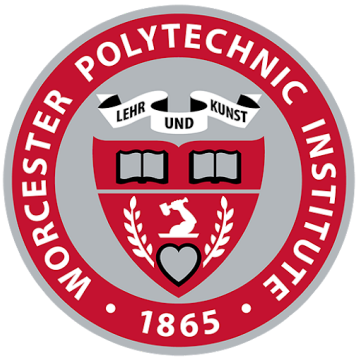

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Analyzing Behavior Across Four Simple Economic Games

A Major Qualifying Project Report

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By:

Morgan Brokaw & Nicol Garcia

Advised By:

Professor Alexander Smith

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Abstract

We present an experiment on the behavior of individual subjects across four simple economic games: the Dictator Game, the Ultimatum Bargaining Game, the Trust Game, and the Public Goods Game. Subjects complete the games using the strategy method with role reversal. We thus gather data from each subject that allows us to construct a full decision plan for each role in each game, and we then study the relationships between behavior at the individual subject level in the different games. We find that dictator giving decisions are highly predictive of offers in the ultimatum game, and also of trust game return decisions. We also find strong relationships between behavior in the trust and public good games. Specifically, amounts sent in the trust game are highly predictive of unconditional contributions in the public good game, and demonstrating high reciprocity in the trust game by returning high proportions after receiving a high amount is highly predictive of heavily conditioning public good game contributions on the contributions of others. The finding that choices in individual games are useful for predicting behavior in other games indicates that the decisions that people make in simple economic games have validity and relevance outside of the specific game in which the decisions were made.

Executive Summary

Simple economic games have been studied by economists for decades and there have been many variations to the basic games to test subjects' behavior in response to certain treatments. Amongst the games are the Dictator Game, the Ultimatum Bargaining Game, the Trust Game, and the Public Good Game. There is a large literature on these individual games; however, there lacks research on the way subjects behave across the four games. Here is an explanation of the four games:

1. Dictator Game: In this game, the Dictator is endowed with $30.00. He has to make a decision about how much of that money he will give to the other player, the Responder. The responder is a passive role so the only decision being made is the allocation of money from the Dictator.
2. Ultimatum Bargaining Game: This game has two active roles, the proposer and the responder. The proposer is endowed with $30.00 and has to decide how much of it he would like to offer to the responder. The responder has the ability to accept or reject the offer. If the Responder accepts, he gets the money offered to him and the Proposer keeps the rest of the endowment. If the Responder rejects, both the Proposer and Responder get $0.00.
3. Trust Game: This game has two active roles, the Sender and the Receiver, who are both endowed with $10.00. The Sender can decide to send any amount of his endowment to the receiver. When money is sent it is tripled, and the Receiver gets the tripled amount. The Receiver then has the opportunity to send money back to the Sender.
4. Public Good Game: This game typically has four players who are each endowed with $10.00. They each have to decide how much they would like to contribute to the public good. The total contributions from all four players gets doubled and then divided evenly amongst the four players, regardless of how much each contributed.

Our experiment is the first that looks at behavior across four simple economic games. Our purpose is to see if behavior in one game is predictive of behavior in the other games. The idea that behavior in one game is predictive of behavior in another game indicates that predicting a person's behavior, such as propensity to free ride, may be made easier through analysis of other economic decisions, like their willingness to give to charity. The results of our experiment can have extensive applications to public policy in the future, as more experiments are conducted on the subject.

We conducted six experiment sessions with eight participants each. The participants sat at computers, without face to face interaction with each other, and made decisions in four simple economic games: the Dictator Game, the Ultimatum Bargaining Game, the Trust Game, and the Public Goods Game. In order to get the most information from each subject, we used the strategy method for collecting economic decisions, and we included role reversal, which means each subject made decisions for each

role in each game. The participants were paid in cash at the end of the study based on their decisions in one of the games that was randomly chosen by the computer. Paying for one of the games ensured valid decision making influenced by real stakes.

We ran regressions to see the extent to which each of the decisions in the games were linked to each other. More specifically, the regressions tested to see how a person's degree of altruism, strategicness, envy (inequity aversion), guilt (inequity aversion), trust, reciprocity, and cooperation could be connected across the games.

IWe found that the Dictator Game giving decision, which measures altruism, is predictive of average proportion returned in the Trust Game, which measures trustworthiness. We also find that the minimum acceptable offer (MAO) in the ultimatum bargaining game, which measures the envy component of inequity aversion, is predictive of the amount offered, which measures altruism and strategicness.

There are three key findings relating to the Trust Game. The first finding is that the amount sent, which measures profit-seeking and expected reciprocity, is predictive of the average proportion returned in the Trust Game, which measures trustworthiness, often thought of as altruism and reciprocity. The second key finding relating to this game is that the amount sent is predictive of the unconditional contribution in the public goods game, linking trust to reciprocity as a result of profit seeking. The last finding is that the strength of reciprocity in the Trust Game is predictive of the strength of reciprocity in the Public Good Game.

Also in the Public Good game, we found that there is a strong relationship between average conditional contributions, which measure altruism and strategicness, and unconditional contributions, which measure reciprocity. Our study shows that knowing behavior from one game can predict behavior outside of the specific game, which has extensive applications to public policy, such as knowing that a person who is altruistic in one situation will also be altruistic in a different situation.

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Chapter 1: Introduction

Many games have been used to test social preferences, including the Dictator Game, the Ultimatum Bargaining Game, the Trust Game, and the Public Good Game. The games test for altruistic behavior, trusting behavior, strategic behavior, reciprocity, and free riding. There is a wealth of literature on these individual games and much research has been done on analyzing behavior in these individual games along with different variations of the games. However, there lacks research of behavior across the four games. By looking across all four, we can see if behavior in one game is predictive of behavior in the other games.

In this study, we conducted lab experiments to test preferences and behavior regarding the allocation of money across the four games mentioned above. In total, we ran six lab sessions in the Worcester Polytechnic Institute Social Science and Policy Studies Department's Experimental Economics Laboratory, with eight subjects in each session. The subjects were asked to make decisions for four stages of the experiment, where each "stage" was one game. The games were ordered based on complexity going from the Dictator Game, to the Ultimatum Bargaining Game, to the Trust Game, and ending with the Public Good Game. The strategy method was used in the experiment so each subject played all roles in each game. The computer system randomly chose a game from the experiment, randomly assigned roles, and implemented the subjects decisions to calculate the payoffs.

We analyzed the data through regression analysis. The behavior we looked for in the Dictator Game was altruism. In the Ultimatum Bargaining Game, we looked for behavior consistent with altruism and strategy. In the Trust Game, we looked for behavior consistent with altruism, strategy, reciprocity, and trust. Lastly, in the Public Good Game we looked for behavior consistent with altruism, strategy, reciprocity, and cooperation. We were able to identify relationships between these behaviors through the regression analyses we ran.

We found that behavior in each game is predictive of behaviors in other games. For example, we found that the Dictator Game giving decision, which measures altruism, is predictive of average proportion returned in the Trust Game, which measures trustworthiness. We also find that the minimum acceptable offer (MAO) in the ultimatum bargaining game, which measures the envy component of inequity aversion, is predictive of the amount offered.

There are three key findings relating to the Trust Game. The first finding is that the amount sent, which measures profit-seeking and expected reciprocity, is predictive of the average proportion returned in the Trust Game, which measures trustworthiness, often thought of as altruism and reciprocity. The second key finding relating to this game this game is that the amount sent is predictive of the unconditional contribution in the public goods game, linking trust to reciprocity as a result of profit

seeking. The last finding is that the strength of reciprocity in the Trust Game is predictive of the strength of reciprocity in the Public Good Game. There was another finding in the Public Good game that there is a strong relationship between average conditional contributions, which measure altruism and strategicness, and unconditional contributions, which measure reciprocity.

The idea that behavior in one game is predictive of behavior in the other games indicates that a person's preferences when making economic decisions are linked to each other. This suggests that in the future, predicting a person's propensity to free ride may be easier through analysis of other economic decisions, such as their willingness to give to charity. These results could have extensive applications to public policy in the future, as more experiments are conducted on the subject. Additional research opportunities could be conducting a similar experiment with different games that measure similar characteristics, replicating the experiment with increased stakes, and increasing group size in some games (such as the public goods game, due to the increased likelihood of people to free ride in a larger group).

Chapter 2: Background

In our background, we discuss four games related to our research. We first discuss the Ultimatum Bargaining Game, followed by the Dictator Game, as well as variables of interest in these two games. We then discuss the Trust Game, the Public Goods Game, and the use of the Strategy Method versus the Direct Response Method in research.

2.1 Ultimatum Bargaining and Dictator Game

Ultimatum Bargaining Game

The ultimatum bargaining game of Güth, Schmittberger, and Schwarze (1982) is a game between two players, a Proposer and a Responder, bargaining over some amount X. The amount X, typically $10, represents the gain of exchange that would be lost if there was no trade. In the game, the Proposer offers an amount Y to the Responder, leaving himself with X-Y if the Responder agrees. If the Responder rejects the offer, both get nothing. There are two common variants to this game: rematching with a new player after each repetition and asking the Responder for a Minimum Acceptable Offer (MAO).

The game is useful for measuring how people feel about allocations of money between themselves and others. The game theory approach assumes that players in this game are self-interested. If this is the case, then in theory the Proposer will offer the lowest amount of money possible and the Responder will agree to the trade because it is in their best interest to leave with something rather than nothing. In reality, Proposers tend to offer somewhere between 40-50% of the total amount and Responders reject offers of less than 20% about half of the time (Güth, Schmittberger, and Schwarze, 1982) , falsifying the assumption that players maximize their payoffs.

The disconnect between theory and reality can be explained by negative reciprocity or inequity aversion. Negative reciprocity suggests that Responders reciprocate unfair behavior by harming the person who treated them unfairly, even at a substantial cost to themselves, as long as the cost to themselves is not larger than the cost to the other person. Inequity aversion theory states that a lopsided distribution is perceived as unfair by the Proposer and Responder as such, the Proposer will be willing to bargain in a way that might be costly to them but will express their concerns for fairness.

Dictator Game

A variation of the Ultimatum Bargaining Game was the first dictator game (Kahneman, Knetsch, and Thaler, 1986). In the first dictator game there were only two allocations: an uneven split favoring the dictator ($18,$2) and an even split ($10,$10). The Dictator was allowed to choose the split he preferred and the other person had no choice. In this sense, the “Responder” now has a passive role in which their

actions do not affect the outcome of the game (Camerer, 2003). In this experiment, they found that ¾ of people chose the equal split of money.

In the dictator games that followed, the "Proposer" could offer any amount available. In these experiments, the Dictators allocated approximately 20% of the amount, showing that the Dictators were less generous than previously demonstrated in the first experiment. The dictator game is similar to the ultimatum game but it removes the pressure that the Responder has on the Proposer to make a more generous offer than he would otherwise (Camerer, 2003). In this sense, the game measures social preferences and altruism rather than strategic thinking. The 20% allocations showed that some of the money allocated in the Ultimatum Games was pure altruism rather than simply a strategic allocation of money to get the other person to accept the offer.

Variables in Ultimatum Bargaining Game and Dictator Game

There are many variables in the Ultimatum Bargaining game and the Dictator game that can be changed to observe the effects on outcomes. Camerer (2003) explains some of the variables in detail. Methodological variables, such as repetition, stakes, and anonymity, can change how the experiment is conducted. Many experiments used stationary replication to see if repeating the Ultimatum Bargaining Game matters. Repetition showed that some subjects adjust offers over time more strongly when they know what other subjects have done before, but in the end repetition had little impact on the outcome. Raising the stakes also has weak effect on rejection of fixed-percentage offers. Lastly, anonymity sometimes lowers Dictator allocations but has little effect in ultimatums. Hoffman, McCabe, and Smith (1994) did a double blind dictator game experiment. To test for the effect of anonymity, the dictator got an envelope and entered a phone booth where he could take out the portion of the $10 he wanted to keep. Then, he would put the envelope in a cardboard box. Once all the dictators did this, the envelopes were taken out to see the distribution allocations. It was found that more than half of the subjects left nothing in the envelope and the mean allocation was 10%. Bolton and Zwick (1995) imposed experimenter-blindness in ultimatum games and found that anonymity lowers rejections very slightly.

Demographic variables include gender, race, and age. In a study of gender in the dictator game with opportunity for third-party punishment, Eckel and Grossman (2001) found that women are more responsive to the price of punishment. It also showed that men are more self-interested than women. Additionally, race did have an effect. They saw that black students offered more and rejected more often. White students also did not repay the trust of Asian students as often (Glaeser et al., 2000). There were also studies done to see if academic major had an effect on the outcome and it showed that economics majors are more self-interested. The age variable also appears to be of interest as before age 5, children are self interested, from ages 5-7 children focus on strict equality as a way of preventing conflict, and

after age 7, they begin thinking in terms of equality (Damon, 1980). Lastly, the effect of beauty and gender was tested with results showing that men were not especially generous towards attractive women, but women offered about 5% more to attractive men (Schweitzer and Solnick, 1999).

The cultural variables are important in societies with more market integration. When conducting cross-cultural experiments, controlling stakes requires the experimenter to match the purchasing power of stakes in two different cultures. It is also important that the conductor keeps the meaning of instructions consistent between languages. The ideal experimenter would speak both languages and would be perceived similarly in both cultures. An ultimatum experiment ran in Peru in the Machiguenga found that the people there offered much less than was observed by any subject group and all offers were accepted except one (Henrich et al., 2000). It is important to note that this group in Peru was very isolated and that could explain why there was no sharing norm. On the other hand, in some cultures people overshared because accepting an unusually generous gift incurs an obligation to repay that person even more and is sometimes considered an insult.

Descriptive variables change the description of the game but not the structure. Framing is an example of a descriptive variable. Describing an ultimatum game as an exchange lowers offers by 10% but leaves rejection rates unchanged (Hoffman, McCabe, and Smith, 1994). Also, it was found calling it a claim from a shared resource pool encourages generosity.

Structural variables also change the game by adding moves. Bohnet and Frey (1999) did a one way identification in the experiment and found that when dictators could see/identify the recipient, the number of dictators leaving zero dollars decreased but the mean allocation stayed the same. However, when the recipient stood up and introduced themselves, the average allocation rose to half and some dictators gave more than half. Adding outside options can also have an affect on the game's outcome. Knez and Camerer (1995) conducted an experiment which added an outside option to the ultimatum game so when the proposers offer was rejected, the proposer earned $2 and the responder earned $3. They found that the disagreement rate was very high in this game at around 50%. In experiments where no information was provided about the amount being divided, responders accepted less in low information conditions and proposers generally exploited this behavior. Another structural change is turning this into a multi-person game. Doing this raises two important questions: What norms of fair division apply to more than two players? Are players willing to punish unfairness when it might affect an innocent party? Camerer (2003) The multiplayer game showed that social preferences are not based on judgments about another player's generosity, they are about judgement of fairness towards oneself. Intentions play a big part in the Ultimatum Bargaining game. Blount-Lyon (1995) was the first to see an important effect of

attribution of cause. She found that a person might reject because he did not like being treated unfairly by someone who benefits from it or because he just does not like unequal payoffs.

