low incentive training round[4] was conducted to teach the participants the Random Price Voting Mechanism (RPVM) (Messer, et al., 2007). The RPVM extends the Becker-DeGroot-Marschak (BDM) (1964) mechanism to multiplayer games. In the loss domain of the RPVM, each member of the group is told their induced personal loss amount and the induced loss amounts of the other members of their group. The participant is then asked to indicate the minimum amount of compensation they personally would be willing to accept in order to have everyone in their group lose their personal loss amount and receive the random price as compensation. If the majority of the members of the group indicate, that is offer or vote for, a compensation that is less than or equal to a randomly chosen price that is chosen after all votes have been collected, then all the participants in the group lose their personal loss amount but receive the random price. If the majority of the members of the group indicate, that is offer or vote for, a compensation that is greater than the randomly chosen price, none of the members of the group lose their personal loss amount nor gain the compensation. Note, if the voting group contains one individual, the RPVM becomes the standard BDM Mechanism.

At the beginning of each round participants were told their personal loss amount, the personal loss amount of the other members of their group, which was always the same as their own, if applicable, and the number of people in their group, one or three. Fourteen training rounds were conducted in Group 1 of our experiments. Private rounds, those with a group size of one, and public rounds, those with a group size of three, were dispersed throughout the training rounds. In Group 2, we separated the private rounds from the public rounds. First the participants practiced the private rounds, and then they practiced the public rounds. To check for understanding of the mechanism in Group 2, as in Noussair et al. (2004), after the voting in each round all of the votes were displayed anonymously on the screen at the front of the room. As a group, participants were then asked by the administrator (if applicable),

1) Can you identify your offer?
2) Which subjects lost their personal loss amount?
3) How much will these subjects be compensated and how much will they earn in this round?
4) How much will the subjects who did not lose their personal loss amounts earn in this round?
5) Did anyone see any offers that someone might regret and why?

Participants answered aloud so the whole group could hear. Participants were also asked to share any strategies and were told why offering their induced value would be the strategy that would guarantee them the highest monetary payoff. After 70% of participants offered within 5% of their induced value, one or two rounds were conducted where the participants voted without having the discussion beforehand to ensure understanding.

For Part A of the experiment, 1 experimental dollar was equal to 33 experimental dollars for Group 1 participants and one experimental dollar was equal to twenty-five experimental dollars for Group 2 participants. All questions and answers up until this point of the experiment were asked and answered publicly. After Part A, all participants were given a short break where they could leave the room and stretch their legs while their water was removed from their computer terminals and replaced with two empty three-ounce Dixie cups. Both Groups 1 and 2 were then given written instructions to read for Part B, which were also presented in a PowerPoint presentation.

All questions from this point on were answered privately. Participants were informed that an autoclave was a device used to sterilize surgical instruments. They were then shown a real dead cockroach in a beaker that had been sterilized in an autoclave with aluminum foil and autoclave tape still in place showing it had been autoclaved. They were told they could expect the cockroach to be as sterile as a surgical instrument since it had been autoclaved. At the front of the room, participants witnessed a glass jug being filled with Poland Spring Water that was identical to the water they had been drinking in the first portion of the experiment. This was also projected onto a screen to ensure everyone could see. The autoclave tape and aluminum foil was removed from the beaker containing the cockroach and the cockroach was placed in a brine shrimp net. The brine shrimp net with the cockroach in it was then placed into the jug with the water in it for a few seconds. Group 2 members were also told of six medical conditions or diseases that cockroaches have been associated with that the Group 1 members were not told. The cockroach was removed, and the water was stirred with a spoon. This method of introducing a sterilized cockroach into drinking water is consistent with the methods of Rozin (2001).

Participants were then asked to indicate the minimum amount of compensation that was necessary for them to be willing to drink a Dixie cup of the cockroach-contaminated water using the RPVM with a group size of 1, or the standard BDM. They were not told they would vote in a public setting later. All of the votes were restricted to be between $0 and $29.99 and the randomly determined compensation was restricted to be between $0.00 and $30.00. Participants were told before any submission of values that if they wanted to guarantee that they would drink the cockroach-contaminated water in the private case, and thus receive the randomly determined compensation, they should submit an offer of $0. Likewise, if they wanted to guarantee that they would not have to drink the cockroach-contaminated water, and also not receive the randomly determined compensation in the private case, they should submit an offer of $30. For each vote, the participants were informed they would receive an initial balance of $10. The exchange rate for all of the votes for this part of the experiment was one experimental dollar was equivalent to $1 U.S. dollar. Group 1 participants were also asked what was the minimum amount of compensation that would be necessary for them to drink the plain Poland Spring water that had not been contaminated by the cockroach and what would be the minimum amount of compensation they would need to drink the cockroach-contaminated water that had been ran through a camp filter, both of which were prepared in the same manner in front of them.[5]

After each Group 2 member had submitted their offer, all offers were posted anonymously on a screen at the front of the room. Participants were then asked to submit their offer again, being fully allowed to change their offer, after they had seen everyone else's offer. This was done to verify that no learning of the true value of cockroach-contaminated water occurred from seeing other participant's valuations in the public rounds. There is no statistical difference between the groups, indicating that learning was not an issue. Given the salience of drinking cockroach-contaminated water, this is to be expected.

To test the different social preference theories simultaneously using a real commodity, in Part C, each participant was sorted into five different groups each containing two other anonymous individuals. In each group, the participants were asked again what was the minimum amount of compensation they would need in order to drink the cockroach-contaminated water, but this time in a group setting. Whether or not the cockroach-contaminated water was drunk and the compensation was to be earned by all the members of the group was determined by the RPVM. In each group, all members had to drink the water if the randomly chosen price, determined at the end of the experiment, was greater than or equal to a majority of the offers, in their group. If the majority of the offers in the group turned out to be more than the randomly determined compensation, all of the members of the group neither drank the cockroach-contaminated water nor received the randomly determined compensation.

For one of the votes, the participants were only told they were in a group with two other individuals in the room, but they did not know the private values of the other members of their group. For the other 4 votes, each group member was shown all 3 group members' private values for the cockroach contaminated-water on their computer screen before they could submit their offers.[6]

This feature of the experiment allowed each group member to know the value that every member of their group would have if they were voting by themselves. Thus, any deviation from an individual's private value in the group setting would indicate some form of social preferences. One of the attractive features of this design is that participants are allowed to continuously choose their optimal minimum compensation in each group scenario, as opposed to having to choose between one of a few different distributions of payoffs previously determined by the experimenter that may be biased towards one obvious choice, as has been a feature of some previous experiments. Additionally, these experiments use a real commodity, to which participants have an emotional reaction. Thus, while a participant may not have strong preferences over who receives an additional dollar when choosing between different distributions of payoffs, many participants have a strong preference for the amount of compensation they would need to consume the cockroach-contaminated water.

Before any submission of values, participants were informed that after everyone's offer for all of the votes had been submitted, one of the votes would be randomly selected to result in actual drinking of the cockroach-contaminated water and receiving of the randomly determined compensation. The vote was selected by pulling a lettered poker chip out of a bag. The bag contained chips that referred to both to the private and the group votes. All participants were also informed before any votes were collected that everyone would be asked to drink a Dixie-Cup of water at the end of the experiment, either containing cockroach-contaminated water or containing plain Poland Spring Water. If it was determined that an individual's group was not drinking the cockroach-contaminated water, Poland Spring Water was poured into one of the Dixie cups on their computer terminal. If it was determined that the cockroach-contaminated water was to be drunk by a participant's group, then this water was poured into one of the cups on the participants computer terminal. Everyone then drank their type of water simultaneously at the end of the experiment so it was not obvious who was drinking the cockroach-contaminated water. This was done to control for any embarrassment (or reward) from drinking the cockroach-contaminated water in public.[7]

IV. Testing the Social Preference Theories Simultaneously

A. Model

To test the social preference theories of F&S, B&O, and C&R, let each voting group, $t = 1,...,T$ contain $i = 1,...,n$ individuals. Define ω as the endowment given to each participant, \$30[8] in our experiment, and κ_i as the amount of money individual i earned in the RPVM practice rounds at the beginning of the experiment. Let λ_i be the loss individual i suffers from drinking the cockroach-contaminated water. This loss is the minimum amount of compensation individual i stated they need in order to be in favor of drinking the cockroach-contaminated water when they are not a part of a group, which is the value they stated in Part B of the experiment. Let ϕ_{it} be the minimum price that individual i in group t stated they need in order to be in favor of having their whole group drink the cockroach-contaminated water. Thus ϕ_{it} is the reservation price of individual i in group t where they are exactly indifferent between having their whole group receive ϕ_{it} and drink the cockroach-contaminated water and not having their whole group drink the cockroach-contaminated water. For an individual who only exhibits self-interest, the total payoff to individual i in group t is $\pi_{it} = \omega + \kappa_i - \lambda_i + \phi_{it}$.[9]

Individual i also knows λ_{-i}, the vector of individual losses the other members of their group will suffer if they drink the cockroach-contaminated water. Since individual i does not observe κ_{-i}, the monetary payoff of the other members of their group from the practice rounds of the RPVM, a natural assumption is that $E_i(\kappa_{-i} \mid \kappa_i) = \kappa_i$.[10] Therefore, individual i can determine the vector of payoffs, $\pi_t = (\pi_{1t},...,\pi_{nt})$, for each group t of which they are a member.

In each of the theories posited by C&R, F&S, and B&O, preferences are modeled as a linear combination of each of their respective social preference measures. In order to ascertain which social preference measures actually coexist simultaneously, we extend each of their theories and model preferences as being linearly related to all of social preference measures contemporaneously, so that

$$(1)\quad U_{it}(\bullet) = \alpha + OWN_{it} + \beta_{EFF} * EFFICIENCY_{it} + \beta_{MAXIMIN} * MAXIMIN_{it} + \beta_{FSA} * FSA_{it} + \beta_{FSB} * FSB_{it} + \beta_{ERC} * B\&OERC_{it},$$

where

$$(2)\quad OWN_{it} = \pi_{it},$$

$$(3)\quad EFFICIENCY_{it} = \sum_{i=1}^{n} \pi_{it},$$

$$(4)\quad MAXIMIN_{it} = \min_{i}(\pi_{it},...,\pi_{nt}),$$

$$(5)\quad FSA_{it} = \tfrac{1}{n-1}\sum_{l \neq i}^{n} \max(\pi_{lt} - \pi_{it}, 0),$$

$$(6)\quad FSB_{it} = \tfrac{1}{n-1}\sum_{l \neq i}^{n} \max(\pi_{it} - \pi_{lt}, 0), \text{ and}$$

$$(7)\quad B\&OERC_{it} = \left(\tfrac{1}{n} - \frac{\pi_{it}}{\sum_{i=1}^{n}\pi_{it}}\right)^2 \text{ if } \sum_{i=1}^{n}\pi_{it} > 0, \text{ and } = 0 \text{ if } \sum_{i=1}^{n}\pi_{it} = 0.$$

Each individual *i* then solves

$$(8)\quad \max_{\phi_{it}} E[U_{it}(\phi_{it}; \kappa_i, \lambda_i, \lambda_{-i}, \omega)]$$

for each decision.

In our experiments, each individual solves (8) for the optimal ϕ_{it}, $\overline{\phi}_{it}$. Thus, $\overline{\phi}_{it}$ is the choice variable that is dependent on the social preference measures. However, the $B\&OERC_{it}$ variable defined above, taken directly from B&O, cannot be solved for $\overline{\phi}_{it}$ in an econometrically feasible manner. This same problem occurs for the ERC variable defined by Engelmann and Strobel (2004) [11]. To solve this, we slightly modify the $B\&OERC_{it}$ variable to

(9) $$ERC_{it} = 1000*(\tfrac{1}{n} - \frac{\bar{\pi}_{it}}{\sum_{i=1}^{n}\bar{\pi}_{it}})^2.$$

In order to maintain the concavity assumed by B&O we believe the squared version of the ERC_{it} variable is the most appropriate to model; however, as will be seen, our results on ERC_{it} are robust to using a squared term or to using the absolute values of the variables.

