

The Role of Guilt in Cooperation

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Abstract

This experiment looked at how the presence or absence of guilt influences cooperation. Expressing guilt may be a way to signal that one regrets his or her previous decision to under-contribute in a collective action. Without negative emotions among members, continued cooperation might be possible. To test this, a modified Voluntary Contribution Mechanism was used. Participants were placed in groups of four and given an endowment. They had to decide how much of the endowment to contribute to the group project and how much to keep for themselves. Their income for each period is calculated by adding the tokens they kept for themselves and their income from the group project. Each person's earnings from the group project was calculated by multiplying the total contribution of everyone by 0.4. At the end of every period, participants could give back to the group any portion of their earnings from the group project. To the extent that returning earnings could be seen as guilt, this experiment looked at the role of guilt in cooperation. The results show that the more guilt others show in the previous period, the higher one's contribution will be the following period.

A group of Amish men is working together to raise a barn for the whole community. At an elementary school, a study group is putting the final touches on a school project. And at a housing cooperative, all of the members have agreed to clean their house over the weekend. Wherever we go, it is easy to find a group of people engaging in collective action—working together to achieve a common goal and sharing the resulting benefits.

Although it seems obvious that individuals with shared interests will work together, there is a hidden problem. What if an Amish man stays home while the rest raise the barn? What if a student feigns sickness leaving her classmates to finish the project? What if a co-op member invests minimal effort, knowing the other housemates will clean? The existence of these free riders—individuals who do not contribute to a collective action—threaten cooperation in their groups. Unless they are excluded, punished, or given incentives to become cooperators, cooperation will unravel because other individuals will reduce their cooperation in response to others' free riding (Fehr & Gächter, 2001). Given the damage caused by free riders both in modern societies and throughout human evolution, it is important to map the mechanisms humans use to solve the free rider problem.

The evolution of human cooperation has been the subject of much debate among behavioral and social scientists. Some of the theories that have been proposed to explain human cooperation are the theories of kin selection, direct reciprocity, indirect reciprocity, and costly signaling. Kin selection explains why a person is more likely to help out individuals who are closely related to him or her genetically (Hamilton, 1964). Direct reciprocity theories deal with selfish incentives in long-term interactions while indirect reciprocity and costly signaling focus

on the importance of reputation-formation (Trivers, 1971; Axelrod and Hamilton, 1981). These theories, however, fail to explain why we see cooperation between non-kin, in one-shot interactions, and when the benefit of reputation-formation is minimal or non-existent. One explanation that has been proposed that could increase cooperation among group members is punishment (Fehr and Gächter, 2001). It has been shown that cooperation may persist when group members are given the opportunity to punish members who are not contributing enough to a collective action. The goal of this research is to look for other mechanisms that could potentially sustain cooperation in groups. More specifically, I would like to investigate the role of guilt in cooperation.

I. Research Question

How does the presence or absence of guilt influence cooperation among group members?

Imagine you are stranded in an island with three other people. All of you have decided to look for food and agreed to divide whatever food you found equally among every person in the group. Three of you were able to bring back food to your camp, but one person forgot that he needed to forage. Feeling guilty because of his carelessness, he decides not to eat any of the food that you and the other members brought back to camp. The following day all of you will once again look for food. How much effort will you put towards looking for food for the group?

Now, imagine the opposite scenario in which the person who forgot to forage actually ate some of the food that you and the other two members brought back to camp. In that scenario, how much effort will you put towards looking for food for the group the following day?

In the second scenario, one might be more inclined to look for food for oneself and not share with the rest of the group if one of the group members is free-riding. Theoretically, it may be possible that expressing guilt may be a way to signal to the group that you are not a threat because you are not intentionally free riding. Without negative emotions between members, continued cooperation might still be possible.

Thus, I hypothesize that in groups where under-contributors show guilt, cooperation will remain stable or decline at a slow rate. If under-contributors do not show guilt, however, cooperation over time will decline at a fast rate.