Overall, methodological variables such as repetition, stakes and blindness had an impact on the results of the ultimatum bargaining and dictator game. It also showed that demographic variables like gender, age and race do have an affect on social preference. Cultural variables also had a large impact due to potential language barriers and the way that giving is perceived in different cultures. It showed that descriptive variables like framing can have a large impact on the rate of rejection in the dictator game. Lastly structural variables, changing the game by adding moves, had a large impact on the outcomes.

Millionaires Behavior in Ultimatum and Dictator Games

In an experiment with a large Dutch bank Smeets, Bauer, and Gneezy (2015) had subjects played the ultimatum and dictator games. People who had more than one million euro in their bank account played the dictator and ultimatum bargaining games with 100 euros. They found that in the dictator game, millionaires gave more money to lower income participants than to other millionaires. They also found that millionaires who were matched with a low income participant gave away more than in any other study done on the dictator game. This act of giving more away could be evidence for charitable giving. In the ultimatum bargaining game, they found that millionaires were not as generous towards low-income participants. Their theory behind this was that millionaires did not want to have an offer rejected by the low income responder and a millionaire could think a low income responder would reject a high offer because the responder could perceive the millionaire as pitying them. However, when asking the millionaires that participated, only 1 out of 106 expressed the pitying fear and 6 expressed concern that they would be rejected. So overall there is no evidence. These findings do have implications for organizations interested in receiving donations for charity from wealthy individuals. For example. Wealthy people may be more generous when they expect no direct benefit as seen in the dictator game. Overall, the results show that the behavior of wealthy individuals is very different from the other groups who have previously participated in studies of the ultimatum and dictator games.

2.2 Trust Game

The Berg, Dickhaut, and McCabe (1995) trust game is designed to measure trust in economic transactions. The first player, the Investor, has X dollars which he can decide to keep or invest. If the player invests T dollars then he keeps X-T dollars for himself. The investment of T dollars earns a return of (1+R) so the new amount of money is (1+R)T dollars. The second player, the Trustee, must decide how to share the new amount with the investor. The Trustee keeps Y dollars and returns (1+R)T-Y to the

investor. In this game, trust is defined as the willingness to bet if another person will reciprocate your actions. Trust is a risky move because it goes against the Trustee's self-interest to return money, but trusting can subsequently show if the Trustee is willing to sacrifice self-interest to satisfy a moral obligation. Typically, truster sends about 50% of what he has and the trustee typically receive about $15 and send back about 1/3 of that ($5).

Berg, Dickhaut, and McCabe (1995) stated that a fundamental assumption in economics is that people act in their own self-interest. However, in choice settings, behavior deviates from self-interest, and this is viewed as irrational. To explore this, they considered the role of trust in a two person exchange. They asked the questions: Is trust primitive in economic models of behavior? What factors increase or decrease the likelihood of trust in economic transaction?

Having participants only play a trust game once with complete anonymity and no fear of punishment, we can see if trust in economic situations is primitive. The investment game goes as follows: Subjects in room A decide how much of their $10 show up fee to send to an anonymous partner in room B. Subjects in room B decide how much of the tripled money to keep and how much to send back to their partner. The experiment consisted of 32 pairs. In room A, only 2 of 32 people sent $0, 5 of the 32 people gave the entire $10. On average $5.16 was sent by room A with an average payback of $4.66 from room B. In room B, of the people who were sent more than $1, 12 returned $0 or $1 to their partner and 11 of the 28 subjects returned more than their partner sent. Investments of $5 had an average payback of $7.17 and investments of $10.00 had an average payback of 10.20. The nash equilibrium for this game with perfect information is to send zero money back. However, reciprocity does occur.

These results bring up the question, why do people trust? Equilibria where trust emerges is a small subset of possible equilibria that may occur and that trust is an evolutionary stable strategy (Kreps, 1990). Trust can be defined in two actions: the trustor gives the trustee the right to make a decision and then the trustee makes a decision that affects both of them. The fact that subjects have no information on the history of the game raises the possibility that their investment decisions are influenced by social norms. Norms are a socially defined right by others to control an individual's actions (Coleman, 1990). If this is the case then it is rational for room A individuals to place trust because the norm is to reciprocate.

When the double blind test was conducted with history of treatment each person received a report of the decisions of the previous 32 pairs of subjects who participated in the experiment already (Berg, Dickhaut, and McCabe, 1995). This showed the people in room A that sent some amount of money that the people in room B did not always reciprocate. In this experiment, of the participants in room A only 3 of 28 subjects sent $0 and 50% of the time subjects sent $5 to $10. In room B, of the 24 B subjects who were sent more than $1, 6 returned $0 or $1. Also, 13 of the 24 returned more than their partner resulting

in positive net returns. Investments of $5 had an average payback of $7.14 and investments of $10 had an average payback of $13.17. On average, subject A sent $5.36 resulting in an average payback of $6.46.

Cox (2004) also conducted trust experiments, except he used a triadic experimental design. Other regarding preferences were defined as altruistic, inequality-averse, quasi-maximum, or malevolent. In this experiment, it was important to distinguish between actions motivated by reciprocity and other regarding preferences. Positive reciprocity was defined as motivation to repay generous or helpful actions of another by adopting actions that are generous or helpful to the other person. Trust was defined as the beliefs that one agent has about the behavior of another.

Cox (2004) designed an experiment that involves three treatments implemented in a between subject design. Treatment A was the investment game, the same one discussed above. Treatment B and C decompose the trust game with B being the first step in the trust game and treatment C being the second stage. Treatment B was the dictator game, so the second mover could not return any of the tripled amount given to them by the first mover. Lastly, treatment C was the reciprocity control dictator game which is the same as the investment game except the first movers did not have a decision to make. Each second mover was given a $10 endowment and first movers were given endowments in amounts equal to the amount kept by first movers in treatment A. Then, second movers were given additional dollar amounts equal to the tripled amounts received by the second movers in treatment A. The subjects were informed with a table of the exact inverse relation between the number of additional dollars received by a "second mover" and the endowment of the anonymously paired first mover.

The experiment consisted of 32 pairs of subjects. For treatment A, there were 6 cases where the first mover sent $0 and the second mover returned $0, 6 first movers sent exactly half of their endowments to the second movers and there were 2 second movers who kept all of the $15 and did not return anything, 4 returned $5 and 1 returned $3. Overall, 26 out of 32 first movers sent positive amounts. Can this be considered trusting behavior? Comparing the behavior of treatments in A and B will make it possible to answer this question. Also, 17 second movers returned positive amounts so there is an overall increasing relationship between the amount sent and the amount returned. Is this reciprocal behavior? Comparing treatment A and C will allow us to answer this question.

When comparing treatment A and B, it is shown that the mean amount sent by first movers in treatment A was $5.97 and in treatment B was $3.63. This supports the conclusion that there is significant trusting behavior in the investment game. When comparing A and C, there were 13 out of 32 second movers in treatment C who returned positive amounts of money to the first movers. In treatment A, second movers sent an average $4.94 and in treatment C second movers sent an average of $2.06. Therefore, there is evidence of other regarding preferences (altruism and reciprocity) in this data. The

study showed that this pattern of results are inconsistent with the subgame perfect equilibria in the case where players are expected to have self regarding preferences. Overall, this experiment provided evidence of altruism and other regarding preferences, trust, and reciprocity.

Research shows that decisions are affected by observations on ethnicity, sex, and attractiveness. Eckel and Petrie (2011) conducted a typical trust game but tested for differences in amounts sent across different ethnicities and sexes. In the Eckel and Petrie variation, an additional step is added where subjects are allowed to purchase the picture of a partner for a predetermined, randomly assigned price for each partner. The experimental procedure for this research differed from that of Berg, Dickhaut, and McCabe (1995) in that the Second Movers made decisions using the strategy method where decisions were made for all possibilities of amounts received before the First Movers sent anything. Brandts and Charness (2011) and Amdur and Schmick (2012) compared literature on direct-response and strategy methods and found that in general, decisions are invariant to the method. Then, each person was paired with six different partners and subjects were randomly assigned to their roles (First or Second Mover). Once all decisions were made, one of the six games was randomly chosen for determining actual payoffs. The design of their experiment allows the possibility of calculating the demand for photos, quantifying their value, and exploring their effect on decisions.

The experiment showed that given the opportunity, not all people purchased the photo - even at the lowest price of $0.20, only 50% of subjects made the purchase. Possible reasons that people choose to not buy this information are that they have time-inconsistent preferences or that they are self-serving and wish to hide their decisions behind bad luck or ignorance. As expected, as price of the photos increased, the purchases decreased. With respect to purchasing pictures, white senders have the highest demand being 40% more likely to buy a picture. Senders have a more inelastic demand for pictures than responders thus pictures are a normal good. This is also explained because senders have to make a more strategic decision compared to responders.

In previous literature on the subject, it was found that men trust more than women but women are more trustworthy (Buchan, Croson, and Solnick, 2008) and that dark-skinned players trust less and are less likely to be trusted, though they are not any less trustworthy (Burns, 2005) (Wilson and Eckel, 2007). On average, white subjects send 1.9 fewer chips to a known black responder than to a known white responder. Whites did not send significantly more or less to an unknown partner than to a known black or white partner. Blacks sent 1.6 fewer tokens to a known black responder than to a known white responder but the difference was not statistically significant. However, blacks on average sent 1.5 tokens less regardless of ethnic group. Other ethnic groups did not differentiate the amounts sent. Additionally, men sent more tokens on average than women did to a known partner.

Using the strategy method, the Sender allocates the amount of chips he wants to send to the Responders and simultaneously, the Responder makes decisions for all possible outcomes of amounts received. This allows to calculate response functions for each responder. In general, higher amounts sent yielded a higher percentage returned meaning that the response function was upward sloping. However, the response function was downward sloping for blacks, and especially black women, such that a smaller percentage was returned from higher offers. The steepest upward sloping response function was demonstrated by white men. These slopes would mean that a money-maximizing sender should send less to a black responder and more to a white responder which was done by white senders but not by black senders. This could mean that black senders did not differentiate amounts due to in-group bias or because they did not anticipate the behavior. Other results based on ethnicity were consistent with in-group bias where responders favored a partner of the same race by sending higher amounts. In general, seeing the picture of a partner increased the percentage returned for any offer compared to not seeing it. The decision profits from this experiment model showed that overall, for white senders, profits were 38.6% higher compared to those who did not buy a picture. There were no significant effects of sex on decision profits on senders and there were also no significant effects of sex or race on decision profits of responders.

Smith (2013) used the data from the Eckel and Petrie (2011) experiment described above to examine the reciprocity effect. Cochard, Nguyen-Van, and Willinger (2004) define this "reciprocity effect" as the tendency for Second movers to return proportions increasing with the amount received. On average, Second movers who receive high amounts return high proportions. Smith argues that aggregate level reciprocity differs from individual level reciprocity. In reality, less than half of Second Movers in the sample for the paper demonstrate individual level reciprocity effects. In total, data from 64 subjects was analyzed meaning that there was data from 32 Second Movers. 31% of Second Movers demonstrated reciprocity effects, 31% were neutral (amount did not change), 13% had decreasing average response functions, and 25% were free riders (returned nothing). When focusing on the response functions for each game, 22% of strategies showed reciprocity effects, 45% were neutral, 7% were anti-reciprocity, and 26% were free riders. The research showed that nearly all subjects had different response functions for different games. Most importantly, the research showed that there is heterogeneity among subjects with respect to demonstrating reciprocity effects.

2.3 Public Goods Game

In the traditional public goods game, which was initially used by people including: Marwell and Ames (1979), Isaac, Walker, and Thomas (1984) and Kim, Walker, and Dawes (1980), there is a group

of players and each has the choice to allocate their tokens between cash and the public good. For the individual exchange X was paid to the investor for each token granted. The group exchange was an investment which gave a Y return per token to the individual as well as the same return to all the others participating. Therefore the payoff that the individual received was dependent on other participants.

The two previously accepted possible theories for outcomes in a public goods game: the economic/game-theoretic prediction, which states that individuals will contribute nothing since the payback for their contributions is half of that contribution, and the sociologic-psychologic prediction, which states that individuals will contribute everything due to social norms, altruism, or group identification (Ledyard, 1995). The ideal outcome would be for individuals to contribute all of their money to the public good but this is not the real outcome. An application of public goods games is to evaluate environments that nurture better choices to get closer to the optimal contribution amount.

There are four main categories of experiments that public goods games can survey - the first which is covered in the research of Ledyard (1995) - voluntary contribution mechanisms over a wide range of environments, wide range of mechanisms over a limited class of economic environments, mechanisms in political environments, and those focused on applications. Some of the major findings on the first category of experiments (voluntary contribution mechanisms) are these: subjects contribute halfway between a Pareto-efficient level and a free-riding level in one-shot trials and initial stages, contributions decline with repeated trials, and face-to-face interactions improve contributions.

Ledyard (1995) compares six major experiments in public goods environments which have had opposing outcomes - Bohm (1972); Dawes, McTavish, and Shaklee (1977); Marwell and Ames (1979); Isaac, McCue, and Plott (1985); Kim and Walker (1984); Isaac, Walker, and Thomas (1984). However, it is noted that all of these experiments differ from each other in at least two variables. These early works identified factors which improved contributions (communication and increases in payoff) and one that decreased contributions (repetition). There were also six other factors which were thought to possibly influence behavior: numbers, provision points, number of tokens, heterogeneity of payoffs and endowments, experience, and moral suasion. Three variable groupings are identified to facilitate analysis which are environmental variables, systemic variables, and design variables.

The six variables discussed in Ledyard (1995) can have an impact on contributions and help to understand how different experiment designs can yield different outcomes (Ledyard, 1995). In addition, the study discusses the importance of a threshold for contributions since this affects the equilibrium point. The first variable analyzed is experience, repetition, and learning. There are a lot of unanswered questions with regards to this variable; however, one of the proven results is that in environments where there is a zero dominant strategy there is a decrease in contributions over time with more repetitions.

The next three variables are those with strong effects on contributions: marginal payoffs, communication, and numbers and rebates. Isaac, Walker, and Thomas (1984) and Isaac and Walker (1988a) present data which suggest that independent of the number of subjects for N=4 or N=10, increasing the marginal payoff from 0.3 to 0.75, increases the participant's' contribution. The number of participants in a study also appears to affect contributions. However, this result is confounded with the results for increasing marginal payoff (as more people are added they must be given fewer tokens or less marginal payoff to maintain returns the same). In several studies, however, it would appear that in larger groups people appear to contribute more.

The purpose of Isaac, Walker, and Thomas' (1984) paper discussed in Ledyard (1995) was to attempt to draw together the ideas of three of the most recent papers: Marwell and Ames (1979), Isaac, McCue, and Plott (1985), and Kim, Walker, and Dawes (1980). There are many definitions for free riding and in this paper they will propose a working definition along with the results of their experiment.