ERC_{it} assumes that the reservation price, $\bar{\phi}_{it}$, is fixed and its affect on ERC_{it} is not considered in solving the utility maximization problem: the ERC_{it} variable just adds and subtracts from utility in a random predetermined manner, but the decision of ϕ_{it} does not affect the ERC_{it} variable. This can be justified by assuming that cognitively individuals are not mathematically savvy enough to do the complicated calculations involved in this model, so they first perform some simplifying calculations (see, for example, Kahneman and Tversky, 1979) to solve the maximization problem[12].

PROPOSTION 1: The optimal reservation price, assuming individuals offer their true value, is

(10) $$\bar{\phi}_{it} = ((1+\beta_{EFF})*\lambda_i + \beta_{EFF}*\sum_{l\neq i}^{n}\lambda_l + \beta_{MAXIMIN}*\max_i(\lambda_1,...,\lambda_n) - \beta_{FSA}*\frac{1}{n-1}\sum_{l\neq i}^{n}\max(\lambda_i-\lambda_l,0) - \beta_{FSB}*\frac{1}{n-1}\sum_{l\neq i}^{n}\max(\lambda_l-\lambda_i,0) - \beta_{ERC}*1000*(\tfrac{1}{n} - \frac{\bar{\pi}_{it}}{\sum_{i=1}^{n}\bar{\pi}_{it}})^2)/(1+n*\beta_{EFF}+\beta_{MAXIMIN}).$$

PROPOSTION 2. The RPVM is incentive compatible for revealing social preferences.

With ϕ_{it} as the choice variable, we estimate the coefficients from the various social preference theories. We assume that each individual's optimal price is normally distributed. Since each individual makes multiple decisions we cluster over the individual. Therefore, we estimate

$$\text{(11)}\quad \begin{aligned}\bar{\phi}_{it} &= \delta_{OWN} * \lambda_i + \delta_{EFF} * \sum_{l \neq i}^{n} \lambda_l + \delta_{MAXIMIN} * \max_i(\lambda_1, ..., \lambda_n) + \delta_{FSA} * \sum_{l \neq i}^{n} \max(\lambda_i - \lambda_l, 0) + \\ &\delta_{FSB} * \sum_{l \neq i}^{n} \max(\lambda_l - \lambda_i, 0) + \delta_{ERC} * (\tfrac{1}{n} - \frac{\bar{\pi}_{it}}{\sum_{i=1}^{n} \bar{\pi}_{it}})^2 + \varepsilon_{it} + \mu_i.\end{aligned}$$

Since $\delta_{OWN} = 1-(n-1)\delta_{EFF} - \delta_{MAXIMIN}$, with respect to the true model parameters, we substitute $1-(n-1)\delta_{EFF} - \delta_{MAXIMIN}$ in for δ_{OWN} and combine terms so that the model is exactly identified. We call this Formulation 1. Alternatively, one could substitute in for δ_{EFF} or $\delta_{MAXIMIN}$, which we call Formulation 2 and Formulation 3, respectively. From this, after acquiring the regression coefficients, we can use the delta method to solve for the true preference parameters.

When considering the inequality measures by F&S, there is a perfect collinearity issue between FSA_{it}, FSB_{it}, $EFFICIENCY_{it}$, and OWN_{it} as Engelmann and Strobel (2004) point out. One way in which they attempt to solve this is by additively combining the inequality aversion term that occurs from being behind others in the distribution of payoffs with the inequality aversion term that occurs from being ahead of others in the distribution of payoffs, FSA_{it} and FSB_{it}, and creating the new variable,

$$\text{(12)}\qquad FSSTRICT_{it} = \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{lt} - \pi_{it}, 0) + \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{it} - \pi_{lt}, 0).$$

This is equivalent to assuming that $\beta_{FSA} = \beta_{FSB} = \beta_{FSSTRICT}$. This formulation, while solving the perfect collinearity issue, loses the feature that individuals' utility is affected differently when they are ahead of others in the distribution of payoffs as opposed to being behind others in the distribution of payoffs. We first test the model with the $FSSTRICT_{it}$ variable for comparison. Then we will show the results from a model that actually preserves the differences between being ahead and behind in the distribution of payoffs.

A coefficient equal to 0 on any of the social preference variables implies that the given variable is not a part of individuals' preferences. *A priori* we would expect $\beta_{EFF}, \beta_{MAXIMIN}, \geq 0$ from the assumptions of the C&R model, that is, an individual's utility is increasing in the sum of the payoffs to the group and the payoff of the least well off individual in their group. F&S assume that both $\beta_{FSA}, \beta_{FSB}, \leq 0$, that is, individuals have a preference against both having a lower payoff than others and from having a higher payoff than others, and the larger these differences, the worse off the individual is. If we assume $\beta_{FSA} = \beta_{FSB}$, then $\beta_{FSSTRICT} \leq 0$. B&O assume that $\beta_{ERC} \leq 0$, so that an individual's utility is decreasing in their relative differences from an even split of the payoffs.

In our experiments we allowed individuals to indicate a loss, $\lambda_{it} \in [\$0, \$30]$. Since other individuals in a group cannot differentiate between $\lambda_{it} = \$30$ being a loss exactly equal to $30 from any number greater than $30, we drop all groups where someone in their group indicated a loss of $30 from our analysis. Removing these groups from our analysis only strengthens our results since these groups are the ones where the strongest social preferences would be revealed[13]. We do not want to underplay these individuals' importance to the understanding of social preferences, but we, as those in the experiment, cannot directly formulate the social preference measures since we cannot distinguish between a loss of $30 and a loss of $1000. Therefore the analysis of their data is beyond the scope of this investigation.

Using a Tobit model we estimate (11). The results for Formulation 1 can be found in Table I, while the results for Formulation 2 and 3 are almost identical. A likelihood ratio test of two times the difference between the log likelihood of the combined sample and the sum of the log-likelihoods of Groups 1 and 2 yields a $\chi^2_{(6)} = 7.2982$[14] and a p-value =.2941[15]. Therefore, we find it reasonable to combine the datasets and henceforth we only consider the combined data. β_{EFF} is positive and significant at the α = .01 level implying that individuals' utility is increasing in the total payoff of their group. This is consistent with the model of C&R. However, $\beta_{MAXIMIN}$ has the incorrect negative sign and is statistically significant at the α = .01 level. This is in direct contrast to the C&R model. Therefore, we find evidence for half of the C&R model. The coefficient on $\beta_{FSSTRICT}$ is negative and significant at the α = .05 level. This is what would be predicted by the F&S model, individuals dislike absolute differences in payoffs. β_{ERC} is positive and significantly different from zero at the α = .01 level. This is the opposite prediction of the B&O model.

We are most interested in analyzing the F&S model where preferences are different when one is ahead of others in the distribution of payoffs versus when one is behind others in the distribution of payoffs. Therefore, we propose squaring the FSA_{it} and FSB_{it} terms to create the new variables

(13) $$FSALPHA_{it} = \left[\tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{lt} - \pi_{it}, 0) \right]^2 \text{ and}$$

(14) $$FSBETA_{it} = \left[\tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{it} - \pi_{lt}, 0) \right]^2 .$$

We use a non-linear concave definition of $FSALPHA_{it}$ and $FSBETA_{it}$, as suggested by Fehr and Schmidt (1999 and 2006). Alternatively, we could omit one of the perfectly collinear terms from the estimation to solve the perfect collinearity issue; however, this runs the danger of having the results be dependent on the variable we omit as Fehr, Naef, and Schmidt (2006) point out. Therefore, we estimate the model again with the inclusion of both the $FSALPHA_{it}$ and $FSBETA_{it}$ variables.

The results of the estimation of the full model can be found in Table II. The results are extremely consistent across formulations giving further evidence to our theory that the different social preference measures may coexist simultaneously. The coefficient on $EFFICIENCY_{it}$ is positive and significant at the α = .01 level, consistent with C&R. The coefficients on both $FSALPHA_{it}$ and $FSBETA_{it}$ are negative and significant at the α = .01 level. Individuals appear to have a preference against being both ahead and behind in the distribution of payoffs. This yields strong evidence that the F&S model resembles true behavior. However, the coefficient on ERC_{it} is significant at the α = .01 level and of the wrong sign.

We again find a negative and significant coefficient on $MAXIMIN_{it}$, contrary to the C&R model. However, this can be completely explained by the individuals who did not change their offer between the private and public rounds. 31.65% of the participants offered \$0 in the private rounds and \$0 in all of the public rounds. Regression analysis assumes that all other variables are held constant, including $EFFICIENCY_{it}$. In order to keep the sum of the payoffs constant, if one of the individuals in a group has a private value of \$0, then at least one of the other members of the group must have a higher value, relatively speaking. This decreases $MAXIMIN_{it}$. Since C&R assume that preferences are such that individuals want the worst off individual in their group to have a payoff that is high as possible, they must be compensated for this decrease in $MAXIMIN_{it}$. In our experiments, individuals indicate this higher compensation by submitting a higher offer. However, since 31.65% of the individuals never change their value from \$0, we have a large proportion of individuals who have a relative decrease in $MAXIMIN_{it}$, but instead of increasing their offer, they offer the smallest amount possible. We correct for this by conducting the analysis without those individuals who did not change their offer between the private and any of the public rounds. 55.4% of the participants changed their offers between the public and private rounds.

The results of the full model analyzing only those who changed their offer at least once between the private and public rounds can be found in Table III. These results can be thought of as the coefficients that would be found given that the individual exhibits social preferences, instead of population coefficients. The coefficient on $MAXIMIN_{it}$ becomes insignificant at all commonly accepted levels. The coefficient on $EFFICIENCY_{it}$ remains positive and significant $\alpha = .05$ level, while the coefficients on $FSALPHA_{it}$ and $FSBETA_{it}$ remain negative and significant at the $\alpha = .05$ level. These last 2 findings may explain why we find no affect of $MAXIMIN_{it}$ here. Individuals care about having the sum of the payoffs be as high as possible by the positive coefficient on $EFFICIENCY_{it}$. Individuals also desire a distribution of payoffs where there is little dispersion between the payoffs, given by the negative coefficients on $FSALPHA_{it}$ and $FSBETA_{it}$. Since individuals want to make everyone's payoff as high as possible, including their own, and they want everyone's' payoff to be as close to theirs as possible, the addition of making the person with the smallest payoff better off is not necessary. This may also explain why we find $\beta_{FSBETA} < \beta_{FSALPHA}$, contrary to the assumptions of F&S. In addition to having preferences against any difference in payoffs from one's own, individuals may have an additional aversion to payoffs that are smaller than one's own, which includes the payoff from the worst off individual.

The question is how do we reconcile our results with previous results and theories. First, our model includes the possibility of a loss, drinking of the cockroach-contaminated water. The previous research has focused on participants choosing from a distribution of gains only.

Participants may be in the mind-frame that no matter what reservation price they choose, they are risking a loss. Therefore, it is reasonable to expect individuals to compute this loss differently than they would a gain (Kahneman and Tversky, 1979). Even B&O explicitly state that their model is only relevant for $\pi_{it} \geq 0$. This may be why, after giving ERC_{it} every chance possible to succeed, we cannot find estimates consistent with their model. It may be that the B&O model only works for a certain class of games and is not more broadly true.

In simple distribution experiments, participants are typically asked to choose their most preferred distribution of payoffs, where the choice of one distribution over another is taken to show that an individual has preferences consistent with one social preference theory over another. As both Engelmann and Strobel (2005 and 2007) and Bolton and Ockenfels (2006) argue, in simple distribution experiments, the distribution of payoffs an individual chooses as their preferred distribution over other less preferred distributions, indicating what social preferences they have, may be dependent on the possible choices the participants are given by the investigator. If the investigator had chosen to give a different set of payoff distributions to choose between, they may have found behavior consistent with a different theory. If more than one of the other social preference models actually reflect how individuals behave, then the choice of a distribution consistent with one of the social preference models may just be because the cost of picking a different distribution was too high with respect to one of the social preference measures. Our study corrects for this and allows individuals to choose their own reservation price instead of voting for their favorite option out of a limited set. We also adjust for this by letting all of the social preference measures exist simultaneously so we are accounting for all of the possible costs and benefits of one distribution over another.