II. Literature Review

Evolutionary Psychology and Emotions

Evolutionary psychology is an approach to studying human behavior, and is informed by the fact that evolutionary processes shaped the architecture of the human mind. It assumes that the mind contains numerous evolved psychological mechanisms designed by natural selection to solve adaptive problems that arose during human evolutionary history (Tooby & Cosmides, 1992). The existence of these mechanisms, however, presents a problem. It is possible that one mechanism might conflict with the function of another mechanism if both of them are activated at the same time. To avoid this problem, the mind must consist of superordinate programs that deactivate some mechanisms when others are activated. In other words, the mechanisms of the mind need to be coordinated. Tooby and Cosmides (2008) argue that the coordination of psychological mechanisms is accomplished by emotions that evolved to solve superordinate demands. One example of an emotional program is anger. Sell, Tooby, and Cosmides (2009) proposed that anger is produced by a neurocognitive program for bargaining and resolving conflicts of interests in favor of the angry person. Like anger, guilt could be another evolved emotional program that could influence economic decision making. Expressing guilt could be a way of repairing one's reputation as a group member and could help sustain group cooperation.

Cooperators, Conditional Cooperators, and Free Riders

Cooperation in public goods game tends to be higher than what neoclassical economic theory predicts (Ledyard, 1995). The type of cooperation that researchers see in the lab, however,

tends to be heterogeneous. Cooperation also has a tendency to decline in repeated interactions when group membership changes in every period and even when it is held constant. Fischbacher, Gächter, and Fehr (2001) sought to find the causes for these phenomena. One explanation they investigated was the existence of “conditional cooperators”. Conditional cooperators are people who are willing to contribute more to a public good as the contribution of other people in the group increases.

To check for the existence of conditional cooperators, Fischbacher, Gächter, and Fehr had participants play a linear public goods game. They asked participants to make two types of decisions. First, subjects had to make a single decision on how much of their endowment they want to contribute to a group project. After making their decision, they had to fill out a contribution table in which they had to specify how much they would contribute in response to each of the 21 possible average contribution levels of the other members of the group.

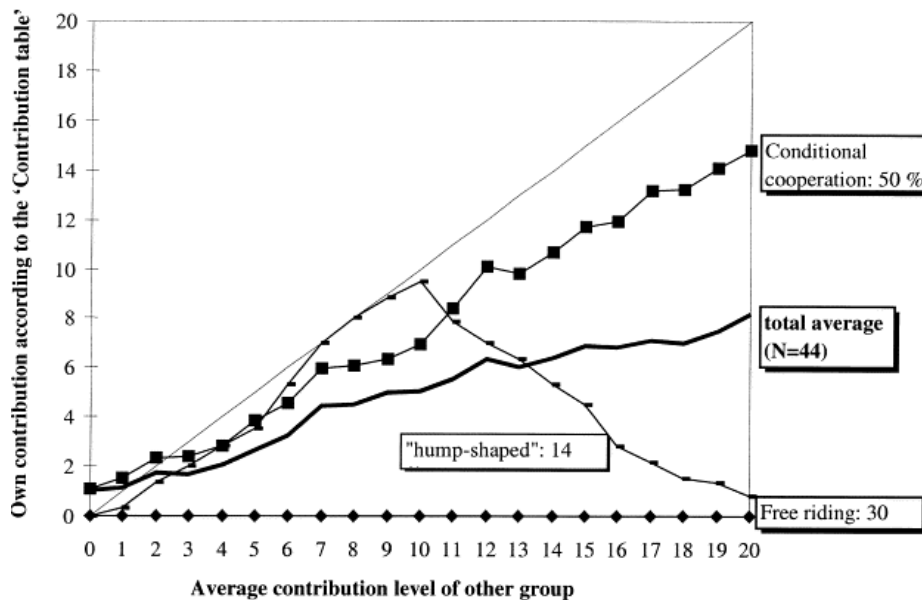


Figure 2.1 Average contribution level as a response to contribution level of other members of the group.

The results of their experiment are summarized in the Figure 2.1. As shown on the graph, 50% of participants fall under the category of conditional cooperators. Free riders made up about 30% of the participants. 14% are hump-shaped contributors who were conditional cooperators in the first half, but decided to decrease their contribution thereafter. This shows that continued cooperation in groups depends on the level of cooperation of the conditional cooperators. Using mechanisms that encourage conditional cooperators to continue contributing is the key to preventing the decline of overall group cooperation.