The participants received these instructions: given a specific endowment of resources, participants faced the decision of allocating them between a private exchange (individual) and a public exchange (group). For the individual exchange $.01 was paid to the investor for each token granted. The group exchange was an investment which gave an equal specific return per token to all individuals participating. Therefore the payoff that the individual received was dependent on all participants' investment. The experiment had three consistent treatment effects: group size, per capita return from the group investment and effect of subject experience in the experimental environment using a basic public goods experimental design. The data revealed that free riding behavior increases with repetition of the decision process and it increases as the MPCR decreases.

The final variable with a strong effect is communication as demonstrated by Dawes, McTavish, and Shaklee (1977). An interesting aspect of communication in public goods is that with repetitions, contributions appeared to increase rather than decrease. This result appears to be pretty stable across experiments with no thresholds. In experiments with thresholds, the evidence is mixed.

Some of the variables that do not yet have enough evidence to support their acceptance are homogeneity and information, gender, beliefs, group solidarity, unanimity, and revision and sequence. Homogeneity is a factor that appears to increase contributions compared to heterogeneity of marginal payoffs unless subjects do not have full information. There are some differences across genders such as those found by Mason, Phillips, and Redington (1991) where women appeared to contribute more than men at the beginning of experiments but that these differences vanished over time. Another research outcome by Isaac and Walker (1988a) found that men contributed higher rates than women did but that when compared, the statistics were very similar. Beliefs also appear to affect individual contributions in a

way such that individuals who contribute more or less also believe that others will do the same. However, the only information on beliefs available comes from surveys therefore there is not enough evidence.

It also appears that creating a sense of belonging to a group, or group identity, increases contributions based on experiments by two researchers but the claim is not certain. With respect to unanimity studied in one experiment, where a vote is held at the end of contributions to gauge whether participants are happy with the total contribution and a single "no" means that everyone receives their money back, there appears to be increased contributions but this is outweighed by a 13% success rate. In a sequential mechanism, subjects choose to contribute in a sequential order. In this method the contribution percent was the same compared to the simultaneous method (45.3 versus 42.9%). The difference is that when the sequential method was followed, the public good was provided about 50% more of the time compared to the simultaneous method. Lastly, the idea of revision is that participants can choose to increase or decrease their contributions in real time. In this method, Dorsey (1992) found an 11.5% contribution rate compared to that of Isaac, Walker, and Thomas (1984) who found a 26% contribution rate. However, more research needs to be done in this area. Also, the decision costs, fairness, and moral suasion variables have unknown effects.

Isaac and Walker (1988b) found that communication has also been investigated in the context of other environments where there were gains from cooperation. Given past evidence of this, they decided to find the implications of a presence or absence of a significant amount of communication.

The game was the same as the one talked about above in Isaac, Walker, and Thomas (1984), however in Design I and II experiments the participants faced two consecutive series of ten decision trials. This allows Isaac and Walker (1988b) to vary communication within an experiment, providing between group, within group, and sequencing comparisons on the effect of communication. In this experiment, unlike previous experiments where communication was not allowed, subjects were brought together at four chairs so they had the opportunity to communicate with each other. They were told to not discuss quantitative aspects of the private information on their screen, side payments or physical threats.

By switching from communication to non-communication, the results of the first test showed that communication reduces free riding even when the opportunity of communication follows substantial free riding in a non communicative environment. However, the second sequence of observations did not lead to higher contribution levels. The ameliorative effects of communication when it follows non-communication are relative to the case in which communication is present from the beginning. Also of the four experiments, three exhibited no defection in group agreements.

In the second design they observed that levels of contributions to the group good increased significantly in the variety of conditions where communication was allowed compared to the base case.

Also they found that levels of contributions in experiments with symmetric endowments, contributions were higher when there were symmetric endowments. Lastly the levels of contributions in periods where there was communication before where much higher than when no communication existed.

Designs I and II indicated that the communication mechanism is capable of increasing efficiency and the effectiveness mechanism is marginally reduced when changes in information and endowment allocations were introduced into the environment. In Design III was conducted with groups of eight and each subject faced a demand curve for the group curve specified as d=$(.003375-.0001x) where x is the quantity of the group good produced per period. Given an identical demand function for each subject, identical returns from the private exchange and 52 tokens per subject, the optimal good contribution is to achieve 212 tokens per period which is only 50% compared to an optimal good contribution of 100% in the other two designs. This experiment found that in aggregate, communication is successful in fostering increases in efficiency even in this more complicated environment.

Isaac and Walker (1988b) also found that group size and varying marginal returns had an effect on contributions. The experiment design was also the same as outlined in the first study, with the variation that out of the 24 experiments, half of them were four-person experiments and the other half were ten-person experiments. The experiments also varied the marginal returns having half of the four-person and twelve-person experiments using an MPCR of 0.3 for half and 0.75 for the other half. Isaac and Walker refer to strong free riders as those individuals who contribute less than a third of their tokens. Their data appears to suggest that as trials move through each consecutive round, the number of strong free riders increases and public good contributions decrease.

The data also suggests that a lower MPCR, 0.3 in this case, greatly increases free-riding behavior. In other words, a lower marginal return for each token put to the public good means that fewer tokens are invested in the public good exchange. On average, groups with the high MPCR of 0.75 contributed 22.7% more than those in the low MPCR (only 3.65% contribution). There was also an average of 95% strong free riders in the group with the low MPCR compared to a 68.3% in the high MPCR group.

Another observation gained from the data is that there are weak effects of number of participants per group in the contributions. The groups with a high MPCR do not seem to show effects for varying group sizes. The group size appears to have some effect on free riding in the groups with low MPCR but the effect is almost negligible. The average of contributions in the four-person groups compared to the ten-person groups is only 1% lower and had an average of only 3.35% more strong free riders.

Andreoni (1995) makes a point to differentiate between kindness and confusion in public goods games. He refers to kindness as when subjects have experience of cooperation from outside the experiment such as benevolence and social customs appealing, that influence their behavior. He refers to

confusion as subjects being incapable of deducing the dominant strategy due to poor instructions or incentives. The experiment had three conditions. The first was the Regular condition which was the standard public goods game. The second was the Rank condition where the subjects were paid based on how their experiment earnings ranked in comparison to the other subjects. This takes away the kindness motivation which means any contribution would be due to confusion. The third was RegRank where the subjects got information on their rank but were paid based on experiment earnings. In this experiment subjects played in groups of 5 and were given 60 tokens for each iteration. The experiment revealed that about 75% of subject were cooperative; half were confused about incentives and half understood free riding but decided to cooperate out of kindness. When comparing Regular to Rank, the Regular contribution should be more cooperative than Rank. In the experiment they found that Rank subjects free ride more the most and Regular subjects free ride the least. When comparing Regular to RegRank the decrease in cooperation from Regular to RegRank can be classified as kindness or confusing because it is solely due to the subjects getting information about their rank. When comparing Rank and RegRank, the Regrank contributions were lower than the Rank contribution therefore information about rank decreases the amount given more than it decreases the number of givers. Overall this experiment shows that kindness and confusion are important in generating cooperative moves in the public goods game.

Andreoni (1988) examines the two most proposed hypotheses for the decay in public goods provision with repeated trials: strategies and learning. The learning hypothesis suggests that a single game does not allow subjects the time to learn incentives. The strategies hypothesis states that participants give more than the free riding amount at the beginning because of rational and strategic play to appear like they do not understand the optimal behavior of free riding. To test for strategic play, two game configurations were created: Partners and Strangers. The Partners configuration was the control group where people remained in the same group of people for all 10 rounds of the game. In the Strangers configuration, they were randomly assigned at each round to a new group. Based on the strategy hypothesis, it is expected that Partners will give more to the public good than Strangers especially in the early game. To test for learning, after the 10th round, the subjects were told that they would start a new set of 10 rounds (the game was ended after 3 rounds). If learning is what causes decay then the restart should have no effect on either of the subjects.

There were six observations made - three related to the strategy hypothesis and three related to the learning hypothesis. The three observations related to the strategy hypothesis were that: Partners gave less than Strangers in all 10 rounds with the difference increasing as the last round approached; Partners choose to free ride a greater percent of the time than Strangers do, with the greatest difference in the last round; Partners give the least in round 10, but still give more than the free riding amount. This result does

not provide support for the strategy hypothesis because based on the strategies hypothesis, it is expected that Partners will give more than Strangers especially early in the game. Additionally, it was expected that in the tenth round, both groups of people would free ride.

The three observations related to the learning hypothesis were these: Strangers gave more than the partners in the last round; the restart affects Strangers only temporarily; after the restart, partners give more to the public good again and the effect appears to last until the last round of the restart. These observations also do not provide support for the learning hypothesis because based on the learning hypothesis, neither of the groups should be affected by the restart of the game. Since neither of these results provide support for either the strategy or learning hypotheses, the paper could not confirm that people follow the standard theorized conceptions of free riding behavior.

An experiment was done to see the effect of punishment on the public goods game and Fehr and Gaechter (2000) hypothesised that when punishment is in play, there will be less free riding. To test this they had four different treatments. The first was stranger-treatment with punishment, in this treatment the subjects groups were changed from period to period. The without punishment condition gave the experimenters a control group for stranger-treatment. The next treatment was partner-treatment with punishment where the members of the group remained the same across all the periods. Lastly was partner-treatment without punishment which also served as a control group. Results showed that the existence of punishment caused a rise on average contribution levels in the stranger-treatment and partner-treatment where on average subjects contributed 58% of their money. In stranger-treatment without punishment average contributions were close to full free riding over time. In the partner-treatment without punishment average contributions converged towards full free riding where the punishment condition caused them to converge to full cooperation. Overall this study showed that the potential for punishment had a large effect on contributions although it conflicts with with models of pure altruism because an altruistic person would not use a costly option to reduce the other subject's payoff.

Conditional cooperation is another variable that was examined by Fischbacher, Gaechter and Fehr (2001). Their experiment was similar to the standard public goods game, there are four subject that decide how to spend 20 tokens. Subjects went to the actual decision situation with two different types of contributions, called unconditional contributions and the conditional contribution table. The unconditional contribution was a single decision about how much to contribute to the public good. The contribution table is where the strategy method is applied. Subjects have to indicate for each of the 21 average contribution levels of other group members, how much they are willing to contribute to the public good.

After the decisions are made, subjects were told that a random mechanism would determine which of their decisions would become relevant. The random generator would pick three players whose

unconditional contribution decision gets implemented and then the fourth persons conditional contribution gets implemented based on the average from the other three members. The game was played only once, so repetition was not examined.

The results showed that the subjects decisions fell into three different categories. The first category, conditional cooperation, showed that 22 (half) of the participants increased the contributions of the other member. The next category was free riders, which was made up of 13 players (30%) who wrote "0" in all of the entries. The last category was made up of six subjects (4%) who had close to perfect levels of contribution up to 10 tokens and then began to steadily reduce their contribution. The interpretation of these results was that a fraction of people will free ride regardless of others contributions and those who do cooperate conditionally display a selfish bias and contribute less than others on average.

Strategy Method

Brandts and Charness (2011) compile and analyze several studies that compare the direct-response versus the strategy-method to check whether the different response methods affect player's actions. The importance of this study is that the strategy method is useful for collecting data for points in a game that are not usually observed. The strategy method also provided more information and additional results than the direct-response method did for certain studies (Brandts and Charness, 2011). There are two theories on the matter: the game-theoretic view says that it should not cause a difference in behavior whether the strategy or direct-response method is used on the results while the behavioral view criticized the cold nature of the strategy method making it less realistic than a direct-response.

There are more studies that find no difference in behavior based on the elicitation method (16) than those that find that the strategy method leads to different behavior (4). There were also nine studies that found mixed results. Using binomial testing, there are a significantly greater amount of studies that find no difference than those that did. Three possible factors could be causing the differences: emotions, complexity and length of the game. Little significance was found for emotions as a factor causing behavioral differences using chi-square testing. However, there is a slight possibility of 1 in 32 that punishment with direct response is higher when using the strategy method. The complexity of the game was a possible factor in determining behavior with differences being more likely when the game had more decisions available to the players. The length of the game, or whether the game was carried out in a single one-shot trial or in multiple rounds, was also considered a factor but it was observed that differences in behavior decrease over time. Overall, Brandts and Charness (2011) conclude that the strategy method does not produce results significantly different from the traditional direct-response method.

Summary

Overall, we have examined four common economic theory games. The ultimatum bargaining game sets up a trade between two participants where one offers a certain quantity and the other can either accept it or reject it. In general, this game shows strategicness as well as altruism and the results tend to show that people offer approximately 40-50% of their endowment and offers of less than 20% are often rejected. The dictator game is similar to the ultimatum bargaining game with the lack of rejection, which shows only the amount of altruism or inequity aversion of the dictator. The usual allocation of money in the dictator game is approximately 20%.

The trust game is a game where a Truster sends money, which is increased by a certain percent on the way, to a Trustee and the Trustee can choose how much money to return. Typically, Trusters send about 50% of their endowment and receive a third of the increased amount back from the Trustees. Lastly, the public good game is that where a group of participants can choose whether to invest in a private or public good with different return rates. Depending on the variables, the results can vary but the variables with the strongest effect are repetition and the percentage of return from the public good.

In all these games, it is possible to use a strategy method or a direct response method which yield similar results. However, the strategy method provides more data for analysis.

No one has analyzed the extent to which these games are interrelated. Is a public good "free-rider" more likely to be less generous as a dictator? Is a more trustworthy person more likely to be a generous contributor to the public good? These are the types of questions we investigate in our study.

Chapter 3: Methodology

Our methodology includes information on experiment procedures, why certain data was collected, and information that the subjects received prior to and during the experiment. All of the data was collected in the Worcester Polytechnic Institute (WPI) Experimental Economics Laboratory on the second floor of the Salisbury Laboratories building on varying times of the day over the course of WPI's B term, 2017.

3.1 Subject Recruitment

Subjects were recruited from an introductory Economics course at WPI where participation in an Economics experiment was required as part of the grade for the course. In order to register for an experiment session, subjects logged into the Regi25 page and chose the upcoming experiment session.

3.2 Experiment

For each experimental session, there were eight (8) subjects. However nine (9) students were invited to each session in case one did not attend. If all of the students showed up on time, then the last student to arrive was paid a show-up fee of 10 dollars and was awarded the credit for participation.

Subjects were seated at individual computer stations which were partitioned by a cubicle wall and used the computer software Ztree to input their allocation decisions. Each session lasted approximately 50 minutes. Subject interaction was limited to inputting choices into the computer. At no point during the experiment was there face-to-face communication between subjects.

Before subjects arrived, the computers that were as widely spaced as possible were turned on. The spacing was to limit verbal and physical communication between the subjects. At the beginning of the session, subjects were given two copies of a consent form outlining procedures, foreseeable risks and discomforts from participation, and payment in the experiment. These forms were approved by the WPI IRB. In order to begin, the subjects had to agree to the terms outlined in the consent form and sign one of the copies that was returned to us; the other copy was for subjects to take with them after the session.