We use Cornell University employees who have very different backgrounds and have not necessarily been exposed to an economics course. Pulling from a different portion of the population may show what the average individual may do as opposed to the average economics student.

Our study also gives a decision that individuals may care very much about. Where the participants may care about whether or not they give another participant a small extra pecuniary payoff, they may exceedingly care about making the correct decision with regards to forcing a colleague to drink cockroach-contaminated water. The use of cockroach-contaminated water was done to make the payoffs extremely relevant to the participants. Likewise, when they are deciding their reservation price, they may be much more careful to show their own preferences so that they are not drinking cockroach-contaminated water without the appropriate amount of compensation.

Finally, people are allowed to choose from several different social preference measures. They can be concerned not only about the sum of the payoffs of their group, but also about how they rank in the distribution of payoffs. Our method assumes all of the preference theories to be relevant and then tests which ones actually are. This investigation shows that no longer is a vote consistent with a particular theory a declaration of a winner in simple distribution experiments. The chosen option may be chosen simply because the other options available to the decision maker cause too much aversion due to one of the preference measures. The decision maker may be weighing the different choices and then deciding which is best from several preferences over the distribution of payoffs.

B. Robustness Checks for Model Specification

We do not have a theoretical reason to conduct the regression analysis with a constant term[16], but these results are robust to the inclusion of a constant. Additionally, if we assume that everyone who sees an offer of \$30 in their group believes the loss associated with it is exactly equivalent to \$30 and we can therefore include every group in our analysis, our results here on the different theories do not change.

When examining the coefficient on ERC_{it}, we find that β_{ERC} is robustly positive and significant in all of our formulations. If one was to believe that the true B&O theory used absolute values instead of the concave version of the variable, we still do not find evidence for ERC_{it}. If behavior was modeled such that individuals do not consider their endowment, ω, and first round earnings, κ, into calculating ERC_{it}, and modeled it as such, we still do not find evidence in favor of ERC_{it}. Our results continue to be robust if we assume that everyone who saw an offer of \$30 believed the true offer would still be \$30 if the constraints were removed. This is also true if we only examine those who changed their offer between the private and public rounds. If we remove the $FSALPHA_{it}$ terms and the $FSBETA_{it}$ terms since these variables are both also measures of inequality aversion and one may believe that the true inequality aversion model is the B&O model, we still do not find evidence in favor of ERC_{it}. All of these possible models were considered to give every chance possible to ERC_{it}, yet we still do not find support for ERC_{it}.

To verify that our results on ERC_{it} are not due to a misspecification of the ERC_{it} variable, we also tried

(15) $$ERCNOPRICE_{it} = 100 * \left(\frac{1}{n} - \frac{\omega + \kappa_i - \lambda_i}{\sum_{i=1}^{n} \omega + \kappa_i - \lambda}\right)^2,$$ and

(16) $$ERCABSOLUTE_{it} = \frac{1}{10} * (OWN_{it} - \tfrac{EFFICIENCY_{it}}{3})^2.$$

$ERCNOPRICE_{it}$ assumes that individuals only care about how far their loss plus their endowment and first round earnings are from an even split. Individuals do not have preferences about their relative standing with respect to the addition of ϕ_{it} since everyone will receive the same price. $ERCABSOLUTE_{it}$ measures how far away each individual is in absolute terms from an even split of the total payoffs. Both of these variables have the added benefit of being able to mathematically solve for the optimal ϕ_{it} as found in (10), but modified for the new ERC_{it} variables.

Each of these versions of the ERC_{it} variable was constructed to reflect the same economic meaning as B&O propose. Bolton and Ockenfels (2006, p. 1910) state, "the simple measures offered by ERC or FS provide a pretty good approximation to population behavior." Thus, we do not believe that slightly modifying the B&O measure in the way we have would be in conflict with their model since the authors state it is an approximation to behavior..

Depending upon how one models preferences, using either the concave version of either of these ERC_{it} variables or the absolute value using and either the data with only those who changed values between the private and public rounds or those who did not change values, we still do not find results that are consistent with the B&O model. This was done both with and without having a theoretical basis for the constant term. Finally, modeling preferences as being dependent only on OWN_{it} and ERC_{it}, that is taking the results in TABLE II and not considering preferences for neither $EFFICIENCY_{it}$, $MAXIMIN_{it}$, $FSALPHA_{it}$, nor $FSBETA_{it}$, using all three versions of the variable, both with and without a constant did not yield evidence for ERC_{it}.

C. Is our Model Consistent with Other Datasets from Different Games?

Noting the drawback of having the experimenter choose the possible distributions from which the subjects can choose, we use the data and results in Engelmann and Strobel (2004) to test and compare our model. They conduct 3 different regression analyses differing on which social preference variables they include, and we replicate all 3 of their regressions. The first 2 columns in Table IV show the results of our model when using the ERC measure that B&O specify in their paper, $(\frac{1}{n} - \frac{\pi_{it}}{\sum_{i=1}^{n} \pi_{it}})^2$. The last 2 columns restate the results from Engelmann and Strobel (2004) where they chose to define the ERC measure differently than B&O, using $100 * | \frac{1}{n} - \frac{OWN_{it}}{EFFICIENCY_{it}} |$ instead. We believe that in order to test B&O's theory, it is most appropriate to use the variable that is as close as possible to the one they propose, which also includes the concavity they assume in their model. For this analysis we construct our variables consistent with Engelmann and Strobel's formulations, including adding the negative sign to the B&O and F&S measures so that when a conditional logit model is used, an odds ratio greater than one for any of the variables implies a result that is consistent with its respective model.

Using Engelmann and Strobel's data and using the ERC measure modeled by B&O instead of the variable Engelmann and Strobel created, we find the exact same results as we do with our data. The odds ratio for $EFFICIENCY$ is >1 and significant at the $\alpha<.01$ level for all 3 formulations, consistent with our results. The odds ratio on the F&S variables is always >1 and is significant at the $\alpha<.05$ level for several of their formulations, but not all. However, the coefficient on $MAXIMIN$ is never significant at any commonly accepted level, with $\alpha=.619$ for 2 of the formulations. To summarize, using Engelmann and Strobel's data, we find evidence for efficiency motives and for the inequality aversion motives of F&S consistent with our findings.

Once the F&S measures are controlled for, *MAXIMIN* no longer seems to additionally affect individual's choices. This is contrary to the conclusions that Engelmann and Strobel draw.

Using Engelmann and Strobel's data we find that the odds ration on *ERC* is <1 and significant at $\alpha<.01$ level for all 3 of their formulations, the opposite of the prediction of the B&O model. This opposite result from the prediction of the B&O model is also found in our data. This implies that once absolute differences in payoffs from one's own payoff are controlled for, individuals prefer relative differences in payoffs. This makes sense given the way B&O model *ERC* . If an individual has a payoff greater than an even split of the payoffs then they will on average have a higher valuation of *ERC* than if they have a payoff smaller than an even split of the payoffs. For example, if an individual's payoff is equal to 100% of the total payoff, they will have an *ERC* valuation that is 4 times larger than if they received 0% of the payoff of their entire group. Thus, *ERC* is inherently greater on average for individuals who have a larger share of the payoffs. In the *ERC* variable that Engelmann and Strobel propose, this is still true, where an individual who has 100% of their group's total payoff has an *ERC* valuation that is 2 times greater than if they had received 0% of their group's payoff. This discrepancy in the degree of difference between those who have a larger portion of the group's payoff versus those who have a smaller portion of the group's payoff may account for the differences between our conclusions and Engelmann and Strobel's conclusions.

We do not doubt, however, that some measures may be of more importance to an individual than others. Thus, for any theory to be proven to model how individuals truly behave it must work in conjunction with other theories and by itself. Individuals are complex human beings, and thus, their preferences should be modeled as such[17].

V. Who Shows Social Preferences and Under What Circumstances are they Relevant?

A. Economics Backgrounds Versus Non-Economics Backgrounds

Fehr, Naef, and Schmidt (2006) argue that those with economics backgrounds tend to be more efficiency oriented, while those who are from non-economics related fields tend to be more equity oriented. Engelmann and Strobel (2006) do not find evidence of these claims. We test the above model using those individuals whose current job or major is in an economics or business related field, including accounting type jobs, and separately with those who are not in economics or business related fields. The results from Formulation 1 can be found in Table V, where the results to Formulation 2 and Formulation 3 are similar[18]. The results show that both non-economists and economists care about $EFFICIENCY_{it}$, $FSALPHA_{it}$, and $FSBETA_{it}$, in line with the theories of both C&R and F&S. However, even though both economists and non-economists care about efficiency and differences in payoffs from being both ahead and behind in the distribution, it appears that there are still differences in preferences between the two groups for which cannot be accounted for by $EFFICIENCY_{it}$, $FSALPHA_{it}$, and $FSBETA_{it}$. A test of 2 times the difference between the log-likelihoods from the individual regressions and the combined sample yield a $\chi^2_{(7)} = 50.5842$ (p-value < .0001),[19] showing strong evidence that economists and non-economists have different underlying preferences. However, both groups show efficiency and inequality aversion preferences.

B. Who Exhibits Any Form of Social Preferences

The natural question to ask after testing the different models of social preferences is if there is a group that seems to be more prone to displaying social preferences than others. To do this with our data, we examine who changed their values from the private rounds to the public rounds. If a participant changed their offer in at least one group between the private and public votes where the private values were known, they almost certainly modified their value due to the group setting. We infer that these individuals exhibit some form of social preferences, although we do not hypothesize what type here. We perform a probit analysis, including a constant term, to analyze which variables affect the probability of showing some form of social preferences. We code those who changed their values between the private and public rounds as a 1 and those who did not change their values as a 0. We also code being a female, having ever used an autoclave, having a job or major in an economics or business related field, and being a student as a 1. Table VI contains the results of this estimation[20].

We find no effect that being in an economics related field affects the probability of exhibiting social preferences. Since economics and business backgrounds are highly collinear with science backgrounds, we did not perform the estimation with these two variables together. If we replace economics and business backgrounds with science backgrounds we find almost identical results with science backgrounds not affecting whether or not someone exhibits preferences over others' payoffs. The only variable that has a statistically significant affect on the probability of exhibiting social preferences is being female, which has a positive effect at the $\alpha = .05$ level. Croson and Gneezy (2007) show several instances of differences in social preferences between genders in their survey. Kamas and Preston (2006) also detail several studies where gender affects social preferences. Another excellent survey of the differences between genders in an experimental setting is Eckel and Grossman (1999). Andreoni and Vesterlund (2001) find that in dictator games woman tend to try to equal payoffs while men either act selfishly or selflessly. Dufwenberg and Astri (2005) find evidence consistent with ours finding that in dictator games women tend to give positive amounts more frequently than men. The above finding that females exhibit social preferences more frequently than males should not be surprising.

We also examine if individuals are more likely to exhibit social preferences when they explicitly know the other group members' payoffs compared to the case where individuals are just left to guess what the true payoffs of others are. We do this by analyzing the proportion of times individuals change their offers between the private rounds and public rounds when they knew the private values of the other members of their group to the case when they did not know the private values of the other members of their group.[21] 33.81% of individuals changed their values between the private and public rounds when they did not know the private values of the other members of their group. When individuals knew the private values of the other members of their group, they changed their offer between the private rounds and the public rounds 41.55% of the time. This difference between these two percentages is significant at the 5% level with a p-value of .0480 using a one-sided test of proportions. Thus, it appears that people are more willing to care about other individuals' payoffs when they are explicitly told what they are.

The reason why individuals are more likely to consider other people's payoffs when they are explicitly told to them may be due to people assuming that everyone is like them. However, this is highly unlikely, especially given that the Group 2 participants know the exact distribution of private offers. This difference in behavior may be due to feelings of guilt that occur when an individual does not change their value when they explicitly know others' values that might not occur when they do not know the values because they cannot be 100% certain of the other individuals' payoffs. This may also be due to participants not wanting to put for forth the effort to think about what other individuals' payoffs are and how they want to adjust their values. Both of these cases may suggest that if people do not know what others values are, they are not responsible for the payoffs. This is consistent with the findings of Lazear, Malmendier, and Weber (2006) and Dana, Weber, and Kuang (2007). The difference in behavior when people explicitly know the distribution of payoffs and when they do not is an area of research that we believe still needs to be fully examined.