Guilt Aversion

Charness and Dufwenberg (2006) argued that when a person believes he or she has let someone down, he or she experiences guilt and may try to minimize it. They refer to this type of motivation as guilt aversion. A player that is guilt averse is motivated by his or her “beliefs about others’ beliefs.” The concept of guilt aversion has theoretical support from social psychology. Research in that field suggests that those who cause harm onto others suffer from guilt (Baumeister, Stillwell, & Heatherton, 1994). Also, fMRI studies show that the medial prefrontal cortex, left posterior superior temporal sulcus, and visual cortex, which are areas associated with social cognition are activated when individuals are shown sentences that involve guilt (Takahashi et al., 2004).

To test the concept of guilt aversion, Charness and Dufwenberg looked at how communication affects behavior in a one-shot principal-agent game. The results of their experiment show that promises that the agents send to the principals can improve trust and cooperation. This is consistent with the concept of guilt aversion that predicts that the more the agent believes the principal is expecting to be helped, the more likely he or she will help the principal.

The fact that guilt aversion was able to increase cooperation in a trust game is consistent with the theory that guilt might be an emotional program that could save partnerships or foster cooperation in groups.

Disposition, History, and Contributions

The Voluntary Contribution Mechanism can be a useful tool in investigating the interaction between individual players' experiences and cooperative dispositions. Gunthorsdottir, Houser, and McCabe (2006) had participants play a ten-round VCM in groups of four. They were given 100 tokens at the beginning of each round. The private account returned one cent while the group account had a specified marginal per capita return (MPCR). Participants were grouped using two different rules. The two rules were crossed with three MPCR levels: 0.30, 0.50, 0.75. The baseline condition was grouped randomly. In the "sorted" condition, participants are grouped based on their contribution level at the end of every round. The four highest investors are grouped together. The next four are grouped together, and so on.

The results of the experiment are shown in Figure 2.2. The results for the random treatments were similar to common findings in public goods games. For the sorted treatments, on the other hand, it was found that when the MPCR is high, contributions are also high, and cooperative decay slows down. When the experimenters type-classified the participants into free-riders and cooperators, they found that for each MPCR, the contributions of the cooperators in the sorted condition were higher than the contribution of the cooperators in the random condition. The sorted treatment gave cooperators a better net group contribution by decreasing their encounters with free riders. These results show that contribution levels can improve by decreasing the number of times cooperators and conditional cooperators interact with free riders.

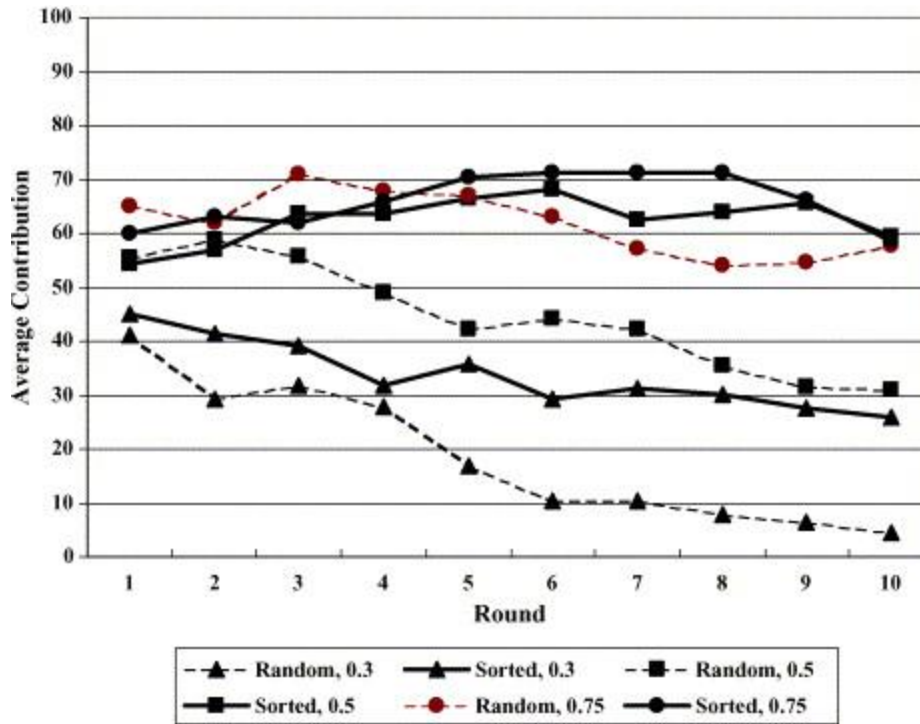


Figure 1.2 Mean contribution for each round by mechanism and MPCR.