Each subject then obtained copies of the instructions. Instructions then were read aloud prior to starting the experiment as well as before each Task, with time for questions and answers (Instructions in Appendix A. The eight subjects that participated in the experiment and were paired or grouped at the end depending on the task selected. At the end of the experiment the computer randomly selected a task for the pay out. All interactions were completed through the computer to ensure that subjects remained anonymous to each other. The experiment was designed using the strategy method, which included

role-reversal so for each of the games, the subjects made decisions for all roles in the game. The experiment consisted of 4 Tasks: the Dictator Game, the Ultimatum Bargaining Game, the Trust Game, and the Public Goods Game. The official names of the games were not disclosed in the instructions to avoid question wording bias and to limit subjects' recognition of the games if they had heard about them previously. Instead, Task 1-4 were called the Giving Game, the Propose and Respond Game, the Send and Return Game, and the Contribution Game. All instructions for each task were handed out immediately prior to each Task, read aloud, and then time was allowed for any questions. Once this was done, subjects made all decisions for each Task.

Task 1

Task 1 had one decision. The instructions informed each subject that he had an endowment of $30. It then explained that each subject had to decide how much of the $30 to keep for himself and how much to give to the recipient. The amount had to be an increment of 3 between 0 and 30. This was done to keep consistency across games in terms of the number of options and reduce the number of choices participants had to make. This also keeps the number of decisions and endowment consistent across games. Subjects were informed that if this was the task randomly chosen for the actual monetary payoff, then there were two potential outcomes. The computer would randomly assign each subject to a pair. Then the first possibility was that a subject was chosen as the giver and the $30 was divided between him and the person with whom he was randomly paired based on his giving decision. The second was that he was not chosen to be the giver and the other subject's giving decision would determine how much of the $30 he received as a potential payoff. After the instructions were read, all subjects made their giving decision. This task was indicative of preferences for altruism and/or guilt: if a subject gave any amount of money to the other subject, since he was not under any pressure to give money for strategic reasons (as in Task 2), any money that was given could be interpreted as either guilt or altruism. Camerer (2003) summarizes previous experiments, results and interpretations in his book *Behavioral Game Theory*.

Task 2

Task 2 is the ultimatum bargaining game, first published by Güth, Schmittberger, and Schwarze (1982). The proposer was endowed with $30 and the responder was endowed with nothing. The subject made two decision plans: one for the amount that he would offer to the responder and one for whether he would accept or reject each possible amount offered. The amount offered to the responder was limited to increments of $3 in order to reduce the number of decisions for the accept/reject decision plan, as well as to equalize the number of decisions between Tasks 2-4 to 12 decisions. Each subject was informed of the

potential monetary payoff he would receive if Task 2 was randomly selected as the actual monetary payoff. If Task 2 was selected, then the computer randomly assigned subjects to pairs. From there, the first possibility was that the subject was randomly chosen to be the proposer and the offer decision plan determined how much he offered to the responder. The other subject's accept/reject decision plan determined whether his offer was accepted. The second possibility was that the subject was randomly chosen to be the responder and his accept/reject decision plan determined whether the proposer's offer was accepted. From this game, we gained insight on each subject's strategic preferences (as the proposer) and inequality aversion or envy (as the responder). If any subject gave any amount of money larger than what he gave in the dictator game, then this must be the amount of money that he is strategically giving in order to have their offer accepted. Analyzing the responder preferences, we can observe the degree to which he is willing to sacrifice his own payoff to avoid an unequal split of money.

Task 3

In Task 3, the Truster and the Trustee were each endowed with $10. This is the game that was created by Berg, Dickhaut, and McCabe (1995). Subjects made two decision plans: an investment plan, the amount he would choose to send to the Trustee out of the $10 he started off with, and a return plan, the amount that he would return to the Trustor after the amount . The subjects were informed of the potential payoffs in the event that Task 3 was randomly chosen for the actual monetary payoffs. If Task 3 was chosen, then the computer would randomly assign subjects to pairs. From there, the first possibility is that the subject was randomly chosen to be the sender and his "send" decision plan determined how much he offered to the receiver. The other subject's return decision plan will determine how much he receives as a payoff. This second possibility was that the subject was randomly chosen to be the receiver and the other player's "send" plan will determine how much he received, then your "return" plan from the dictator like position will determine how much you keep (and give back to the sender) as payoff. This game measures predisposition to trust and altruism. When we examine the amount sent by the truster, we can see trusting behavior and if we examine the amount sent back by the trustee we can look for the level of altruism and reciprocity (Cox, 2004).

Task 4

In Task 4, all four subjects in a group were endowed with $10. Subjects made two decision plans: an unconditional contribution, an amount they would contribute regardless of how much others in the group contributed, and a conditional contribution plan (Fischbacher, Gaechter, and Fehr, 2001), the amounts they would contribute for each average contribution by the others. If Task 4 was chosen for the

actual monetary payoff, then the computer would randomly assign subjects to groups of four. It would then randomly choose the unconditional contribution for three out of four people in the group. The fourth subject's conditional contribution was determined based on the three unconditional contributions. Actual payoffs were determined using the payoff equation:

$$payoff = 10 - individual\ contribution \frac{2 * sum\ of\ contributions}{4\ people}$$

for each subject's contribution amounts chosen in the two previous steps. This game measures the subjects' willingness to contribute to the public good. From the results we can identify those who free ride and those who cooperate.

Once all tasks were completed, a questionnaire was administered to the subjects collecting demographic as well as contact information. Earnings for the subjects were randomly chosen from the potential payoffs from Tasks 1 through 4. At the end of the experiment, subjects were asked to sign cash receipt forms to confirm that they had received money from the study and then were paid in a private manner.

3.3 Nash Equilibrium & Social Optimum

Under the traditional assumption of self-interest, the Nash Equilibrium can be determined for the four games. The Social Optimum on the other hand focuses on maximizing the total payoff, and says nothing about the distribution of payoffs.

The Nash equilibrium in the Dictator Game is for the Giver to give $0, since the dictator is self-interested and wants to keep the maximum amount for himself. However, people tend to not follow this equilibrium, they usually allocate about 20% of their endowment (Camerer, 2003). The social optimum in the dictator game is any allocation because at the end of the game, $30 is distributed amongst the players regardless of the decisions made.

The Nash equilibrium for the Ultimatum Bargaining Game is for the Proposer to give the minimum payment of $3 or $0 since he is self-interested and wish to give the least amount possible. The Responder should accept any amount greater than $0, according to Nash Equilibrium because he is self-interested and any amount larger than $0 is considered a gain, i.e. receiving something is better than receiving nothing. However if the responder is offered $0, he is indifferent between accepting or rejecting because he ends up with the same amount regardless of that decision. Thus it is safer for the proposer to offer $3 and ensure that he will end up with the $27. Typically, proposers offer somewhere between 40-50% of the endowment and Responders reject offers of less than 20% about half of the time (Güth,

Schmittberger, and Schwarze, 1982; Camerer 2003). The social optimum in the ultimatum bargaining game is any offer as long as it gets accepted.

The Nash equilibrium for the Trust Game is for the Truster and Trustee to send and return $0 since they are both self-interested and expect the other to be self-interested too. Since the Truster knows that the Trustee is self-interested and does not have any incentive to return money, the Truster will send $0. For the self-interested Trustee, it is rational to keep all the money that he receives and not return anything. The social optimum in contrast is for the trustor to send his whole endowment. This way, the total amount of $40 can be obtained. Typically the truster sends about 50% of what he has and the trustee typically receives about 33% of that back (Berg, Dickhaut, and McCabe, 1995; Camerer, 2003).

The Nash equilibrium of the Public Good Game is for each group member to give $0 and end up with $10. The social optimum would be for everyone to contribute their $10 this way the total of $80 is reached and each player would receive $20 back. With conditional cooperation, about 30% are free riders who follow the null hypothesis and 50% contribute at the level of the conditional contribution (Fischbacher, Gaechter and Fehr, 2001).

3.4 Hypotheses

Hypothesis 1: The amount offered will have a positive relationship with the giving decision and a positive relationship with the minimum acceptable offer (MAO).

Rationale: There is a positive relationship with the giving decision because is a measure of altruism and the guilt component of inequity aversion. So if all the other components are accounted for, we expect that someone who gives a lot in the dictator game is more likely to send more in the ultimatum bargaining game due to altruism. There is a positive relationship between amount offered and MAO because someone who offers more will expect to be offered more and therefore not be willing to accept less and have a higher MAO.

Hypothesis 2: The MAO will have a negative relationship with the giving decision and positive relationship with the amount offered.

Rationale: There is a negative relationship with the giving decision because someone who gives more would be willing to accept less due to altruism. There is a positive relationship with the amount offered because someone who accepts less and has a higher MAO would offer more due to inequity aversion.

Hypothesis 3: The amount sent will have a positive relationship with giving decision, a positive relationship with amount offered, a negative relationship with MAO, a positive relationship with the average proportion returned in the Trust Game, and a positive relationship with the responsiveness to the amount received in the Trust Game.

Rationale: There is a positive relationship with the giving decision because someone who is altruistic in the dictator game would expect others to be altruistic and therefore be more trusting and send more money in the trust game. There is a positive relationship with amount offered because a proposer that sends more money out of altruism than strategicness, is likely to be more altruistic than a proposer who sends less. A more altruistic person is more likely to expect others to behave similarly, so he would expect the Receiver to return a considerable amount. Since there is this expectation on the returns, the Sender is likely to send more money. There is a negative relationship with MAO because if the responder rejects low amounts is because of inequity aversion specifically envy. Therefore he will give less as a sender in the trust game because he wants equal payouts and it will be equal for each person to leave with their initial endowments than to contribute and have the receiver keep more making the payoff unequal. There is a positive relationship with the average proportioned returned because due to reciprocity so if someone sends more as the sender, they are likely to send more back as the receiver. There is a positive relationship with the responsiveness to the amount received in the trust game because someone who sends more is doing it because they expect reciprocity so they would give more back as a receiver to reciprocate the action.

Hypothesis 4: The average proportion returned will have a positive relationship with giving decision, a positive relationship with amount offered, a positive relationship with MAO, a positive relationship with amount sent, and a positive relationship with responsiveness to amount received.

Rationale: There is a positive relationship with the giving decision because if the dictator sends more money it is because of altruism so the average proportion returned would be higher. There is a positive relationship with the amount offered if the proposer offers more in the ultimatum game out of altruism instead of strategy, then he is likely to send a large amount back as the receiver. There is a positive relationship with the MAO because if the responder in the is altruistic then he will be willing to accept low amounts and he will give a larger proportion back back to the sender in the trust game. There is a positive relationship with the amount sent because someone who sends more is doing it because they expect reciprocity so they would return a larger proportion as the receiver to reciprocate the action. There

is a positive relationship with the the responsiveness to the amount received in the Trust Game because if the player is more responsive he will send back more money leading to a higher proportion returned.

Hypothesis 5: The responsiveness to amount received in the Trust Game will have a positive relationship with the giving decision, a positive relationship with amount offered, a positive relationship with MAO, a positive relationship with the average proportion returned in the Trust Game, and a positive relationship with amount sent.

Rationale: There is a positive relationship with the giving decision if a dictator sends more money, this would mean that he is more altruistic or exhibits inequality aversion since he has no pressure to send any money. Likewise, the receiver has no pressure from the sender to return money back to the sender. So the more money a person sends as a Dictator, the more money he will return as a Receiver. There is a positive relationship with the amount offered because if the proposer offers more in the ultimatum game out of altruism instead of strategy, then he is likely to send a generous amount back to the sender in the trust game. There is a positive relationship with the MAO because if the responder in the is altruistic then he will be willing to accept low amounts and he will give more back to the sender in the trust game. There is a positive relationship with the average proportion returned in the trust game because if the player is more responsive he will send back more money leading to a higher proportion returned. There is a positive relationship with the amount sent because someone who sends more is doing it because they expect reciprocity so they would give more back as a receiver to reciprocate the action.

Hypothesis 6: The strength of conditioning on the contributions of others has a positive relationship with the giving decision, a negative relationship with amount offered, a negative relationship with MAO, a negative relationship with the amount sent, a positive relationship with the average proportion returned, a positive relationship with the responsiveness to amount received, a positive relationship with the unconditional contribution, and a positive relationship with the average conditional contribution.

Rationale: There is a positive relationship with the amount given because the more the person gives altruistically, the more he will match others contributions to maximize overall payoffs. There is a negative relationship with amount offered which can be attributed to a strategist mindset: a strategist is a person who gives a high amount as a proposer because he wants to maximize his payoffs and any amount that is rejected will not accomplish this. However, a strategist would give a low amount as a conditional contribution because the payoffs have already been secured and giving an amount of zero would be

strategic to maximize payoffs. There is a negative relationship with the MAO in the trust game because in the trust game if the responder rejects low offers because of inequity aversion, then he will be a strong conditional cooperator in the public goods game.

There is a negative relationship with the amount sent if the sender is profit seeking and sends money with that motivation. This could cause them to send more to increase likeliness of a higher payoff and contribute less to the public good for the same reason. There is a positive relationship with the average proportion returned and responsiveness to amount received in the Trust Game because all three of these decisions are dependent on the contributions of others. For trust the amount he gives back is dependent on the sender and the total payout in the public goods is contingent on the other three people's contribution. So someone who has more money as a receiver will be likely to send a higher percentage back and for the conditional public goods the player is more likely to match the amount to maximize payoffs for everyone.T

There is a positive relationship with unconditional contribution someone who is willing to contribute their entire endowment as their unconditional contribution is more likely to give at least the average conditional contribution. The same goes for the opposite. Someone who contributes 0 as their unconditional contribution is more likely to contribute less than or equal to the average contribution during the conditional contribution. There is a positive relationship with the average conditional contribution because as a person's average conditional contribution increases, this means that he is more likely to give to the public good and likewise, a person with a stronger conditioning on the contributions of others is more likely to give to the public good if others contribute.

Hypothesis 7: The average conditional contribution has a positive relationship with the giving decision, a positive or negative relationship with the amount offered, a positive or negative relationship with the MAO, a positive or negative relationship with amount sent, a positive relationship with the average proportion returned, a positive relationship with the responsiveness to amount received in the Trust Game, a positive relationship with the unconditional contribution, and a positive relationship with strength of conditioning on the contributions of others.

Rationale: There is a positive relationship with the giving decision if a dictator gives more then that means that he is acting with altruistic behavior. Likewise, a conditional contribution is a choice made when the player has full information on the choices of others but only has personal motivations, again like altruism, that are independent of other players' because the other players have no way of retaliating against the person making the conditional contribution. So a person who gives more as a dictator is more

likely to give more as his conditional contribution. The relationship with amount offered can go either way depending if the person is a strategist or an altruist. The negative relationship can be attributed to a strategist mindset: a strategist is a person who gives a high amount as a proposer because he wants to maximize his payoffs and any amount that is rejected will not accomplish this. However, a strategist would give a low amount as a conditional contribution because the payoffs have already been secured and giving an amount of zero would be strategic to maximize payoffs. The positive relationship would be one where the person is an altruist. This person would give a high amount as a proposer because he is altruistic and would also give a high amount as a conditional contribution for the same reason, even though his payoff does not depend on how much he gives. The relationship with MAO can go either way. There is a positive relationship if the responder is altruistic than he are willing to accept low amounts in the trust game and will be a strong conditional cooperator in the public goods game. There is a negative relationship if the responder rejects low offers because of inequity aversion, then he will be a strong conditional cooperator in the public goods game.