VI. Economic Efficiency of Majority Rules Voting Increases when Social Preferences are Considered

Understanding individuals' social preferences may also help to make the correct allocation of public goods when using majority rules voting. It has long been known that majority rules voting does not always produce the most efficient outcome (see, Bergstrom, 1979; Goodman and Porter, 1985; Lacy and Niou, 2000; and Tideman and Tullock, 1977; for example). Others have tried to show under what conditions majority rules voting does produce the Pareto Optimal outcome (see, Bowen, 1943; and Nitzan and Paroush, 1982; for example). We consider how individuals who care about the distribution of payoffs, which affects their vote, affects the majority rules voting mechanism.

Incorporating social preferences into economic efficiency calculations appears to improve the probability of achieving the economically efficient outcome in majority rules voting situations. In these experiments, the economically efficient outcome is determined by whether or not the group should drink the cockroach-contaminated water at a given price. At each price, we determine if the total payoff to the group would be higher if the cockroach-contaminated water is consumed or if it is not consumed. If individuals vote in their group with knowledge of other individuals' values and we assume these votes reveal their true preferences in the group and are thus the basis of determining the economically efficient outcome, we say social preferences are incorporated into determining the optimal result. Likewise, if individuals are assumed to vote their own private values in a group setting and these private values reveal their true preferences in a group setting and are thus the basis of determining the economically efficient outcome, we say social preferences are not incorporated into the optimal result.

If social preferences are incorporated into determining the economically efficient outcome, on average, the groups in our experiment will not achieve the economically efficient outcome for only 7.00% of the random prices. In comparison, if social preferences are not incorporated into determining the economically efficient outcome, on average, the groups will not achieve the economically efficient outcome for 9.64% of the random prices[22]. This difference is highly significant using a paired t-test (p = .0002), indicating that the addition of social preferences actually increases the economic efficiency of majority rules voting. Our analysis can be found in Table VII. This result is not driven by the magnitudes of the percentages. For each group, when analyzing whether incorporating social preferences into economic efficiency produces the economically efficient result most frequently, 71 groups produce the economically efficient result more frequently when social preferences are included compared to the 43 groups that produce the economically efficient result more frequently when social preferences are not included. Using a sign test, this result is significant at the $\alpha < .01$ ($p \leq .0004$) level[23].

To verify that this is not just an artifact of the groups the participants saw, we generate all $\binom{139}{3}$ possible groups from our experiments[24]. We then assume that if a participant changed values between the private and any of the public rounds where they knew the other members of their groups values, they have preferences consistent with the estimates of β_{EFF}, $\beta_{FSALPHA}$, and β_{FSBETA} in Formulation 1 from the full model. If we assume that individuals who display social preferences in a group setting vote consistent with these social preferences, out of the 437,989 groups, 264,896 groups achieve the efficient solution more frequently than if everyone had voted their own private values. This is compared to the 125,015 groups that achieve the efficient solution less frequently. Using a sign test, this is significant at the $\alpha<.0001$ level. On average, if individuals vote their private values, they will achieve the inefficient solution 12.51% of the time compared to only 10.26% of the time if individuals vote consistent with the social preferences found in our analysis. This result is highly significant at the $\alpha<.0001$ level using a t-test.

We further analyze how incorporating social preferences into utility improves the efficiency of majority rules voting by generating 437,989, to be consistent with our previous result, voting groups of 3, where each individual's private price is chosen randomly from a uniform distribution on [0,30]. We then assume that each individual has a 55.4% chance of exhibiting social preferences, which is the same as in our experiments. For the individuals who exhibit social preferences, we assume they are of the form that is consistent with the estimates of β_{EFF}, $\beta_{FSALPHA}$, and β_{FSBETA} in Formulation 1 from the full model. Out of the 437,989 groups, 262,793 achieve the efficient solution more frequently when individuals' votes include social preferences. This is compared to the 136,337 groups that achieve the efficient solution more frequently when individuals always vote their own private values. Using a sign test this is significant at the $\alpha<.0001$ level. On average, when individuals vote their own private values, the inefficient outcome will occur 8.34% of the time. However, when social preferences are included, the inefficient outcome will occur on average only 5.83% of the time. This is significant at the $\alpha<.0001$ level using a t-test. If we use a normal distribution with a mean of 8.239 and a standard deviation of 10.7478, as we had in our experiments, where we truncate any random draw above \$30 to be equal to \$30 and any random draw below \$0 to be equal to \$0, including social preferences in the efficiency calculation will result in the more efficient result

266,294 times and the more inefficient result 128,323 times. On average, when individuals vote their own private values, they will achieve the inefficient solution 8.42% of the time compared to the 5.98% if social preferences are included. These are both significant at the $\alpha<.0001$ level using a sign-test and a t-test, respectively.

VII. Conclusion

The vast majority of evidence in the experimental laboratory and the laboratory of the world we live in shows that people care about others. Not only do people care about others, but they seem to care about others in more than one way. Thus, any test of the social preference theories should not necessarily put the social preference theories at odds with one another, but should test whether any of the theories work in conjunction with one another. Our analysis is able to do this because of the continuous nature of the data and the ability of the participants to pick their optimal distribution of payoffs.

We do this with a real commodity that is emotionally charged, cockroach-contaminated water. Using this commodity extends a meaningful chance for people to show if they truly care about others payoffs. We conducted our experiments with staff members at Cornell University, who are more attractive to use as participants compared to economics and business undergraduate students because they are more representative of the population as a whole. Testing the models together we find strong evidence for the efficiency motives and for both forms of the Fehr and Schmidt (1999) inequality aversion model, which we are able to separate. We do not find evidence for the Bolton and Ockenfels (2000) model. While it appears that individuals care about the worst off person in their group, this preference seems to come through the combination of the efficiency, maximizing one's own personal payoff, and being averse to any payoff that is lower than ones' own. These results are consistent regardless if we use individuals with business and economics backgrounds or if we use individuals from different fields, which have been hypothesized to be a determinant of what motives affect behavior.

Human beings are complex species and thus their motives should be considered to be equally complex. The social preference theories should not be in competition with one another, rather they should be tested in conjunction with one another to see which ones truly affect human behavior. Our results show that it is important to consider all of the motives individuals might possess. Since almost all of the social preference theories are closely related, leaving out some of the motives might lead to erroneous results.

We test to see what factors help to determine if an individual will have preferences beyond straight selfishness. The only determinate that seems to be correlated with caring about other individuals' payoffs is gender. Females are much more likely to change their values in a group setting from what they were in a private setting. Factors such as age and economics or science backgrounds, seem to have no affect. It may be that those who did not change their values are showing some sort of paternalistic altruism because they believe they are helping others out by not changing their value. Those participants with $\lambda_i = 0$, for example, may know that drinking the cockroach-contaminated water will not be hurtful and will only result in a higher monetary payoff. Therefore, not changing one's offer may be a form of caring for others since they are trying to increase the monetary payoffs of everyone. Paternalistic altruism is an area of research that needs much more consideration.

Beyond paternalism, individuals seem to care less about others' payoffs when they are not explicitly told what they are. They may know that there are payoff differences, but unless the payoffs are explicitly told to them, they seem less likely to have preferences that are consistent with changing their own personal value. This may be due to not wanting to move others' payoffs in the wrong direction in the event the decision maker may have approximated others' payoffs incorrectly. It may also be that there is some sort of guilt involved in not accounting for others' payoffs when one is told what they are, but this guilt may be far less prevalent if one can claim they did not know. Much work still needs to be done to see under what conditions individuals show social preferences and under what conditions they do not.

There is a large body of evidence from multiple games as described by F&S, B&O, and C&R that individuals do care about other people's payoffs and are willing to let this affect their own personal payoff when making decisions. Therefore, it only makes sense that individuals will exhibit their social preferences in majority rules voting scenarios. If individuals are voting consistent with their true valuations, which are consistent with their social preferences, then determining when the economically efficient outcome occurs should be based off of individuals' values inclusive of their social preferences. As we have shown, when individuals' social preferences are taken into account, the efficient solution occurs significantly more often than when considering individuals' private selfish payoff. This increase in economic efficiency should be encouraging given the multitude of pubic goods decisions that are decided by majority rules voting.

Appendix A

Sample Instructions – (Part A)-Group 1

This is an experiment in the economics of decision making. In the course of the experiment, you will have opportunities to earn money. Any money earned during this experiment is yours to keep. It is therefore important that you read these instructions carefully. Please do not communicate with other participants during the experiment. As stated in the Consent Form, which you signed, your participation in this experiment is voluntary. Therefore, you are welcome to leave at any point; however, if you leave you will also forfeit all of your earnings to that point except the show up fee of $20.00 which everyone will receive.

In today's experiment, you will be asked to indicate the lowest amount of money you would accept as compensation and still vote in favor of different programs, as will be explained below. In the first part of the experiment, a program is simply a distribution of monetary loss. As you will see, the amount that you indicate will become a vote in favor or against the program and will determine whether the program is implemented. The procedures that will be followed are the same for all programs. However, each program and vote is independent from the other.

In each program, you may be the only voter or you may be part of a group of three voters.

First, you and everyone else in your group will receive an initial balance of $10.00. You will then be informed of your personal loss amount for this program. Your personal loss amount is the amount of money that you will lose if the program is implemented. The personal loss amounts will vary during the course of the experiment. The possible amounts will be $6, $15, and $24. For programs where the group size is three, the personal loss amounts for the other voters in your group, which will likewise be $6, $15, or $24, will be indicated on your computer screen.

You will then be asked to determine the lowest amount that you would accept as compensation and still vote in favor of this program; we will call this your offer. For each program, you can offer any amount between $0.00 and $30.00. Once you have decided your offer, you will submit it by typing in the amount into the spreadsheet, pressing the "Enter" key, and then clicking on the "Submit" button.

The compensation for the program will be determined by reading off four numbers from a random number table. The starting number will be determined by dropping an uncapped pen tip down onto a random number table. (If more than one mark occurs from the drop, then the one closest to the upper-left corner will be used.) The numbers will then be read from left to right on the table. The first two numbers will represent the dollar amount. The third number will represent the dime amount. The forth number will represent the penny amount. Together, the four numbers will form a compensation amount between $0.00 and $29.99. Note: since these numbers have been generated by a random number table each compensation amount between $0.00 and $29.99 is equally likely.

Whether or not the programs are implemented depends on your offer, the offers by the other members of your group, and the compensation of the particular program. There are two possible outcomes:

The program is IMPLEMENTED: The program is implemented if a majority of offers from your group are less than or equal to the compensation determined from the random number table. In this case, you and every other member of your group will receive the determined compensation in addition to the initial balance. However, everyone will also have to pay their personal loss amount. Therefore, your earnings for this portion of the experiment would be the initial balance ($10.00) plus the compensation minus your personal loss amount.

The program is NOT IMPLEMENTED: The program is not implemented if the majority of the offers from your group are greater than the compensation determined from the random number table. In this case, neither you nor any member of your group will receive the random compensation nor pay your personal loss amount. Therefore, your earnings for this portion of the experiment would simply be your initial balance of $10.00.

Note how your offer is like a vote for or against implementing the program. With your offer, you are indicating and submitting the lowest amount of compensation you would accept and still vote for the program. Therefore, your offer is like a vote in favor of the program if your offer turns out to be less than or equal to the randomly determined compensation. On the other hand, your offer is like a vote against the program if your offer turns out to be more than the compensation. In the programs in which you are the only voter, you are in a group of one, your offer will determine whether the program is implemented or not.

Calculation of Your Earnings

While your offer helps determine whether the program is implemented or not, your earnings for a particular program are based on your initial balance, your personal loss amount, the determined compensation, and whether the majority of offers are greater than or less than the determined compensation.