Altruistic Punishment

Cooperation in a public goods game tends to decrease over time in repeated interactions. This is true in cases where participants played with different group members in every period and also in cases where group composition remained constant. But as Fehr and Gächter (2001) demonstrated, punishment is one of the possible solutions that can help prevent cooperation from unraveling. If free riders are punished, cooperation might flourish. Also, if free riding were minimized by punishment, the whole group would benefit, so it might be in the best interest of group members to punish a free rider even if it means they will have to pay a small cost to punish that member. Such an act is referred to as altruistic punishment. It means that people will punish another person despite the fact that punishing is costly to them and will not give them any direct monetary gain.

To test for the existence of altruistic punishment in humans, Fehr and Gächter (2001) conducted a public goods game where each group member received an endowment, and they had to choose how much of it to contribute to a group project. Participants will get to keep the money that is not placed in the group project. Their experiment had two conditions. In one of the conditions, members are allowed to punish their group mates, and in the other conditions, members did not have the option to punish. A person who decides to punish another individual will incur a small cost for punishing. The results for the experiment are shown in Figure 2.3.

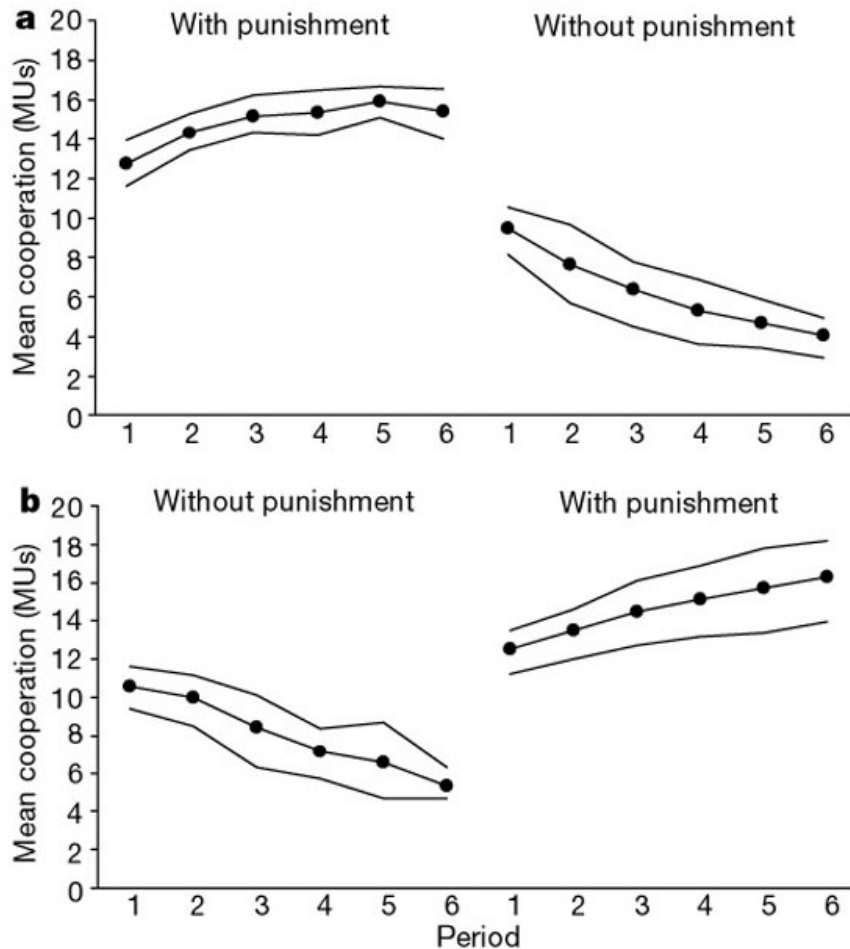


Figure 2.3 Time trend of mean cooperation in an experiment that involves periods with punishment and without punishment.