The relationship with amount sent can go either way. There is a positive relationship when someone who sends the maximum amount in the trust game is more likely to contribute greater than or equal to the conditional contribution in the public goods game if they are giving out of altruism. There is also a negative relationship if the sender is profit seeking and sends money with that motivation. This could cause them to contribute less to the public good because they are trying to maximize their payoff. There is a positive relationship with the average proportion returned because both of these decisions are dependant on the contributions of others. For trust the amount he gives back is dependant on the sender and the total payout in the public goods is contingent on the other three people's contribution. So someone who has more money as a receiver will be likely to send a higher percentage back and for the conditional public goods the player is more likely to match the amount to maximize payoffs for everyone. There is a positive relationship with the responsiveness to the amount received in the Trust Game because they are linked by reciprocity and responsiveness. So if a player reciprocates more in the Trust Game they will likely reciprocate the conditional contribution in the Public Good Game.

There is a positive relationship with the unconditional contribution because someone who is willing to contribute high amounts unconditionally is also likely to give at least the average conditional contribution, if not more. The opposite is true for people who are less willing to contribute unconditionally; these people will give less than or equal to the average conditional contribution. There is a positive relationship with strength of conditioning on the contributions of others because as a person’s average conditional contribution increases, this means that he is more likely to give to the public good and

likewise, a person with a stronger conditioning on the contributions of others is more likely to give to the public good if others contribute.

Hypothesis 8: The unconditional contribution will have a positive relationship with the giving decision, a positive relationship with amount offered, a negative relationship with MAO, a positive relationship with amount sent, a positive relationship with the average proportion returned in the Trust Game, a positive relationship with responsiveness to amount received, a positive relationship with the strength of conditioning on the contributions of others, and a negative relationship with the average conditional contribution.

Rationale: There is a positive relationship with the giving decision because someone who offers more in the dictator game does it because of altruism so he is likely to offer more of his endowment in the public goods game. There is a positive relationship with amount offered because if a proposer sends more money, that means he is more altruistic or strategic. If the person is motivated by altruism and he offers more as a proposer, he will contribute more unconditionally because he has the expectation that others are also altruistic and expect others to do the same. There is a negative relationship with the MAO because if he is profit seeking then he will be willing to accept low amounts and have a high unconditional contribution in the public goods game.

There is a positive relationship with amount sent because if the sender gives his full endowment to the truster in the trust game, then the sender is trying to maximize the total profits and they have reached the socially optimal equilibrium. For the public goods game the unconditional contribution would also be the entire endowment because he is trying to maximize total payoffs and reach the socially optimal equilibrium. There is a positive relationship with the average proportion returned in the Trust Game because if the receiver in the trust game is altruistic then they will return a large proportion to the sender and they would have a high unconditional contribution sue to altruism as well. There is a positive relationship with the responsiveness to amount received because if the player will give more back that they receive then they are likely to have a high unconditional contribution.

There is a positive relationship with the conditioning on the contributions of others because someone who is willing to contribute a large amount to the unconditional contribution is more likely to give at least the average conditional contribution. There is a negative relationship with the average conditional contribution because is a player gives less as an unconditional contribution it is because he has a strong preference for fairness or inequity aversion. So he would contribute more to the average conditional contribution because he knows others contributions and the fair amount for him to contribute.

Chapter 4: Results

We conducted six sessions with eight subjects each, for a total of 48 subjects. The strategy method was used in all four games, giving us 1 decision in the Dictator Game, 12 decisions in the Ultimatum Bargaining, 12 decisions in the Trust Game and 12 decisions in the Public Good Game. This gave us 37 observations per subject, 296 observations per lab session and 1,176 observations in total. The payoffs in each game had the potential to range from $0.00 to $30.00. The average payoff from this experiment was $13.18 with a minimum of $0.00 and a maximum of $27.00.

The summary statistics are outlined in Table 1 below. The average giving amount in the Dictator Game was approximately $11.56, approximately one-third of the subject's initial endowment of $30. Comparing this to the literature, the number is slightly higher than the commonly occurring 20% giving of the initial endowment (Camerer, 2003).

For the Ultimatum Bargaining Game, we can compare statistics on the minimum acceptable offer and the offer to the literature. In our experiment, we see that the average MAO is $8.81, roughly 29% of the proposer's offer. This statistic is also a bit high compared to the 20% found in literature. Proposers in our experiment, gave an amount almost exactly the same as the amount expected of 40% of their endowment, $12.19 of the given $30.

In table 1, there are also statistics on the Trust Game for each proportion returned, represented by the "TG prX" and on the amount that was sent in the Trust Game. Our statistics for this game match up nicely to previous experiment results: Trustees typically return approximately an average of one-third the amount that they receive and Trusters send 50%, or $5.02, of their initial endowment of $10. The minimum amount given of $0 suggests that there were subjects that gave $0 and the maximum amount given is $10 which suggests that there were also subjects that gave all of their endowment, which matches previous experiments.

For the final game, the Public Good Game, Table 1 shows that the average unconditional contribution is approximately half of the $10 endowment and there are people giving $0 as well as $10. This shows that there are free-riders as well as perfect contributors. This is also the case for the minimum and maximum conditional contributions. However, for the conditional contributions we also observe that the amount contributed increases as the average amount contributed by others increases which is consistent with Fischbacher, Gaechter and Fehr (2001).

In our results, we will analyze patterns in the raw data for the Dictator Game, Ultimatum Bargaining Game, Trust Game, and Public Good Game variables. We will also discuss regressions between these games.

Statistical Summary of Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
DG Giving Decision	48	11.563	6.126	0	30
UG MAO	48	8.813	5.338	0	21
UG Offer	48	12.188	4.306	3	18
TG pr3	48	0.306	0.314	0	
TG pr6	48	0.330	0.272	0	1
TG pr9	48	0.326	0.260	0	1
TG pr12	48	0.335	0.247	0	1
TG pr15	48	0.364	0.237	0	1
TG pr18	48	0.367	0.222	0	0.667
TG pr21	48	0.367	0.216	0	0.667
TF pr24	48	0.364	0.216	0	0.667
TG pr27	48	0.363	0.214	0	0.667
TG pr30	48	0.353	0.220	0	0.667
TG Sent	48	5.021	3.125	0	10
PG Unconditional	48	5.063	3.405	0	10
PG Cond_0	48	0.792	2.526	0	10
PG Cond_1	48	1.188	2.349	0	10
PG Cond_2	48	1.771	2.252	0	10
PG Cond_3	48	2.333	2.291	0	10
PG Cond_4	48	3.438	2.858	0	10
PG Cond_5	48	4.125	2.818	0	10
PG Cond_6	48	4.688	2.955	0	10
PG Cond_7	48	5.208	3.121	0	10
PG Cond_8	48	5.5	3.513	0	10
PG Cond_9	48	6.208	3.632	0	10
PG Cond_10	48	6.708	4.026	0	10

Table 1: Summary Statistics

4.1 Dictator Game Results

In the Dictator Game, the mean amount given was $11.56. The distribution of offers is represented in in *Figure 1*. The most common offer was $15.00 with 18 subjects giving that amount. Traditional economic theory predicts that the dictator would give nothing because of self interest. Only four subjects followed theory and gave $0.00. The rest of the subjects diverged from traditional theory and we can attribute this behavior to altruism. Additionally, we see four subjects giving more than half of their money, suggesting that these may have been confused during this game.

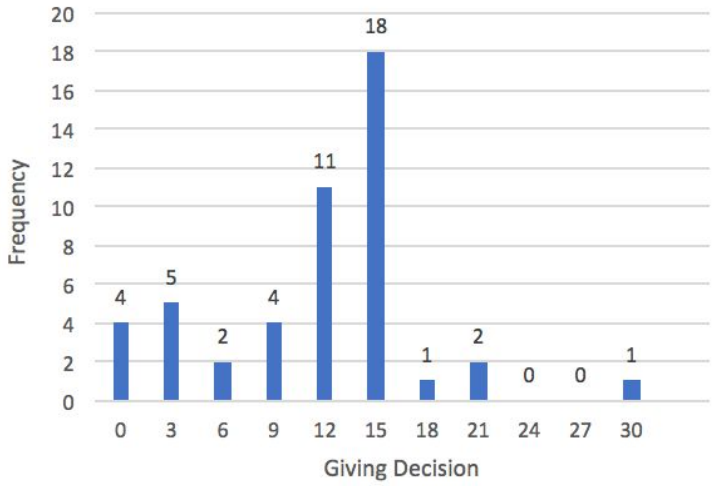

Figure 1. Giving Decision Amounts in the Dictator Game (Increments of 3, Max. 30)

4.2 Ultimatum Bargaining Game Results

In the Ultimatum Bargaining Game, the average amount offered was $12.18. The most common offer was $15.00 with 26 subjects offering that amount. Theory suggests that the proposer offers the minimum increment above $0.00 and the responder accepts any offer greater than $0.00. The proposer would not offer $0.00 because there is the possibility that the responder will reject due to the fact that there is no benefit either way. There were no $0.00 offers which can be attributed to strategy. However only 7 subjects gave the minimum increment above 0, the rest of the subjects gave more than that, as seen in *Figure 2*. One subject proposed an amount greater than half of the amount, which is unusual behavior.

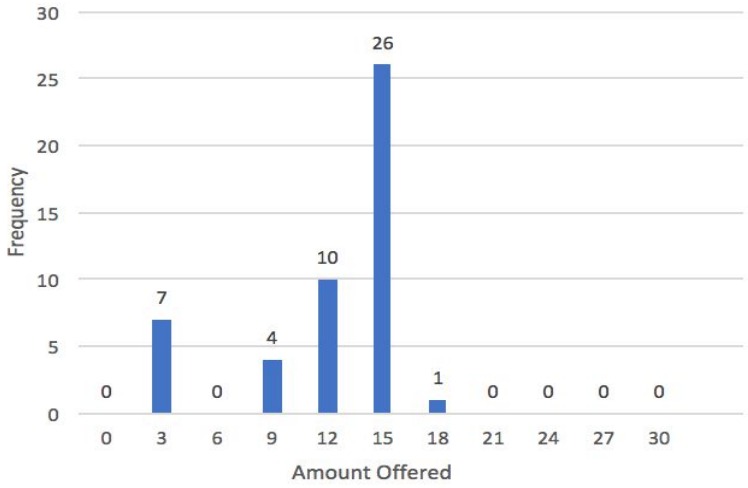

Figure 2. Ultimatum Bargaining Amount Offered (Increments of 3, Max. 30)

The average minimum acceptable offer was $8.18. Four subjects said that they would accept an offer of $0.00 and 11 subjects said they would accept an offer of $3.00 which adheres to traditional theory. The distribution of minimum acceptable offers can be seen in *Figure 3*.

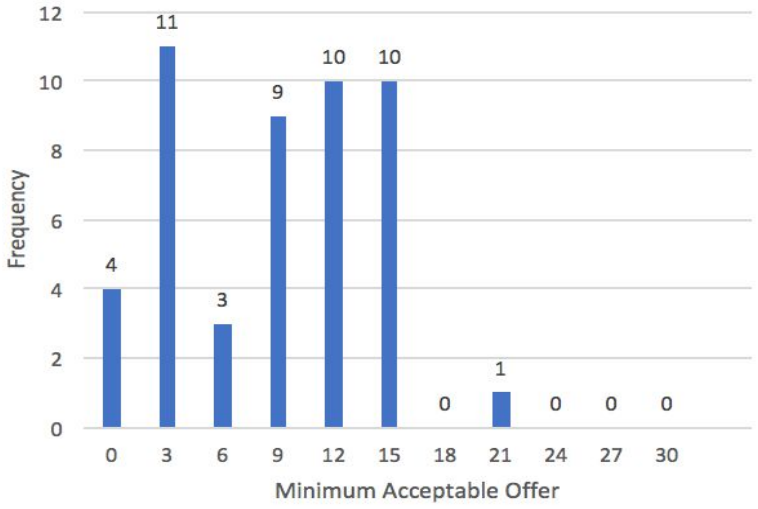

Figure 3. Ultimatum Bargaining Minimum Acceptable Offer Amounts (Increments of 3, Max. 30)

4.3 Trust Game Results

In the Trust Game, the average amount sent was $5.02 and the most common offer was $5.00 with 11 subjects offering that amount and the second most common offer was $10.00, the full endowment, with nine subjects offering that much. Traditional economic theory predicts that sender would not send any of their endowment and only 4 of the subjects played according to theory. The distribution of the amount sent can be seen in *Figure 4*.

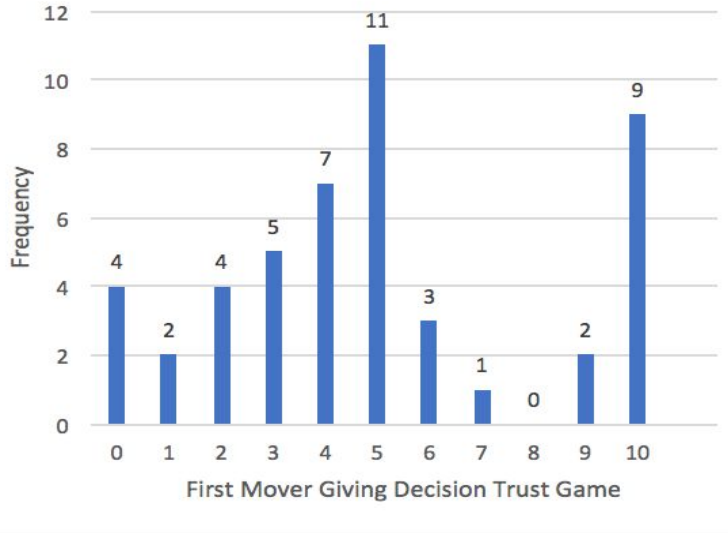

Figure 4. Trust Game Amount Sent (Increments of 1, Max. 10)

The average proportion returned from amount received was calculated by $\Sigma(\frac{Partner\ Amount\ Sent}{Amount\ Received})/n$, where n equals the number of participants. The proportions returned averaged between 30.6% and 36.7% for each of the potential amounts received. Traditional theory predicts that the responder would return nothing to the sender but the data shows that the responders did reciprocate.