Once everyone in the experiment has submitted their offers and the compensation has been determined, the administrator will advise you to click the “Update” button. You will then learn whether the program was implemented and your earnings will be calculated. The computer will add up your experimental earnings from all of the programs and convert this amount to US dollars by applying an exchange rate of one US dollar in exchange for thirty-three experimental dollars. For example, if you earn 99 experimental dollars, your monetary payoff from this part of the experiment would be $3.

Notice in front of you is a plastic cup full of water. Please feel free to drink as much of this water as you desire during the experiment. If you need more water at anytime, please raise your hand and we will provide you with more.

It is important that you clearly understand these instructions.
Please raise your hand if you have any questions.
Please do not talk with other participants in the experiment.

Sample Instructions – (Part B)-Group 1

At the end of part of Part C of the experiment everyone will be asked to drink from an additional three-ounce Dixie cup of water.

In this part of the experiment you will be asked to indicate the lowest amount of compensation you would accept in order to drink water from a three-ounce Dixie (or Solo, which we will call Dixie from now on) cup. However, in some cases the water will be modified. The modifications to the water include:

No Modification – In this case, you will be asked to drink Poland Spring water from a three-ounce Dixie cup. This water is identical to the water you have previously had on your desk in Part A. This water is in the pitcher labeled “SW” at the front of the room. According to the company:

> Poland Spring® Natural Spring Water comes from protected sources deep in the woods of Maine.

Sterilized Cockroach Dipped – In this case, you will be asked to drink Poland Spring Water from a three-ounce Dixie cup that has had a sterilized dead cockroach dipped into it and then removed. This water is in the pitcher labeled "CW" that is in the front of the room. Note that this cockroach has been subjected to steam sterilization in an autoclave. An autoclave is a pressurized steam-heated vessel that is typically used to sterilize surgical materials and laboratory instruments. Sterilization is defined as the complete destruction of all forms of microbial life, including bacterial spores. Therefore, you can expect the cockroach to be as sterile as a surgical instrument. According to the manufacturer (Getinge):

> Getinge's steam sterilizers represent the most comprehensive range of general purpose, high performance sterilizers available. They are designed for sterilizing a broad spectrum of materials involved in industrial processing, research and development, and quality control.

The cockroach was in the autoclave for 30 minutes at settings of 15 psi of pressure and 121 degrees C.

Sterilized Cockroach Dipped and then Filtered – In this case, you will be asked to drink Poland Spring Water from a three-ounce Dixie cup that has had a sterilized dead cockroach dipped into it. Additionally, this water will have been put through a Mountain Safety Research (MSR) "Sweetwater Microfilter" commonly used while camping. This water is in the pitcher labeled "FW" at the front of the room. According to MSR:

> The Sweetwater Microfilter eliminates over 99.9999% of all waterborne bacteria and 99.9% of common protozoan parasites such as Giardia and Cryptosporidium.

The procedures in Part B are similar to the ones used in Part A, except for two important differences. First, there are only three programs, one for each modification of the water. There will be an additional five programs in Part C. Only one of these eight programs will be selected and result in cash earnings and drinking of the water. All offers will be submitted prior to determination of which program will be selected. At the conclusion of the experiment, the program will be determined by having a volunteer subject draw from a bag containing eight chips, lettered A through H, which correspond to each of the programs. Second, for the program that generates cash earnings, the exchange rate will be one US dollar in exchange for one experimental dollar. For example, if you earn 12.25 experimental dollars in the second part of the experiment, your monetary payoff would be $12.25.

For each program, the experiment proceeds as follows:

You and every other member of your group will receive an initial balance of $10.00. For each program, once you have decided your offer, you will submit it by typing in the amount into the spreadsheet, pressing the “Enter” key, and then clicking on the “Submit” button. Again, you can offer any amount between $0.00 and $30.00.

Note, if you want to guarantee that you do not drink the water in the private case, you can submit an amount of $30.00, which ensures that you will not have to drink the water. Likewise, if you want to guarantee that you will receive the compensation (and drink the water) you can submit an amount of $0.00.

While we will not select the program until the end of the experiment, please note that the compensation for drinking the water will be determined in the same manner as in Part A using a new random number table. However, the compensation for drinking the water will now be received by each person in your group if the program is chosen.

Whether or not a program is implemented (i.e., whether the modified glass of water is drunk) depends on the offers by the members of your group and the compensation for drinking that particular glass of water. There are two possible outcomes:

The program is IMPLEMENTED: The program is implemented if a majority of offers from your group are less than or equal to the compensation determined from the random number table. In this case, you and every other member of your group will receive the determined compensation for the program in addition to your initial balance. Everyone will also have to drink the water that is associated with the chosen program from a three-ounce Dixie cup. Therefore, your earnings for Part B and Part C together would be the initial balance ($10.00) plus the compensation and you will drink the water associated with the chosen program from a three-ounce Dixie cup.

The program is NOT IMPLEMENTED: The program is not implemented if the majority of the offers from your group are greater than the compensation determined from the random number table. In this case, neither you nor any member of your group will receive the random compensation nor will you drink the modified water. Therefore, your earnings for Part B and Part C together would simply be the initial balance of $10.00. If the program is NOT implemented, we will ask you to drink the water you were drinking in Part A, which has NOT been modified in any way, from a three-ounce Dixie cup.

The programs in which you are a group of one, are identical to the programs you experienced in the first part of the experiment. Therefore, the program is not implemented if your offer is greater than the compensation determined from the random number table, and the program is implemented if your offer is equal to or less than the determined compensation. In Part B, you will only be in a voting group of 1.

Note once again how your offer is like a vote for or against implementing the program. With your offer, you are writing down the lowest amount of compensation you would accept and still vote for the program. Therefore, your offer is like a vote in favor of the program if your offer turns out to be equal to or less than the randomly determined compensation. On the other hand, your offer is like a vote against the program if your offer turns out to be more than the randomly determined compensation. When a majority of offers are equal to or less than the determined compensation, this translates into a majority vote in favor of the program. Similarly, when a majority of offers are greater than the determined compensation this translates into a majority vote against the program for that compensation.

After having collected everyone’s offers for each of the eight programs we will randomly choose which program to implement as explained above. Then everyone will drink water from a three-ounce Dixie cup. If the program is implemented, you will drink the water associated with the chosen program from a three-ounce Dixie cup. If the program is not implemented, you will drink non-modified water from a three-ounce Dixie cup. Therefore, some people may be drinking modified water and some people may be drinking non-modified water. To make sure there is no confusion, we will put the modified water in one color of cup and the non-modified water in another color of cup. After you personally receive your Dixie cup, please wait to drink until everyone has received his or hers. Then everyone will drink his or her water simultaneously when instructed.

When you have finished Part B, please wait to be instructed before moving onto Part C.

Please remember, as was stated in the Consent Form, at any point in time if you do not want to continue participating in this experiment, you are free to leave. If you choose to leave, please raise your hand. If you do not fully complete the experiment, including drinking the cup of water, you will forfeit any earnings made in the experiment and will leave with $20 for having attended the experiment.

It is important that you clearly understand these instructions.
Please raise your hand if you have any questions.
Please do not talk with other participants in the experiment.

Sample Instructions – (Part C)-Group 1

In this part of the experiment, the members of your group may have changed. Otherwise Part C is exactly the same as Part B, except you will be only submitting offers for the CW. Also, before you submit your offers in Part C for programs E through H, you will know the offers that the other members of your new group submitted for the CW in Part B, which will be shown on your computer screen. Then, as in Part B, you will be asked to indicate the lowest amount of compensation you would accept in order to drink the CW from a three-ounce Dixie cup.

For each program, the experiment proceeds as follows:

You and every other member of your group will receive an initial balance of $10.00. For each program, once you have decided your offer, you will submit it by typing in the amount into the spreadsheet, pressing the “Enter” key, and then clicking on the “Submit” button. Again, you can offer any amount between $0.00 and $30.00.

After submitting your offer for each program, please wait until you are instructed to go onto the next program. To do so, press the “Retrieve Offers” button to see the offers of the members of your group. The members of your group may different for each of the treatments E through H. In treatment D, you will not know the previous offers of the members in your group.

After all offers are submitted, the program will be determined by having a volunteer subject draw from a bag containing eight chips, lettered A through H, which correspond to each of the programs. For the program that generates cash earnings, the exchange rate will be one US dollar in exchange for one experimental dollar.

Please remember, as was stated in the Consent Form, at any point in time if you do not want to continue participating in this experiment, you are free to leave. If you choose to leave, please raise your hand. If you do not fully complete the experiment, including drinking the cup of water, you will forfeit any earnings made in the experiment and will leave with $20 for having attended the experiment.

Calculation of Final Earnings

To calculate your earnings from Parts A, B & C, the administrator will inform you when to click the “Update” button. We will audit the spreadsheets to ensure accuracy.

Appendix B

Sample Instructions – (Part A)-Group 2

Welcome to an experiment in the economics of decision making. In the course of the experiment, you will have opportunities to earn money. Any money earned during this experiment is yours to keep. Therefore it is important that you read these instructions carefully. Please do not communicate with other participants during the experiment. As stated in the Consent Form, which you signed, your participation in this experiment is voluntary. Therefore, you are welcome to leave at any point; however, if you leave you will also forfeit all of your earnings to that point except the show up fee of $20.00 that everyone will receive.

In this experiment, you will be asked to indicate the lowest amount of money you would accept as compensation and still vote in favor of different situations. We will call the lowest amount of money you would accept as compensation your offer. The procedures that will be followed will be the same for each vote you make and each vote is independent from all other votes. You may be the only voter or you may be part of a group of three voters.

In Part A of the experiment, for each vote, you and everyone else in your group will receive an initial balance of $10.00. You will then be informed of your personal loss amount. Your personal loss amount is the amount of money you will lose if your offer turns out to be greater than the random compensation to be selected, as will be explained below. The personal loss amounts will vary during the course of the experiment. The possible amounts will be $6, $15, and $24. When the group size is three, the personal loss amounts for the other voters in your group, which will likewise be $6, $15, or $24, will be indicated on your computer screen.

You will then be asked to determine the lowest amount of money that you would accept as compensation and still vote in favor of losing this personal loss amount. For each personal loss amount, you can offer any amount between $0.00 and $30.00. Once you have decided your offer, you will submit it by typing in the amount into the spreadsheet, pressing the “Enter” key, and then clicking on the “Submit” button.

The compensation will then be determined by reading off numbers from a random number table. The compensation amount will be between $0.00 and $29.99. Since these numbers have been generated by a random number table each compensation amount between $0.00 and $29.99 is equally likely. The starting number will be determined by dropping an uncapped pen tip down onto a random number table. If more than one mark occurs from the drop, then the one closest to the upper-left corner will be used. The numbers will then be read from left to right on the table.

The cash earnings for each vote will be determined by your offer, the offers by the other members of your group, and the compensation of the particular situation. There are two possible outcomes:

If a majority of offers from your group are less than or equal to the compensation determined from the random number table, you and every other member of your group will receive the determined compensation in addition to the initial balance. However, everyone will also have to pay his or her personal loss amount. Therefore, your earnings will be the initial balance ($10.00) plus the compensation minus your personal loss amount.

If the majority of the offers from your group are greater than the compensation determined from the random number table, neither you nor any member of your group will receive the random compensation nor pay your personal loss amount. Therefore, your earnings will simply be your initial balance of $10.00.

For the first several personal loss amounts you are presented, you will be in a voting group of one.

After everyone has submitted their offers for the vote and the compensation amount has been determined, the administrator will display all of the offers on the screen in the front of the room. These offers will be displayed anonymously from lowest to highest and no subject numbers will be associated with these offers. The administrator will then ask all the participants the following questions:

1) Can you identify your offer?
2) Which subjects lost their personal loss amount?
3) How much will these subjects be compensated and how much will they earn in this round?
4) How much will the subjects who did not lose their personal loss amounts earn in this round?
5) Did anyone see any offer that someone might regret and why?

Calculation of Your Earnings

The administrator will advise you when to click the "Update" button. You will then learn whether you lost your personal loss amount and your earnings will be calculated. The computer will add up your experimental earnings from each vote and convert this amount to US dollars by applying an exchange rate of one US dollar in exchange for twenty-five experimental dollars. For example, if you earn 75 experimental dollars, your monetary payoff from this part of the experiment will be $3.