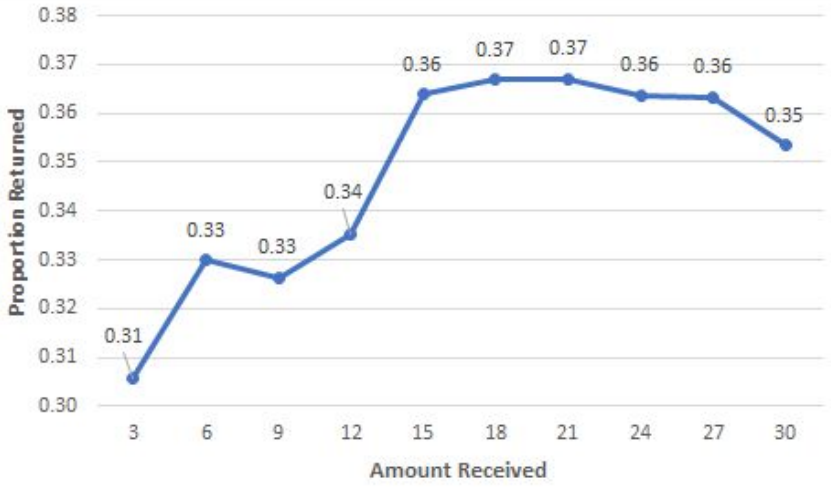

Figure 5. Trust Game Average Proportion Returned

For each subject, we individually regressed the proportion returned on the amount that was sent to the subject The Alphas represent the intercepts of these regression analyses and the Betas represent the slopes. The distribution of Alphas and Betas can be seen in *Figure 6* and *Figure 7*

The Beta shows how responsive people are to changes in the amount received. A negative Beta signifies that as the amount received increases, the person returns a smaller proportion. A Beta of 0 indicates that the amount received has no effect on the amount returned. A positive Beta means that as the amount received increases, so does the proportion returned. Theory predicts that a person would have a Beta of 0, since they would return 0 for each amount received. In our sample, 14 people had a positive Trust Game Beta and 5 had a negative Trust Game Beta. 27 people had a Beta close to zero.

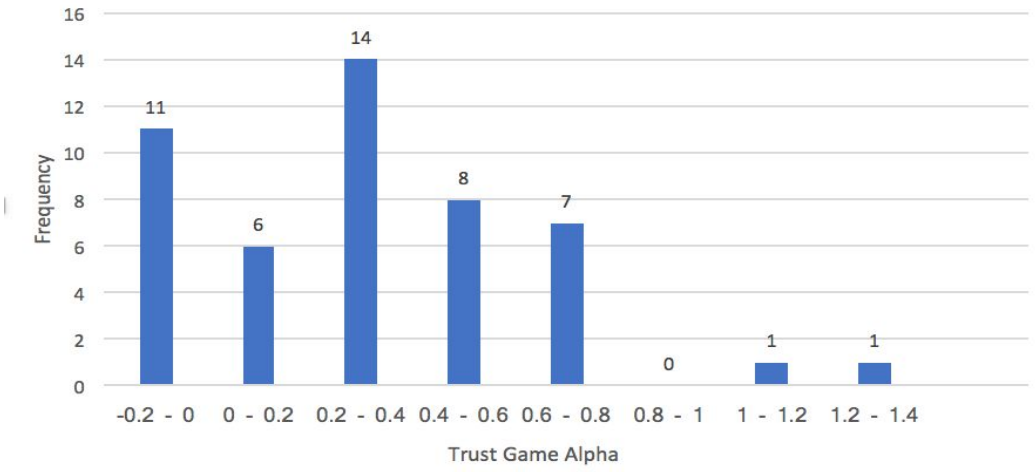

Figure 6. Trust Game Individual Alphas for Proportion Returned

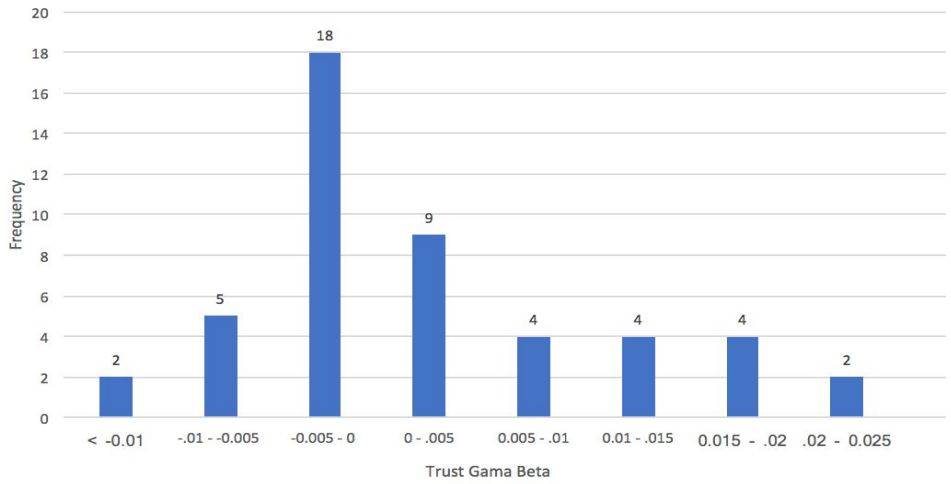

Figure 7. Trust Game Individual Betas for Proportion Returned

4.4 Public Good Game Results

In the Public Good Game, theory predicts that subjects do not contribute anything to the public good. The mean unconditional contribution was $5.06; however, the most common contribution was

$10.00, contributed by 10 subjects, the next was $5.00, contributed by 9 subjects, and then $0.00 and $4.00, contributed by 7 subjects each. The unconditional contributions can be seen in *Figure 8*.

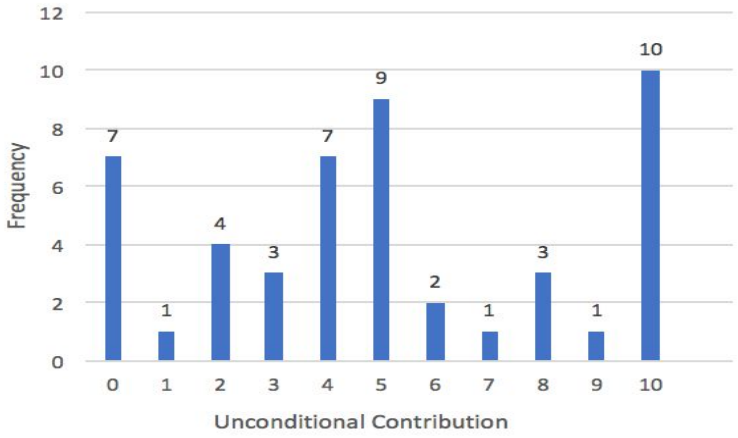

Figure 8. Public Good Unconditional Contributions

Figure 9 shows the average conditional contribution made by the subjects in the Public Good Game. This was calculated by $\Sigma(Conditional\ Contributions)/n$ for each of the amounts of Others Contributions where n equals the number of participants. We can see that the line is upwards sloping so as other's average contribution increased, the average conditional contribution increased. The increase in the average conditional contribution shows cooperation so when others contribute more and it is known to the subject, they are likely to reciprocate that action and cooperate to maximize the benefit to the public good.

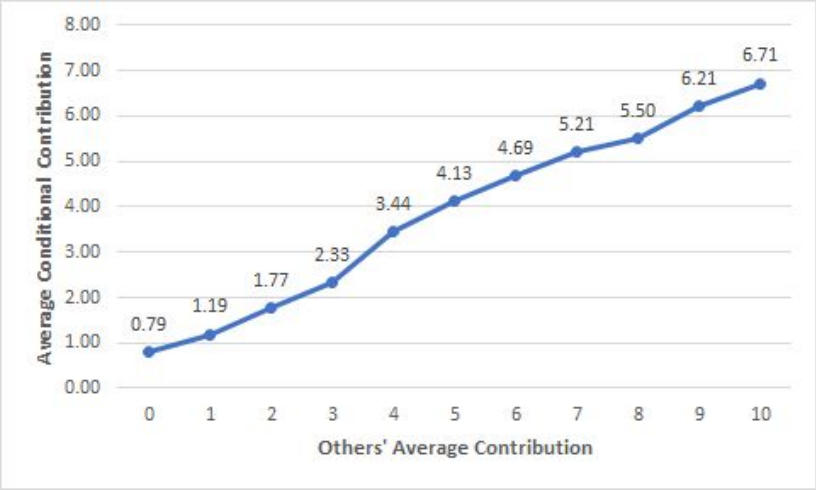

Figure 9. Average Conditional Contribution Based on Others Contributions

For each subject, we individually regressed the conditional contribution on the average contribution of others from the Public Good Game. The Alphas represent the intercepts of these regression analyses and the Betas represent the slope intercept. The distribution of Alphas and Betas can be seen in *Figure 10* and *Figure 11*.

The Public Good Beta shows how responsive people are to the average amount contributed by other members of the group.. A negative Beta signifies that as others' average amount contributed increases, the person contributes a smaller proportion. A Beta of 0 indicates that others' amount contributed has no effect on the amount returned. A positive Beta means that as others' average amount contributed increases, so does the proportion contributed. Theory predicts that a subject would have a Beta of 0, since he should not be contributing anything to the public good regardless of what others contributions are. In our sample, 27 people had a positive Public Good Beta and 2 had a negative Public Good Beta. 19 people had a Beta close to zero.

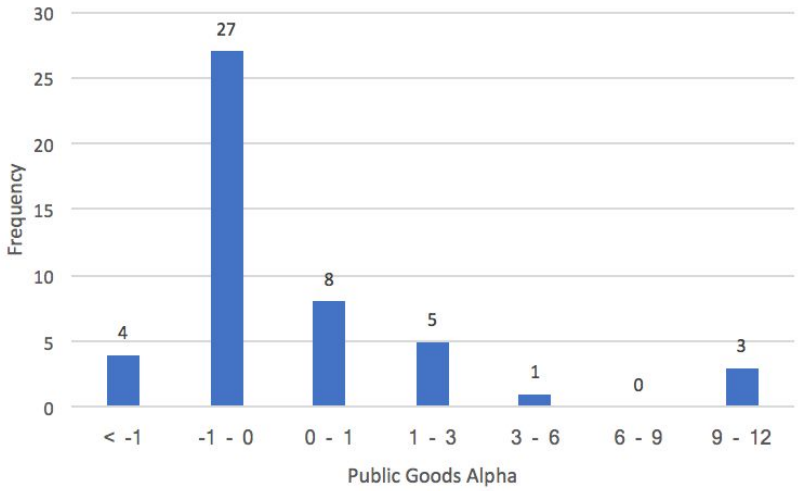

Figure 10. Public Good Game Individual Alphas for Conditional Contribution

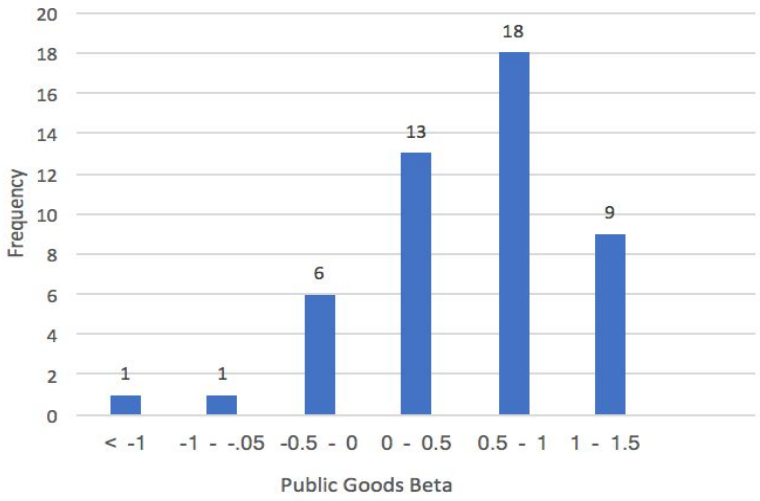

Figure 11. Public Good Game Individual Betas for Conditional Contribution

4.5 Regressions

In this section, we will present a total of 27 regressions on 8 different variables: Amount Offered, MAO, Amount Sent, Average Proportion Returned (a + 15b), TG Beta, PG Beta, Average Conditional Contribution (a + 5b), and Unconditional Contribution. The Average proportion returned which is referred to as a+15b in our regressions is the midpoint of the response function from the Trust Game and uses the Alphas and Betas described above and the number 15 is used because the subject has the potential to return anything from 0 to 30. The Average Conditional Contribution which is referred to as a+5b in our regressions is the midpoint of the response function from the Public Good Game. It also uses the Alphas and Betas found through the individual regression analyses and the number 5 is used because the subjects have the potential to return anything from 0 to 10.

For the purposes of the regressions, we analyze that the games - Dictator Game, Ultimatum Bargaining, Trust Game, Public Good Game - in order of increasing complexity. For each of our regression tables, we follow a similar structure: in the first regressions, the more primitive game variables are the focus (Dictator Game and Ultimatum Bargaining are grouped together in one regression table due to their similar nature and Trust Game variables tend to have a separate regression, if applicable). In the following regressions, we regress the other variables within the same game on the current variable of focus. In the final regression, we regress all other variables on the variable of choice to determine whether any variables maintain their significance.

	Amount Offered			MAO		
	1	2	3	4	5	6
Giving Decision	0.410***	-	0.397***	0.074	-	-0.101
	(0.084)		(0.082)	(0.128)		(0.153)
MAO	-	0.223*	0.184*	-	-	-
		(0.114)	(0.094)			
Amount Offered	-	-	-	-	0.343*	0.426*
					(0.175)	(0.217)
Constant	7.442	10.222	5.976	7.953	4.634	4.779
	(1.098)	(1.174)	(1.302)	(1.671)	(2.268)	(2.292)
# observations	48	48	48	48	48	48
R^2	0.341	0.077	0.393	0.007	0.076	0.085

Table 2: Ultimatum Bargaining Game Variables Regressed on Dictator Game Variables

The data shows a significant (at the 99% level) positive relationship between the giving decision from the dictator in the Dictator Game and the amount offered from the proposer in the Ultimatum Bargaining Game. This supports hypothesis 1 which says a subject who gives a lot of money as a dictator will likely give a lot of money as a proposer because they are being driven by altruism. These was also a significant positive relationship (at the 90% level) between amount offered and minimum acceptable offer (MAO) which suggests that the more someone offers as the proposer, the less they are willing to accept as the responder. There is a strong positive relationship (at the 90% level) between MAO and the amount offered in the Ultimatum Bargaining Game. This suggests that the if the subject has a higher MAO they will offer more and if they offer more they are likely to have a higher MAO which supports hypothesis 2.

	Amount Sent			Avg. Proportion Returned (a+15b)			TG Beta		
	1	2	3	4	5	6	7	8	9
Giving Decision	0.168**	-	0.074	0.020***	-	0.016***	-0.000	-	0.000
	(0.076)		(0.092)	(0.005)		(0.004)	(0.000)		(0.000)
Amount Offered	0.256**	-	0.161	0.011	-	0.012*	0.000	-	0.001*
	(0.112)		(0.119)	(0.007)		(0.006)	(0.001)		(0.000)
MAO	-0.042	-	-0.055	-(0.005)	-	0.001	0.000*	-	0.000
	(0.073)		(0.075)	(0.004)		(0.003)	(0.000)		(0.000)
Amount Sent	-	-	-	-	0.039***	0.014*	-	0.002***	0.001
					(0.007)	(0.007)		(0.000)	(0.000)
Avg. Proportion Returned (a+15b)	-	8,939***	5.358*	-	-	-	-	-0.028***	-0.040***
		(1.803)	(2.861)					(0.008)	(0.008)
TG Beta	-	101.294***	71.257	-	-8.283***	-8.567***	-	-	-
		(35.347)	(42.461)		(2.238)	(1.848)			
Constant	0.318	1.744	0.709	0.023	0.162	-0.044	-0.007	0.004	-0.007
	(1.191)	(0.744)	(1.196)	(0.073)	(0.046)	(0.062)	(0.004)	(0.003)	(0.004)
# observations	48	48	48	48	48	48	48	48	48
R^2	0.357	0.368	0.415	0.499	0.427	0.678	0.125	0.251	0.429

Table 3: Trust Game Variables Regressed on Dictator Game and Ultimatum Bargaining Variables

Table 3 shows a positive relationship (at the 90% level) between the average proportion returned (a + 15b) and the amount sent. This means that if a person sends more, then he will tend to return a higher average proportion. This would align with expectations: a person that sends more money and is trusting of others would return a greater proportion in the position of the receiver. This supports hypothesis 4 which says there is a positive relationship between the amount sent from the sender and the proportion returned from the receiver.

The average proportion returned also has a positive relationship to the giving decision (at the 99% level) which supports hypothesis 4. This means that a person returning a higher proportion of the amount that he received would also be willing to give more in the Dictator Game, ultimately linking trustworthiness and altruism. The more trustworthy a person is, the more altruism he will show. Also, there is a positive relationship (at the 90% level) between the average proportion returned to amount sent in the Trust Game which supports hypothesis 4. The data suggests that someone who returns a money as the receiver is likely to trust others more therefore send more of their endowment as the sender.

	PG Beta			
	1	2	3	4
Giving Decision	0.007	-	-	-0.006
	(0.015)			(0.014)
Amount Offered	0.026	-	-	-0.001
	(0.023)			(0.019)
MAO	-0.004	-	-	-0.014
	(0.015)			(0.011)
Amount Sent	-	-0.017	-	-0.018
		(0.025)		(0.029)
Avg. Proportion Returned (a+15b)	-	0.786**	-	0.262
		(0.376)		(0.500)
TG Beta	-	31.998***	-	34.423***
		(6.457)		(6.508)
Unconditional	-	-	0.014	-0.001
			(0.028)	(0.030)
Ave. Conditional (a+5b)	-	-	0.078*	0.116**
			(0.041)	(0.040)
Constant	0.250	0.369	0.247	0.318
	(0.240)	0.132	(0.141)	(0.182)
# observations	48	48	48	48
R^2	0.070	0.377	0.172	0.583

Table 4: PG Beta Regressed on Dictator Game, Ultimatum Bargaining Game, Trust Game, and Public Good Game Variables

Table 4 shows a positive relationship between the Trust Game Beta and the Public Good Beta (at the 99% level). This means that there are high levels of reciprocity in both games so reciprocity in the Trust Game can be predictive of high reciprocity in the Public Good Game. This supports hypothesis 6 which says that if the receiver in the Trust Game reciprocates the actions of the sender, then his conditional contribution in the Public Good Game will reciprocate the the actions of those around him and he is likely to cooperate. There is also a positive relationship between the average conditional contribution (a + 5b) and the Public Good Beta (at the 95% level). This would mean that the more a person contributes conditionally, the more they will contribute if other's unconditional contributions are greater which supports hypothesis 6.

Avg. Conditional Contribution (a+5b)				
	1	2	3	4
Giving Decision	0.153**	-	-	0.036
	(0.060)			(0.049)
Amount Offered	0.093	-	-	-0.049
	(0.089)			(0.067)
MAO	-0.073	-	-	0.019
	(0.059)			(0.049)
Amount Sent	-	0.018	-	-0.239**
		(0.116)		(0.098)
Avg. Proportion Returned (a+15b)	-	6.059***	-	4.451**
		(1.749)		(1.674)
TG Beta	-	9.241	-	-37.098
		(29.981)		(30.325)
Unconditional	-	-	0.405***	0.437***
			(0.078)	(0.084)
PG Beta	-	-	0.971*	1.519**
			(0.505)	(0.527)
Constant	1.553	1.618	1.166	0.456
	(0.0943)	(0.615)	(0.483)	(0.683)
# observations	48	48	48	48
R^2	0.274	0.323	0.481	0.723

Table 5: Average Conditional Contribution Regressed on Dictator Game, Ultimatum Bargaining Game, Trust Game and Public Good Game Variables

Table 5 shows a negative relationship (at a 95% level) between amount sent in the Trust Game and the public good beta which supports hypothesis 7. This could be because the subject sent a significant amount of money because they are profit seeking and not because of kindness. So this player would offer more money in the Trust Game and free ride with the conditional contribution of the Public Good Game.

This is consistent with Hypothesis 18 with the motivation being strategic, not altruistic. There is a positive relationship (at the 95% level) between the average conditional contribution in the Public Good Game and the average proportion returned in the Trust Game. This relationship says that high levels of reciprocity in the conditional contribution of the Public Good Game is predictive of high levels of reciprocity from the receiver in the Trust Game which supports hypothesis 7.

There is also a strong positive relationship between the ave conditional contribution and the unconditional contribution in the Public Good Game. This says that high conditional contributions to the public good are predictive of a high unconditional contribution. This supports hypothesis 7 which also says that if someone contributes very little to the conditional contribution and free rides, then they are likely to contribute a minimal amount of his endowment to the unconditional contribution and continue to free ride.

	Unconditional Contribution			
	1	2	3	4
Giving Decision	0.116	-	-	0.005
	(0.087)			(0.073)
Amount Offered	0.315**	-	-	0.167
	(0.129)			(0.096)*
MAO	-0.126	-	-	-0.049
	(0.085)			(0.061)
Amount Sent	-	0.677***	-	0.604***
		(0.161)		(0.158)
Avg. Proportion Returned (a+15b)	-	0.346	-	-6.952**
		(2.414)		(2.448)
TG Beta	-	-9.223	-	-32.154
		(41.402)		(45.378)
Ave. Conditional (a+5b)	-	-	0.932***	0.933***
			(0.178)	(0.184)
PG Beta	-	-	0.404	-0.023
			(0.795)	(0.858)
Constant	0.998	1.562	1.260	-0.712
	(1.367)	(0.849)	(0.756)	(1.008)
# observations	48	48	48	48
R^2	0.287	0.396	0.442	0.718

Table 6: Unconditional Contribution Regressed on Dictator Game, Ultimatum Bargaining Game, Trust Game and Public Good Game Variables

There is a significant relationship (at the 99% level) between the amount sent in the Trust Game and the unconditional contribution in the Public Good Game that supports hypothesis 8. This says that if the sender sends more money it is because he is trying to maximize his profits so therefore he would send more as his unconditional contribution because he is also trying to either maximize the payoff in that game or is expecting reciprocity from the responder. There is also a significant relationship between the unconditional contribution and the average conditional contribution in the Public Good Game (at the 99% level) which supports hypothesis 8. The data suggests that someone who is willing to contribute more of their endowment as their unconditional contribution would give at least the average for their conditional contribution.

There is also a significant negative relationship (at the 95% level) between the unconditional contribution in the Public Good Game and the average proportion returned in the Trust Game. This could be due to multicollinearity because it is suggests that the more you contribute as your unconditional contribution, the less you return in the Trust Game which is inconsistent with our other findings.

Chapter 5: Conclusion

Overall, our findings showed support for several of our hypotheses regarding relationships between behaviors in different games. One of our major findings is that the giving decision in the Dictator Game is highly predictive of the amount offered in the Ultimatum Bargaining Game and the proportion returned in the Trust Game. With this information we can determine that these behaviors are driven by altruism more than strategy. Another major finding is that there is a strong relationship between the reciprocity in the Trust Game and the strength of conditioning on the contributions of others in the Public Good Game. This also has important applications outside of these games because if you know that a person will reciprocate because of behavior in the Public Good Game you can trust them more in other instances, such as in the Trust Game, or maybe even any situation resembling the Trust Game.

The idea that behavior in one game is predictive of behavior in another game indicates that a person's characteristics when handling economic decisions are linked to each other. This suggests that in the future, predicting a person's propensity to free ride may be made easier through analysis of other economic decisions, such as their willingness to give to charity. These results could have extensive applications to public policy in the future, as more experiments are conducted on the subject. Additional research opportunities could be conducting a similar experiment with different games that measure similar characteristics, replicating the experiment with increased stakes, and increasing group size in some games (such as the public goods game, due to the increased likeliness of people to free ride in a larger group).

In this study we found that there is validity to looking at the behaviors across games because behavior in one game is predictive of behaviors in other games. It shows that knowing behavior from one game can predict behavior outside of that specific game.

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Appendix A: Instructions

This is an experiment in decision-making. It lasts about 45 minutes. The allocation decisions that you make will result in actual monetary payoffs paid in cash at the end of the experiment. Please do not talk to others during the experiment. If you have a question, raise your hand, and we will help you.

The experiment consists of four tasks, each with a unique potential monetary payoff. You are to complete all four tasks. We will explain each task immediately before it begins. You will input your allocation decisions using your computer. After all tasks are completed, the computer will randomly determine and inform you of which potential payoff you will receive as an actual payoff.

During each task, you will receive information that is relevant to determining your potential payoff for that task. Since you will not know (while making your decisions) which task will be used for determining your actual payoff, you should make all of your decisions carefully.

After you receive final information on your actual monetary payoff (cash at the end of the study), we will ask you some demographic and contact information. Payments will then be made in a private manner.

Are there any questions?

Are you ready for the instructions for Task 1?

A1: Task 1

Task 1 is called the giving game. Two people are randomly paired, and one person within each pair is randomly chosen to be the giver; the other becomes the recipient. The giver is provided with $30 (the recipient is provided with nothing). The giver must decide how much of the $30 to give to the recipient (a multiple of 3 between 0 and 30, inclusive. Ex: 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, or 30). The giver keeps the rest of the $30. For this task, everyone will make a giving decision, but once all decisions are made the computer will randomly decide who is the giver.

Payoffs:

If Task 1 is later chosen randomly by the computer to determine actual monetary payoffs, there are two possibilities:

1) You are randomly chosen to be the giver and your giving decision will determine how the

$30 is divided between you and the person with whom you are randomly paired.

2) You are not chosen to be the giver and the other person's giving decision will determine how much of the $30 you receive.

Are there any questions?

Are you ready to do the decision-making for Task 1?

A2: Task 2

Task 2 is called the propose and respond game. Two people are randomly paired, and one person within each pair is randomly chosen to be the proposer; the other becomes the responder. The proposer is provided with $30. The proposer offers some part of the $30 (a multiple of 3 between 0 and 30, inclusive) to the responder. The responder either accepts or rejects the offer. If the responder accepts, the responder receives the offer as his potential payoff, and the proposer keeps the $30 minus the offer as his potential payoff. If the responder rejects the offer, both people get nothing as their potential payoffs, and the game is over.

For this task, everyone will make decisions for both the roles of proposer and responder. To clarify, you will make two decision plans: how much to offer as a proposer and whether you will accept or reject each potential offer amount. These decisions will determine your potential payoff for this task.

Payoffs:

If Task 2 is later chosen randomly by the computer to determine actual monetary payoffs, there are two possibilities:

1) You are randomly chosen to be the proposer and your offer decision plan will determine how much you offer to the responder. The other person's accept/reject decision plan will determine whether your offer is accepted.

2) You are randomly chosen to be the responder and your accept/reject decision plan will determine whether you accept or reject the proposer's offer.

Are there any questions?

Are you ready to do the decision-making for Task 2?

A3: Task 3

Task 3 is called the send and return game. Two people are randomly paired, and one person within each pair is randomly chosen to be the sender; the other becomes the receiver. Both people start with $10. The sender decides how much of his $10 (a whole number between 0 and 10, inclusive) to send to the receiver. The amount sent is tripled before it is received by the receiver (this means that the receiver could potentially receive any amount between $0 and $30, in increments of $3). The receiver will then have his starting $10 plus the amount he received. The sender will have $10 minus the amount sent. The receiver then chooses how much of the amount received (a whole number between 0 and the amount received, inclusive) to return to the sender. The receiver keeps the rest as a potential payoff. The sender gets $10 less the amount sent, plus the amount that the receiver chose to return as a potential payoff, and the game is over.

Everyone will make decisions for both the roles of sender and receiver. To clarify, you will make two decision plans: how much to send (a whole number between 0 and 10, inclusive) and how much to return for every possible amount received (whole numbers between 0 and the amount received, inclusive).

Payoffs:

If Task 3 is later chosen randomly by the computer to determine actual monetary payoffs, there are two possibilities:

1) You are randomly chosen to be the sender and your "send" decision plan will determine how much you send to the receiver. The receiver's return decision plan will determine how much you get back from the receiver, and therefore, how much you get as a payoff.

2) You are randomly chosen to be the receiver and the other player's "send" plan will determine how much you receive, and then your "return" plan will determine how much you keep (and give back to the sender). The sum of your starting $10 and the part that you receive from the sender that you keep will be your payoff.

Are there any questions?

Are you ready to do the decision-making for Task 3?

A4: Task 4

Task 4 is called the contribution game. Everyone is randomly assigned to groups of 4. Each person starts with $10. Each person decides how much of his $10 (a whole number between 0 and 10, inclusive) to contribute to the "group account." Any amounts not contributed are simply kept by the person. The sum of all four people's contributions to the group account is doubled, and then divided evenly among all four people in the group – this is equivalent to returning 0.5 times the sum of contributions to each person in the group. Therefore, payoffs in the contribution game can be calculated using the following equation:

$$payoff = 10 - individual\ contribution + \frac{2 * sum\ of\ contributions}{4\ people}$$

For this task, everyone will make two contribution plans. The first one will be an "unconditional" contribution, which will not depend on how much others contribute. You simply choose a contribution amount (whole number between 0 and 10, inclusive).

The second contribution plan is "conditional" and depends on how much others contribute. Based on the average contribution of the other three people in your group (rounded to the nearest whole number), you will choose how much of your $10 you would like to contribute (a whole number between 0 and 10, inclusive).

You should make all of your contribution decisions carefully because when you make them, you will not know which one will be relevant for determining actual monetary payoffs.

Payoffs:

If Task 4 is later chosen randomly by the computer to determine actual monetary payoffs, the computer will follow these steps:

1) The computer randomly chooses 3 out of the 4 people in the group to have their unconditional contributions count as their actual contributions.
2) The fourth person's conditional contribution is determined based on the three other unconditional (now actual) contributions.
3) Actual payoffs are now determined using the payoff equation and all players' contribution amounts, as determined by steps 1) and 2).