Notice in front of you is a bottle of water. Please feel free to drink as much of this water as you desire. If you need more water at anytime, please raise your hand and we will provide you with more.

It is important that you clearly understand these instructions.
Please raise your hand if you have any questions.
Please do not talk with other participants in the experiment.

Sample Instructions – (Part B)-Group 2

At the end of the experiment everyone will be asked to drink from an additional three-ounce Dixie cup of water.

In this part of the experiment you will be asked to indicate the lowest amount of compensation you would accept in order to drink Poland Spring Water (just like you had in front of you in Part A) from a three-ounce Dixie (or Solo, which we will call Dixie from now on) cup. However, the water will be modified.

The procedures in Part B are similar to the ones used in Part A, except for two important differences. First, there are only two votes. There will be an additional five votes in Part C. Only one of these seven votes will be selected and result in cash earnings and drinking of water. All offers will be submitted prior to the determination of which vote will be selected. At the conclusion of the experiment, the vote will be determined by having a volunteer subject draw from a bag containing seven chips, lettered A through G, which correspond to each of the votes. Second, for the vote that generates cash earnings, the exchange rate will be one US dollar in exchange for one experimental dollar. For example, if you earn 12 experimental dollars in the second part of the experiment, your monetary payoff will be $12.

Sterilized Cockroach Dipped – The water has been modified by dipping a sterilized dead cockroach into it and then removing it. Cockroaches have been known to carry, transmit, or cause gastroenteritis, salmonella, staphylococcus, streptococcus, allergies, and the polio virus. This water is in the pitcher labeled “CW” that is in the front of the room. Note that this cockroach has been subjected to steam sterilization in an autoclave. An autoclave is a pressurized steam-heated vessel that is typically used to sterilize surgical materials and laboratory instruments. Sterilization is defined as the complete destruction of all forms of microbial life, including bacterial spores. Therefore, you can expect the cockroach to be as sterile as a surgical instrument. According to the manufacturer (Getinge):

> Getinge’s steam sterilizers represent the most comprehensive range of general purpose, high performance sterilizers available. They are designed for sterilizing a broad spectrum of materials involved in industrial processing, research and development, and quality control.

The cockroach was in the autoclave for 30 minutes at settings of 15 psi of pressure and 121 degrees C.

After we have received everyone’s offer, we will then display all of the offers anonymously from lowest to highest at the front of the classroom. After everyone has seen everyone else’s offer we will ask you to submit your offer for the modified water again. You may change your offer from the first vote to the second vote.

For each vote, the experiment proceeds as follows:

You and every other member of your group will receive an initial balance of $10.00. For each vote, once you have decided your offer, you will submit it by typing in the amount into the spreadsheet, pressing the “Enter” key, and then clicking on the “Submit” button. Again, you can offer any amount between $0.00 and $30.00.

Note, if you want to guarantee that you do not drink the water in Part B, you can submit an amount of $30.00, which ensures that you will not have to drink the water. Likewise, if you want to guarantee that you will receive the compensation (and drink the water) you can submit an amount of $0.00.

While we will not select the vote that will result in the drinking of the water and actual cash earnings until the end of the experiment, the compensation for drinking the water will be determined in the same manner as in Part A using a new random number table.

Whether the modified cup of water is drunk depends on your offer, the offers by the members of your group, and the compensation for drinking that particular glass of water. There are two possible outcomes:

If a majority of offers from your group are less than or equal to the compensation determined from the random number table, you and every other member of your group will receive the determined compensation in addition to your initial balance. Everyone will also have to drink the water associated with the chosen vote. Therefore, your earnings for Part B and Part C together will be the initial balance ($10.00) plus the compensation and you will drink the water associated with the chosen vote.

If the majority of the offers from your group are greater than the compensation determined from the random number table, neither you nor any member of your group will receive the random compensation nor will you drink the water. Therefore, your earnings for Part B and Part C together will simply be the initial balance of $10.00. We will ask you to drink the

Poland Spring Water you were drinking in Part A, which has NOT been modified in any way, from a three-ounce Dixie cup.

The votes in which you are a group of one, are identical to the votes you experienced in the first part of the experiment. Therefore, the water is not drunk if your offer is greater than the compensation determined from the random number table, and the CW is drunk if your offer is less than or equal to the determined compensation. In Part B, you will only be in a voting group of one.

After having collected everyone's offers for each of the seven votes we will randomly choose which vote is selected as explained above. Then everyone will drink water from a three-ounce Dixie cup. Therefore, some people may be drinking modified water and some people may be drinking non-modified water. To make sure there is no confusion, we will put the modified water in one color of cup and the non-modified water in another color of cup. After you personally receive your cup, please wait to drink until everyone has received his or hers. Then everyone will drink his or her water simultaneously when instructed.

When you have finished Part B, please wait to be instructed before moving onto Part C.

Please remember, as was stated in the Consent Form, at any point in time if you do not want to continue participating in this experiment, you are free to leave. If you choose to leave, please raise your hand. If you do not fully complete the experiment, including drinking the cup of water, you will forfeit any earnings made in the experiment and will leave with $20 for having attended the experiment.

It is important that you clearly understand these instructions.
Please raise your hand if you have any questions.
Please do not talk with other participants in the experiment.

Sample Instructions – (Part C)-Group 2

In this part of the experiment, the members of your group may have changed. Otherwise Part C is exactly the same as Part B. Also, before you submit your offers in Part C you may know the offers of the members of your group from the last vote in Part B, which will be shown on your computer screen. Then, as in Part B, you will be asked to indicate the lowest amount of compensation you would accept in order to drink the water.

For each vote, the experiment proceeds as follows:

You and every other member of your group will receive an initial balance of $10.00. For each vote, once you have decided your offer, you will submit it by typing in the amount into the spreadsheet, pressing the "Enter" key, and then clicking on the "Submit" button. Again, you can offer any amount between $0.00 and $30.00.

After submitting your offer for each vote, please wait until you are instructed to go onto the next vote. To do so, press the "Retrieve Offers" button to see the offers of the members of your group. The members of your group may be different for each of the votes C through G. In at least one vote, you will not know the previous offers of the members in your group.

After all offers are submitted, the vote that will result in drinking of the water and actual cash earnings will be determined by having a volunteer subject draw from a bag containing seven chips, lettered A through G, which correspond to each of the votes. For the vote that generates cash earnings, the exchange rate will be one US dollar in exchange for one experimental dollar.

Please remember, as was stated in the Consent Form, at any point in time if you do not want to continue participating in this experiment, you are free to leave. If you choose to leave, please raise your hand. If you do not fully complete the experiment, including drinking the cup of water, you will forfeit any earnings made in the experiment and will leave with $20 for having attended the experiment.

Calculation of Final Earnings

To calculate your earnings from Parts A, B, & C, the administrator will inform you when to click the “Update” button. We will audit the spreadsheets to ensure accuracy.

It is important that you clearly understand these instructions.
Please raise your hand if you have any questions.
Please do not talk with other participants in the experiment.

Appendix C

Proof of Proposition 1. Maximizing utility is equivalent to equating the utility when the cockroach-contaminated water is drunk to the utility when the cockroach-contaminated water is not drunk, so that $E(U_{it}(\bar{\phi}_{it};\kappa_i,\lambda_i,\lambda_{-i},\omega \mid \phi_{it} \le \psi)) = E(U_{it}(\bar{\phi}_{it};\kappa_i,\lambda_i,\lambda_{-i},\omega \mid \phi_{it} > \psi))$, where ψ is the randomly chosen compensation, such that if $\phi_{it} > \psi$, each individual *i* in group *t* will neither receive ψ nor suffer a loss of λ_i. From this one can solve for the optimal ϕ_{it}. Recalling that

$$\begin{aligned}\mathrm{U}_{it}(\pi;\beta) = {} & \pi_{it} + \beta_{EFF} * \sum_{i=1}^{n} \pi_{it} + \beta_{MAXIMIN} * \min_i(\pi_{it},...,\pi_{nt}) + \beta_{FSA} * \tfrac{1}{n-1} \sum_{l \ne i}^{n} \max(\pi_{lt} - \pi_{it}, 0) + \\ & \beta_{FSB} * \tfrac{1}{n-1} \sum_{l \ne i}^{n} \max(\pi_{it} - \pi_{lt}, 0) + \beta_{ERC} * 1000 * \left(\tfrac{1}{n} - \tfrac{\bar{\pi}_{it}}{\sum_{i=1}^{n} \bar{\pi}_{it}}\right)^2 .\end{aligned}$$

One can solve for the unique optimal ϕ_{it} since U_{it} is strictly increasing in the necessitated minimum compensation, $\frac{\partial U_{it}}{\partial \phi_{it}} = 1 + 3\beta_{EFF} + \beta_{MAXIMIN}$. Thus,

$$\begin{aligned} & \pi_{it} + \beta_{EFF} * \sum_{i=1}^{n} \pi_{it} + \beta_{MAXIMIN} * \min_i(\pi_{it},...,\pi_{nt}) + \beta_{FSA} * \tfrac{1}{n-1} \sum_{l \ne i}^{n} \max(\pi_{lt} - \pi_{it}, 0) + \\ & \beta_{FSB} * \tfrac{1}{n-1} \sum_{l \ne i}^{n} \max(\pi_{it} - \pi_{lt}, 0) + \beta_{ERC} * 1000 * \left(\tfrac{1}{n} - \tfrac{\bar{\pi}_{it}}{\sum_{i=1}^{n} \bar{\pi}_{it}}\right)^2 \\ & = (\omega + \kappa) + \beta_{EFF} * \sum_{i=1}^{n} (\omega + \kappa) + \beta_{MAXIMIN} * \min_i((\omega+\kappa),...,(\omega+\kappa)).\end{aligned}$$

Solving through for the optimal price yields

$$\begin{aligned}\bar{\phi}_{it} = {} & ((1+\beta_{EFF}) * \lambda_i + \beta_{EFF} * \sum_{l \ne i}^{n} \lambda_l + \beta_{MAXIMIN} * \max_i(\lambda_1,...,\lambda_n) - \beta_{FSA} * \frac{1}{n-1} \sum_{l \ne i}^{n} \max(\lambda_i - \lambda_l, 0) \\ & - \beta_{FSB} * \frac{1}{n-1} \sum_{l \ne i}^{n} \max(\lambda_l - \lambda_i, 0) - \beta_{ERC} * 1000 * \left(\tfrac{1}{n} - \tfrac{\bar{\pi}_{it}}{\sum_{i=1}^{n} \bar{\pi}_{it}}\right)^2) / (1 + n * \beta_{EFF} + \beta_{MAXIMIN}).\end{aligned}$$

The same reasoning applies to all of the ERC_{it}, $FSALPHA_{it}$, and $FSBETA_{it}$ formulations.