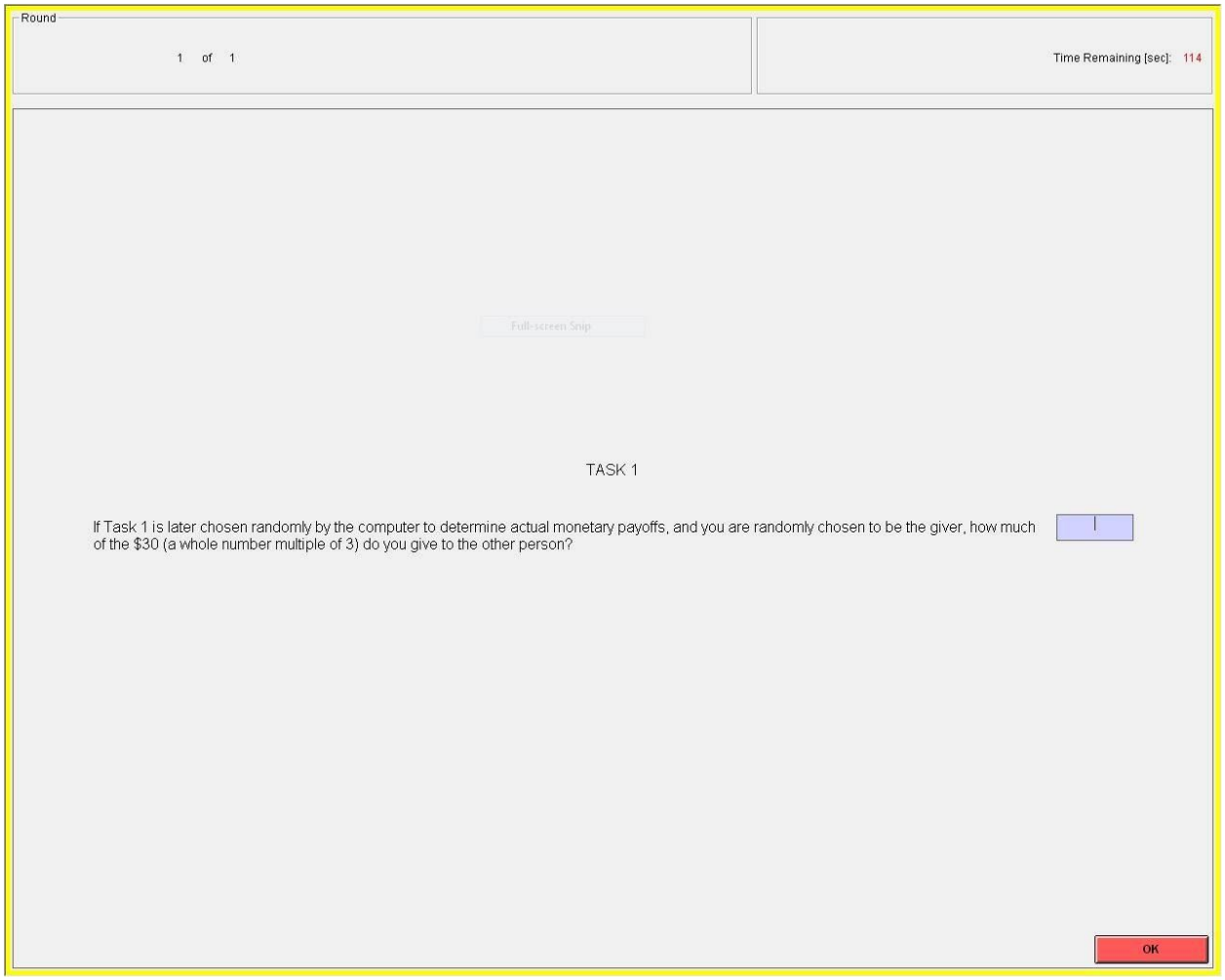
Are there any questions?

Are you ready to do the decision-making for Task 4?

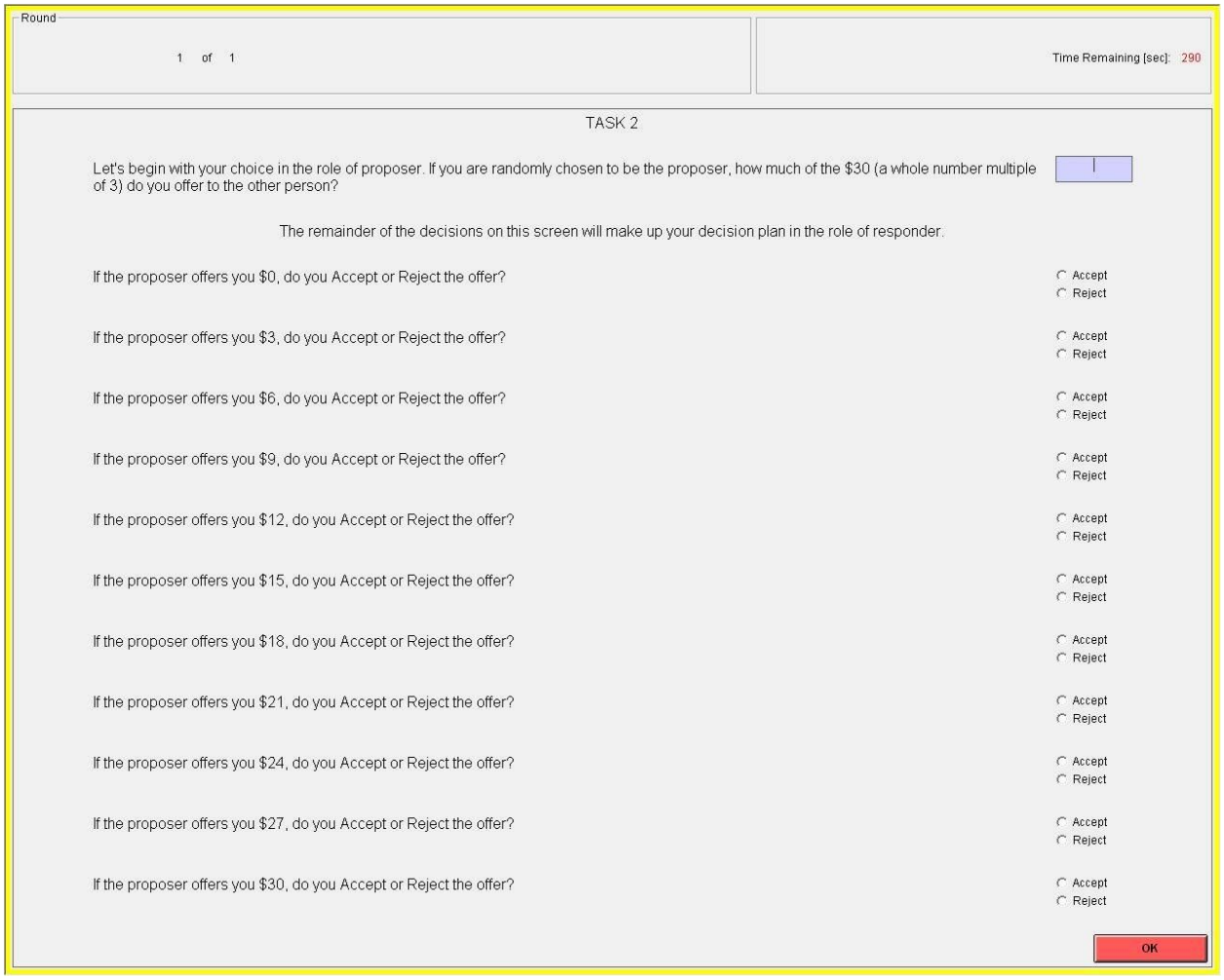
Appendix B: Screenshots

The following appendices present screenshots of what subjects saw during the experiment session.

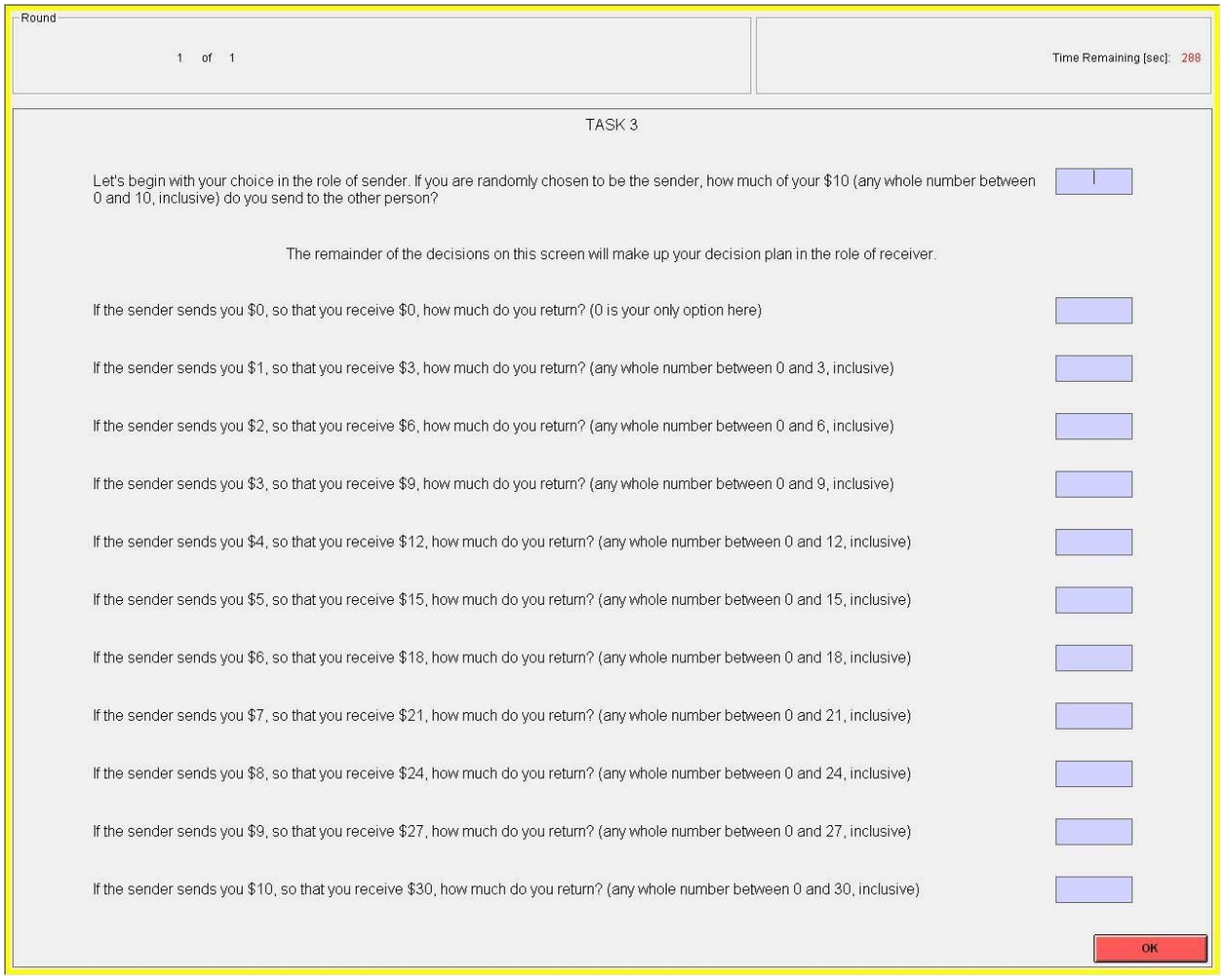
B1: Task 1 Screenshot



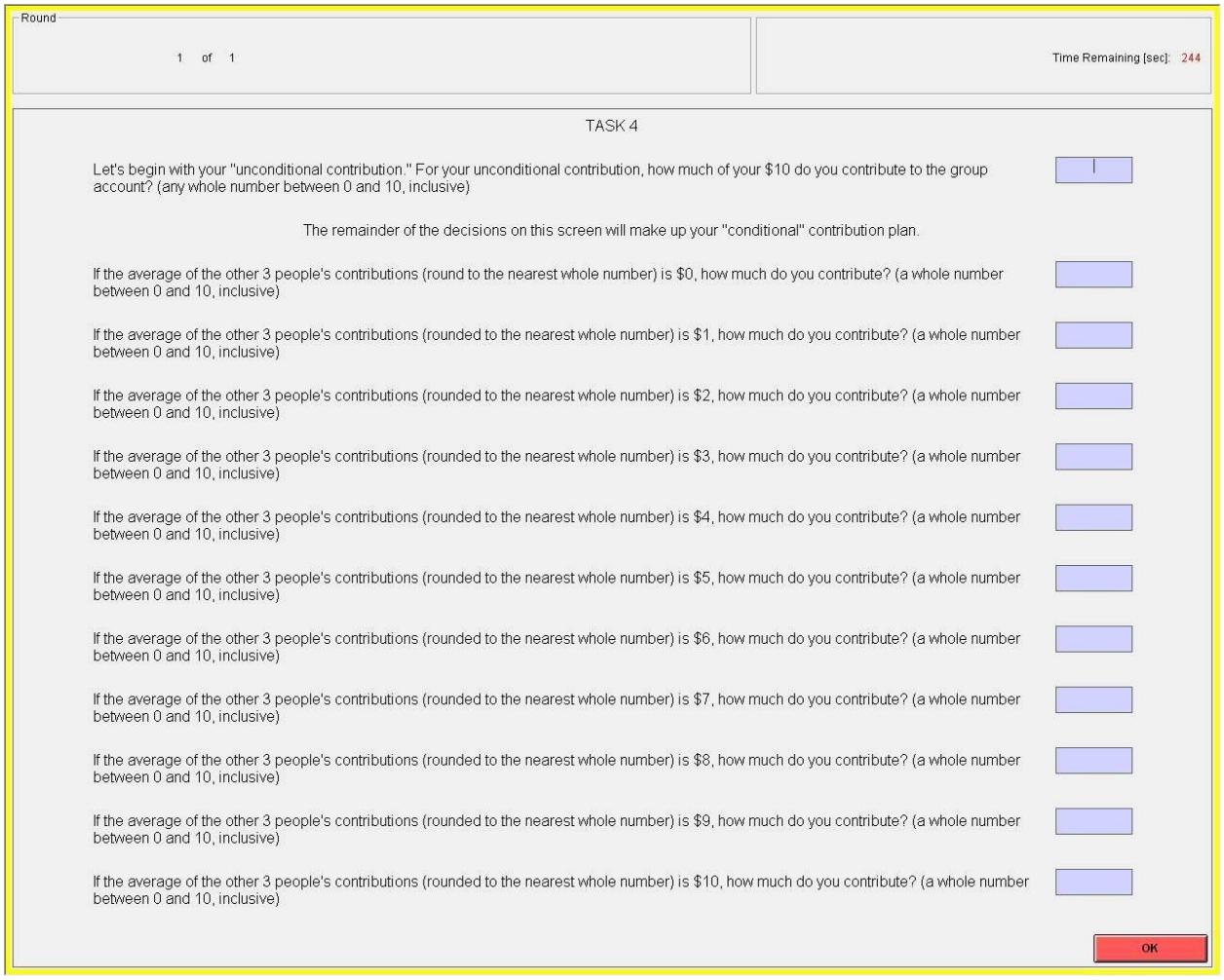
B2: Task 2 Screenshot



B3: Task 3 Screenshot



B4: Task 4 Screenshot



B5: Payoff Feedback Screenshot