Proof of Proposition 2. Assume individual i believes that for all $j \neq i$ other members in their group, each will offer $\lambda_j + \varepsilon_{jt}$, where ε has some continuously differentiable distribution, $G(X)$, such that $G'(X) = g(x) > 0$ for all x. Then individual i can calculate the probability that they will be the median voter, $p(\phi_{(n-1)/2,t} < \phi_{i,t} < \phi_{(n+1)/2,t})$, where $\phi_{(n-1)/2,t}$ and $\phi_{(n+1)/2,t}$ are the (n-1)/2 and (n+1)/2 highest offers, respectively, in group t excluding the offer of individual i. Since $g(x) > 0$ for all x, $q(\phi_{(n-1)/2,t} < \phi_{i,t} < \phi_{(n+1)/2,t}) = \varsigma_{it} > 0$. Therefore, individual i places some positive probability on being the median voter. Let υ_{it} be i's expected payoff if they are not the median voter. Let $p(\theta)$ be the probability density function of the randomly drawn compensation, such that $\theta \in [\psi_{\min,}\psi_{\max}]$, where $\psi_{\min}$ is the smallest possible compensation and $\psi_{\max}$ is the largest possible compensation. Recalling that preferences are of the form

$$\mathrm{U}_{it}(\pi;\beta)=u(\pi_{it} + \beta_{EFF} * \sum_{i=1}^{n} \pi_{it} + \beta_{MAXIMIN} * \min_{i}(\pi_{it},...,\pi_{nt}) + \beta_{FSA} * \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{lt} - \pi_{it}, 0) + \beta_{FSB} * \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{it} - \pi_{lt}, 0) + \beta_{ERC} * 1000 * (\tfrac{1}{n} - \frac{\bar{\pi}_{it}}{\sum_{i=1}^{n} \bar{\pi}_{it}})^2),$$

individual i chooses their offer, ϕ_{it}, to

$$\underset{\phi_{it}}{Maximize}\ \varsigma_{it} (\int_{\psi_{\min}}^{\phi_{(n-1)/2,t}} p(\theta)(u(\pi_{it} + \beta_{EFF} * \sum_{i=1}^{n} \pi_{it} + \beta_{MAXIMIN} * \min_{i}(\pi_{it},...,\pi_{nt}) +$$
$$\beta_{FSA} * \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{lt} - \pi_{it}, 0) + \beta_{FSB} * \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{it} - \pi_{lt}, 0) + \beta_{ERC} * 1000 * (\tfrac{1}{n} - \frac{\bar{\pi}_{it}}{\sum_{i=1}^{n} \bar{\pi}_{it}})^2)) +$$
$$\int_{\phi_{(n-1)/2,t}}^{\phi_{it}} p(\theta)(u(\pi_{it} + \beta_{EFF} * \sum_{i=1}^{n} \pi_{it} + \beta_{MAXIMIN} * \min_{i}(\pi_{it},...,\pi_{nt}) + \beta_{FSA} * \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{lt} - \pi_{it}, 0) +$$
$$\beta_{FSB} * \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max(\pi_{it} - \pi_{lt}, 0) + \beta_{ERC} * 1000 * (\tfrac{1}{n} - \frac{\bar{\pi}_{it}}{\sum_{i=1}^{n} \bar{\pi}_{it}})^2)) + \int_{\phi_{it}}^{\phi_{(n+1)/2,t}} p(\theta)(u((\omega + \kappa) +$$
$$\beta_{EFF} * \sum_{i=1}^{n} (\omega + \kappa) + \beta_{MAXIMIN} * \min_{i}((\omega + \kappa),...,(\omega + \kappa)) + \beta_{FSA} * \tfrac{1}{n-1} \sum_{l \neq i}^{n} \max((\omega + \kappa) - (\omega + \kappa), 0) +$$

$$\beta_{FSB} * \tfrac{1}{n-1}\sum_{l\neq i}^{n}\max((\omega+\kappa)-(\omega+\kappa),0)+\beta_{ERC} *1000*(\tfrac{1}{n}-\tfrac{\omega+\kappa}{\sum_{i=1}^{n}\omega+\kappa})^{2}))+$$

$$\int_{\phi_{(n+1)/2,t}}^{\psi_{\max}} p(\theta)(u((\omega+\kappa)+\beta_{EFF} *\sum_{i=1}^{n}(\omega+\kappa)+\beta_{MAXIMIN} *\min_{i}((\omega+\kappa),...,(\omega+\kappa))+$$

$$\beta_{FSA} * \tfrac{1}{n-1}\sum_{l\neq i}^{n}\max((\omega+\kappa)-(\omega+\kappa),0)+\beta_{FSB} * \tfrac{1}{n-1}\sum_{l\neq i}^{n}\max((\omega+\kappa)-(\omega+\kappa),0)+$$

$$\beta_{ERC} *1000*(\tfrac{1}{n}-\tfrac{\omega+\kappa}{\sum_{i=1}^{n}\omega+\kappa})^{2})))d\theta+(1-\varsigma_{it})*\upsilon_{it}.$$

Taking the first order condition with respect to ϕ_{it}, noting that $\pi_{it}=\omega+\kappa+\phi_{it}-\lambda_i$, yields

$$u(\pi_{it}+\beta_{EFF} *\sum_{i=1}^{n}\pi_{it}+\beta_{MAXIMIN} *\min_{i}(\pi_{it},...,\pi_{nt})+\beta_{FSA} *\tfrac{1}{n-1}\sum_{l\neq i}^{n}\max(\pi_{lt}-\pi_{it},0)+$$

$$\beta_{FSB} *\tfrac{1}{n-1}\sum_{l\neq i}^{n}\max(\pi_{it}-\pi_{lt},0)+\beta_{ERC} *1000*(\tfrac{1}{n}-\tfrac{\bar{\pi}_{it}}{\sum_{i=1}^{n}\bar{\pi}_{it}})^{2})$$

$$=u((\omega+\kappa)+\beta_{EFF} *\sum_{i=1}^{n}(\omega+\kappa)+\beta_{MAXIMIN} *\min_{i}((\omega+\kappa),...,(\omega+\kappa))).$$

Solving through for the optimal offer yields

$$\overline{\phi_{it}}=((1+\beta_{EFF})*\lambda_i+\beta_{EFF} *\sum_{l\neq i}^{n}\lambda_l+\beta_{MAXIMIN} *\max_{i}(\lambda_1,...,\lambda_n)-\beta_{FSA} *\tfrac{1}{n-1}\sum_{l\neq i}^{n}\max(\lambda_i-\lambda_l,0)-$$

$$\beta_{FSB} *\frac{1}{n-1}\sum_{l\neq i}^{n}\max(\lambda_l-\lambda_i,0)-\beta_{ERC} *1000*(\tfrac{1}{n}-\tfrac{\bar{\pi}_{it}}{\sum_{i=1}^{n}\bar{\pi}_{it}})^{2})/(1+n*\beta_{EFF}+\beta_{MAXIMIN})=$$

$$\underset{\phi_{it}}{Maximize}\;\; u(\pi_{it}+\beta_{EFF} *\sum_{i=1}^{n}\pi_{it}+\beta_{MAXIMIN} *\min_{i}(\pi_{it},...,\pi_{nt})+\beta_{FSA} *\tfrac{1}{n-1}\sum_{l\neq i}^{n}\max(\pi_{lt}-\pi_{it},0)+$$

$$\beta_{FSB} *\tfrac{1}{n-1}\sum_{l\neq i}^{n}\max(\pi_{it}-\pi_{lt},0)+\beta_{ERC} *1000*(\tfrac{1}{n}-\tfrac{\bar{\pi}_{it}}{\sum_{i=1}^{n}\bar{\pi}_{it}})^{2}).$$

which is equivalent to solving for the optimal price when each individual reveals their true value. Note, none of the calculations required that any of the coefficients be not equal to zero. Therefore, we can find an equilibrium with any version of utility that is linear a function of OWN_{it} and any combination of the social preference measures. The same reasoning applies to all of the ERC_{it}, $FSALPHA_{it}$, and $FSBETA_{it}$ formulations. Also, nothing has been assumed about the distribution of the ε 's other than $g(x) > 0$. So the distribution may originate from i 's subjective beliefs about j 's social preferences or any other multitude of reasons. The existence of ε is heavily supported since social preferences are exhibited in numerous situations, such as the consistent high level of giving in dictator games, even under significantly different settings (Forsythe, et al., 1994; Hoffman, et al., 1994; and Hoffman, et al., 1996; for example). To further generalize, if we assume individuals do not believe that ε exists in any capacity, that is individuals believe everyone always offers their private values, offering one's true value is still a weakly dominant strategy.

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[1] Efficiency here solely refers to the sum of the payoffs of the relevant group members. This is not the same concept as Pareto efficiency that economists normally discuss.

[2] C&R extend their model to consider reciprocity. Since B&O state their model is explicitly for one-shot games and F&S claim their model can include intentions, but do not show how to model this, we study only intentions free models. Other models that consider intentions have been theorized. Rabin (1993) models a 2-person normal form game where individuals return kindness for kindness and unkindness for unkindness. Dufwenberg and Kirchsteiger (2004) propose a sequential reciprocity equilibrium for extended form games that may include more than two players. They explicitly note they are disregarding distributional concerns in their analysis. Falk and Fischbacher (2001) model a theory of reciprocity based on kindness and intentions. The F&S model and the B&O model can be incorporated into their model for a particular parameterization. For an overview of fairness and reciprocity work, see Fehr and Schmidt (2001).

[3] For future recruiting purposes, we determined it was better to let the staff members participate twice and not use their second data point than to give the appearance that we were giving a preference to students. We also did not use the data of one individual who worked in the plant science/breeding department where the cockroaches had been autoclaved. This participant told us in the exit questionnaire that he knew of the experiment ahead of time. We excluded him so as not to risk biasing our results.

[4] The range of earnings in Part A of the experiment was $3.59-$9.96. The average earnings for Group 1 was $5.10, the average earnings for Group 2 was $7.60, for a combined total average earnings of $6.36.

[5] While the data on the Poland Spring Water and the filtered cockroach-contaminated water is of interest, we do not proceed to use it in this study. This data can be found in Kerley, Messer, and Schulze (2007) and Kerley, et al., (2007).

[6] The groups were formed to guarantee that each participant saw an adequate amount of variation in their groups. However, care was given to ensure that the groups were created in a nearly random fashion. The groups where the individuals did not know the private values of the other members of their group was done by subject number, which was randomly determined. The other 4 set of groups were formed as follows. The first set of groups was formed to minimize the variance by putting the individuals with the 3 smallest private values in a group, the next 3 individuals with the smallest private values into another group, etc. The next set of groups was formed to maximize the variance by putting the individual with the lowest private value with the individual with the ninth and the individual with the seventeenth lowest values. The individual with the second lowest value was put with the individual with the tenth and the individual with the eighteenth lowest private values, etc. The next set of groups was formed to have asymmetric values. The individual with the lowest private value was placed in a group with the individuals with the two highest private values. The individual with the second lowest private value was placed in a group with the individuals with the next two highest values, etc. The last set of groups was made to have asymmetric values, but in the opposite order. The individuals with the lowest two private values were placed in a group with the individual with the highest private value, and so on. The only difference between Group 1 and Group 2 was that within Group 2 the order of the random groups was switched between experiments, while this did not occur for Group 1. However, the participants never knew how any of the groups were formed.

[7] One of the administrators always drank the cockroach-contaminated water with the participants at the end of the experiment. This was done to assure the safety of the water. This fact was not told to the participants until all of the votes had been collected. While the authors do not encourage the making of one's own cockroach-contaminated water at home, to the interested reader, it tastes exactly like plain Poland Spring Water.

[8] This is the sum of the $20 show-up fee and the $10 endowment given from the randomly chosen round of voting that resulted in the actual drinking of the cockroach-contaminated water and the pecuniary earnings.

[9] As we will show, the inclusion of the endowment and earnings from the practice rounds in the structure of the payoffs only affects the variable ERC in the actual estimation of the coefficients. Since B&O state that their

model is only valid for situations where $\pi_{it} \geq 0$ for all *i* and *t*, and our experiments allow for $\pi_{it} < 0$, we choose to leave ω and κ_i in our formulation to ensure positive payoffs.

[10] The mean absolute deviation from the mean κ for each session in our sample was $.30 with a standard deviation of $.26 and a maximum absolute deviation of $1.46. Thus, we believe this is a reasonable assumption and does not change any of our results.

[11] They choose to use a non-concave version of the ERC variable and define *ERC* as $100^* | \frac{1}{n} - \frac{OWN_{it}}{EFFICIENCY_{it}} |$. However, the concavity is essential to some of B&O's proofs. We will consider the implications of defining the ERC variable as Engelmann and Strobel do.

[12] We will also test two other versions of this variable as robustness checks, and the results on B&O's ERC measure are consistent using these 2 variables as well.

[13] For example, we had 3 individuals change their offer from $0 in the private voting setting to $30 in the public voting setting because one other person in their group had an offer of $30 in the private setting. This means there are individuals who are willing to give up $30 just to help out a completely anonymous individual.

[14] Four degrees of freedom are obtained from the β terms and one degree of freedom each from σ_ε^2 and σ_u^2 since we are using a random effects model.

[15] Formulation 2 yields a $\chi^2_{(6)} = 6.0764$ (p-value = .4147) and Formulation 3 yields a $\chi^2_{(6)} = 5.8076$ (p-value = .4451).

[16] A constant term could be modeled if individuals have a preference for or against making this decision in a group.

[17] A separate attempt at modeling social preferences was done by Andreoni and Miller (2002). They propose a constant elasticity of substitution utility model for two people such that

$U_i(\pi_i, \pi_j; \alpha, \rho) = (\alpha \pi_i^\rho + (1-\alpha)\pi_j^\rho)^{(1/\rho)}$.

Cox and Sadiraj (2007), after analyzing the F&S, B&O, and C&R with variations of the dictator game and conducting indifference curve analysis found significant evidence that the results were not consistent with any of the above models and constructed their egocentric altruism model based on a CES utility function and the work of Andreoni and Miller. They extend and modify their model and allow for $n > 2$. They hypothesize that individuals have a utility function of the form $U_i(\pi_i, ..., \pi_n; \alpha, \theta) = \frac{1}{\alpha}(\pi_i^\alpha + \theta \sum_{j \neq i}^{n} \pi_j^\alpha)$, if $\alpha \in (-\infty, 1) \setminus \{0\}$ and

$U_i(\pi_i, ..., \pi_n; \theta) = \pi_i (\prod_{j \neq i}^{n} \pi_j)^\theta$, if $\alpha = 0$, with parameter restrictions of $\alpha < 1$ and $\theta \in (0,1]$.

Cox, Friedman, and Gjerstad (2007) extend this model for a two-player game where they assume that θ is a function of reciprocity, r, and one's status, s, which is independent of the payoffs in the relevant comparison group. They model, $\theta_i = \theta(r, s) + \varepsilon_i$, where ε_i has the error function distribution. For the case where reciprocity and status do not play a role or are not known, $\theta(r, s) = \overline{\theta}$. Thus, where reciprocity and status do not play a role, their model is essentially Cox and Sadiraj (2007). The main differences between the models is that Cox, Friedman, and Gjerstad (2007) specify the placement and the distribution of the error term while Cox and Sadiraj (2007) do not, and Cox and Sadiraj (2007) requires $\theta \in (0,1]$ while Cox, Friedman, and Gjerstad (2007) allows for $\theta \in (-\infty,\infty)$.

Engelmann and Strobel (2007), propose a utility function that depends on an individual's rank in the distribution. They order the payoffs in ascending order where, the relevant decision maker has a rank of *d*. Individual *d*'s utility function is $U_d(\pi_1,...,\pi_n;\theta^1,...,\theta^n) = u(\pi_d) + \sum_{i=1}^{n}\theta^i\pi_i$, where *u* is concave.

We examined these social preference theories and did not find any compelling evidence supporting any of them. We did this using assuming the errors were normally distributed. However, since certain parameterizations of these models can be incorporated into the B&O, F&S, and C&R models we do not proceed with more analysis of them here.

18 Background information was collected in a survey done after the conclusion of the experiment and a few participants did not answer every question, giving rise to the difference in sample sizes. We do not believe that this omission should be correlated with any of the variables of interest for this analysis.

19 Formulation 2 yields a $\chi^2_{(7)} = 50.2313$ (p-value < .0001) and Formulation 3 yields a $\chi^2_{(7)} = 49.7375$ (p-value < .0001).

20 This estimation does not include any of the individuals who stated that $\lambda_i = 30$ since some of these individuals may have been willing to change their values in the public vote, but the data are not able pick up this change because ϕ_{it} may still be outside of $\phi_{it} \in [0,30]$.

21 Once again, those who indicated a private value of $30 are not included in the analysis because we cannot fully interpret the results.

22 These numbers are based on the groups the participants were shown, provided that no one in the group offered a price of $30. Since there are many groups that consist entirely of individuals who voted $0 in both the public and private settings, the difference between the average percentages should be analyzed and not the percentages by themselves.

23 In real world voting situations, individuals may not know the exact private values of others, but individuals may have some idea of where they rank in the distribution of values. If we test to see if the same pattern holds for the case where the participants know they are in a group but do not know what the exact values of the other individuals in their group are, we find evidence of the same pattern. When including social preferences into economic efficiency, the economically inefficient outcome would occur on average between the groups only 5.90% of the time, whereas the economically inefficient outcome would occur on average between the groups 7.15% of the time if social preferences are not included. While this is not significant at commonly accepted levels using a paired one-tailed t-test ($p \leq .1589$), this is based on only 30 groups, several of which include all three individuals voting $0. Looking at the number of groups, incorporating social preferences yields the economically efficient outcome more frequently than not incorporating social preferences in 14 groups. Not incorporating the social preferences does better in 5 groups. This difference is significant at the $\alpha = .10$ level ($p \leq .0636$) using a sign test.

24 For this analysis, we allow groups to include individuals who indicated a value of $30 in the private rounds.

TABLE I

Determination of the Reservation Price, Random-Effects Tobit Estimates

All Formulations include OWN_{it}

Parameters on each of the Social Preference Measures Determined by the Delta Method

	β_{EFF}	$\beta_{MAXIMIN}$	$\beta_{FSSTRICT}$	β_{ERC}
Formulation 1:				
Group 1	0.6145***	-0.8032**	-0.8788**	0.5411***
	(0.2112)	(0.3650)	(0.4167)	(0.1681)
Group 2	0.4128***	-0.5031**	-0.3677	0.2246***
	(0.1392)	(0.2502)	(0.2571)	(0.0803)
Combined	0.4579***	-0.5550***	-0.4692**	0.3016***
	(0.1120)	(0.1980)	(0.2100)	(0.0726)

Number of Observations = 217, 224, and 441, respectively

Log-Likelihood = -600.61861, -634.0464, and -1238.3141, respectively

Standard Errors are in Parentheses

*** Statistically Significant at the 1-Percent Level; ** Statistically Significant at the 5-Percent Level

TABLE II
Determination of the Reservation Price, Random-Effects Tobit Estimates
All Formulations include OWN_{it}

Parameters on each of the Social Preference Measures Determined by the Delta Method

	β_{EFF}	$\beta_{MAXIMIN}$	$\beta_{FSALPHA}$	β_{FSBETA}	β_{ERC}
Formulation 1	0.2933***	-0.4971***	-0.0219***	-0.0743***	0.5972***
	(0.0949)	(0.1024)	(0.0073)	(0.0095)	(0.0804)
Formulation 2	0.3121***	-0.5132***	-0.0234***	-0.0751***	0.6111***
	(0.0984)	(0.1047)	(0.0075)	(0.0097)	(0.0828)
Formulation 3	0.2954***	-0.4957***	-0.0224***	-0.0747***	0.6036***
	(0.0941)	(0.1005)	(0.0073)	(0.0094)	(0.0801)

Number of Observations = 441
Log-Likelihood = -1214.7158, -1207.2241, and -1205.3712, respectively

Standard Errors are in Parentheses
*** Statistically Significant at the 1-Percent Level

TABLE III
Determination of the Reservation Price, Random-Effects Tobit Estimates
All Formulations include OWN_{it}
Not Including Those Whose Reservation Price Did Not Change Between the Public and Private Rounds
Parameters on each of the Social Preference Measures Determined by the Delta Method

	β_{EFF}	$\beta_{MAXIMIN}$	$\beta_{FSALPHA}$	β_{FSBETA}	β_{ERC}
Formulation 1	0.2602**	-0.1082	-0.0506***	-0.0853***	1.9003***
	(0.1253)	(0.1505)	(0.0157)	(0.0191)	(0.3943)
Formulation 2	0.2892**	-0.0889	-0.0546***	-0.0848***	2.0159***
	(0.1366)	(0.1577)	(0.0173)	(0.0200)	(0.4423)
Formulation 3	(0.2700)**	-0.0628	-0.0530***	-0.0831***	1.9956***
	(0.1306)	(0.1567)	(0.0167)	(0.0197)	(0.4307)

Number of Observations = 252
Log-Likelihood = -705.27056, -699.33318, and -697.9461, respectively

Standard Errors are in Parentheses
*** Statistically Significant at the 1-Percent Level; ** Statistically Significant at the 5-Percent Level

TABLE IV
Testing and Comparing our Model which uses the ERC Measure Found in B&O with the Data and Results Found in Engelmann and Strobel (2004)
Conditional Logit Results

	Odds Ratio Using our Model	Significance (p-value) Using our Model	Odds Ratio Using Engelmann and Strobel's Model	Significance Using Engelmann and Strobel's Model
$\gamma_1(EFF)$	1.351	0.001	1.232	0.012
$\gamma_2(MAXIMIN)$	1.093	0.619	1.492	<0.001
$\gamma_4(FSA)$	1.499	0.018	1.245	0.161
$\gamma_5(FSB)$	1.311	0.356	0.816	0.286
$\gamma_6(ERC_{\text{Using the Measure from B\&O}})$	0.936	0.012		
$\gamma_6(ERC_{\text{Englelmann and Strobel's Measure}})$			0.953	0.078
$\gamma_1(EFF)$	1.307	0.002	1.109	0.026
$\gamma_2(MAXIMIN)$	1.093	0.619	1.492	<0.001
$\gamma_3(OWN)$	1.105	0.678	1.373	0.150
$\gamma_4(FSSTRICT)$	1.402	0.058	1.007	0.937
$\gamma_6(ERC_{\text{Using the Measure from B\&O}})$	0.936	0.012		
$\gamma_6(ERC_{\text{Englelmann and Strobel's Measure}})$			0.953	0.078
$\gamma_1(EFF)$	1.362	<0.001	1.286	<0.001
$\gamma_3(OWN)$	1.035	0.863	1.032	0.862
$\gamma_4(FSSTRICT)$	1.523	<0.001	1.351	<0.001
$\gamma_6(ERC_{\text{Using the Measure from B\&O}})$	0.925	<0.001		
$\gamma_6(ERC_{\text{Englelmann and Strobel's Measure}})$			0.898	<0.001

TABLE V
Determination of the Reservation Price, Random-Effects Tobit Estimates
All Formulations include OWN_{it}

Parameters on each of the Social Preference Measures Determined by the Delta Method

	β_{EFF}	$\beta_{MAXIMIN}$	$\beta_{FSALPHA}$	β_{FSBETA}	β_{ERC}
Formulation 1					
Non-Economists:	0.2684***	-0.4792***	-0.0282***	-0.0914***	0.8420***
	(0.1037)	(0.1108)	(0.0089)	(0.0117)	(0.1203)
Economists:	0.2466**	-0.5544***	-0.0149*	-0.0788***	0.4822***
	(0.1049)	(0.1291)	(0.0081)	(0.0135)	(0.0868)

Number of Observations = 354 and 83, respectively
Log-Likelihood = -969.69114 and -209.52817, respectively

Standard Errors are in Parentheses
*** Statistically Significant at the 1-Percent Level; ** Statistically Significant at the 5-Percent Level; * Statistically Significant at the 10-Percent Level

TABLE VI
Probit Analysis on Factors that Determine if an Individual Exhibits Social Preferences

Female	.7066*
	(.2921)
Age	-.0019
	(.0119)
Have Used an Autoclave	-.1905
	(.2713)
Current Job or Major is in an Econ Related.	-.0045
	(.3063)
Student	.0100
	(.4083)

Standard Errors are in Parentheses, N=122
*Statistically Significant at the 5-Percent Level

TABLE VII
Tests to See if Considering Individual's Social Preferences Improves the Economic Efficiency of Majority Rules Voting

	Groups the Participants Saw	All Possible Groups	Groups Generated from a Uniform Distribution	Groups Generated from a Normal Distribution
# of Groups that did Better when Social Preferences are:				
Taken into Account	71	264,896	262,793	266,294
Not Taken into Account	43	125,015	136,337	128,323
p-value of a sign test	0.0004	<0.0001	<0.0001	<0.0001
Average Percentage of the Time the Inefficient Solution Would Occur when Social Preferences are:				
Taken into Account	7.00	12.51	5.83	5.98
Not Taken into Account	9.64	10.26	8.34	8.42
p-value of paired t-test	0.0002	<0.0001	<0.0001	<0.0001