The results show that having the option to punish individuals who under-contribute can increase the mean cooperation of members in a group. It could also prevent the decline of group cooperation. The experiment found that most of the punishing was performed by cooperators. Even in one-shot interactions, players tend to punish free riders even when it is costly for them to do so. This type of behavior is consistent with the idea that emotions can influence economic decision-making. Free riding might elicit negative emotions from cooperators, and these negative emotions could trigger cooperators to punish free riders.

The design of this experiment most closely resembles the design of Fehr and Gächter's experiment on altruistic punishment. They looked at how punishment can influence cooperation in groups. This experiment, on the other hand, investigates whether or not showing guilt in one's previous action can influence the level of contributions in a public goods game. The same VCM was used in this experiment. But instead of having the option to punish, participants had the option to return none, some, or all of their income from the group project. This particular amendment to the VCM, to the best of my knowledge, has never been done before. The reason why I introduced this amendment to the game is because it might be possible that some players decide to contribute few or no tokens at all to the group project not because they want to receive the return on the group project without incurring some personal costs, but because they just happen to be risk averse or simply afraid that they will be taken advantage of by other players. From this point on, I will refer to this type of players as unintentional free riders.

If some players under-contribute because of the latter reasons and not because of intentional free riding, then it follows that those players should be willing to turn down their share of the payoffs from the public account when given the option. If a player were free riding intentionally, however, then that player would always choose to accept his or her share of the

return from the public account whenever the opportunity arises.

If an unintentional free rider were part of a group in which everyone else contributed a fair amount of tokens to the public account, that player might develop a feeling of guilt, which could potentially lead him or her to turn down his or her share of the public account. On the other hand, I would expect an intentional free rider under the same scenario to fail to develop a feeling of guilt for his or her actions because that particular scenario is exactly what he or she would like to see happen. The intentional free rider's lack of guilt might lead that person to accept his or her share of the public account.

III. Method

Participants

44 undergraduate students (23 female) from the University of California, Santa

Barbara participated in this experiment. The average age of the participants was 22. They were recruited from a subject pool that included persons from different disciplines. Each participant was paid for his or her participation. The amount of money they received depended on their performance in the public goods game that they played.

Apparatus

The experiment was programmed and conducted in a computer lab with the software z-tree (Fischbacher, 2007). Each computer monitor was equipped with a privacy screen to ensure the anonymity of each player. A questionnaire was used to collect demographic and personality questions after participants played the VCM.

Procedure

I ran an experiment using the Voluntary Contribution Mechanism. The experiment had two conditions. In the experimental condition, participants played a finitely repeated VCM. They were randomly assigned into groups of four to increase the possibility of there being a low contributing member in the group. Participants were given an endowment of 20 tokens in each of the ten rounds of the game. Their task was to decide how much of their endowment to keep for themselves and how much to invest in a group project. The return on the group project was

higher than the return on the tokens they kept for themselves. I provided participants with examples to better explain how their profits were going to be calculated.

Their income for each period consisted of the tokens they decided to keep for themselves and their income from the group project. Their income from the group project was calculated by adding everyone's contributions to the group project and multiplying it by 0.4. Everyone's income from the group project was calculated the same way. This means that everyone in the group received an equal share of the income from the group project in every period. The income for each participant was calculated as follows:

$$\Pi = (20 - g) + 0.4(G)$$

The equation shows that the an individual's profit in each period, Π , is equal to 20 minus his or her contribution to the group project, g , plus the total of everyone's contribution, G , times 0.4. At the end of each round, every participant was shown the average group contribution along with the contribution level of every member of the group. Every participant also saw their payoffs from the group project in the previous round.

After seeing the returns, each member of the group was asked how much of the income from the group project he or she wanted to return to the group. The amount returned was divided equally among the three other players in that player's team.

The game was played anonymously, so players did not know the identities of the other players in their own group. They were not given the chance to communicate with their group mates. They were told that they would play the game with the same group of people for 10 periods. Thus, they knew when the final period of the experiment was.

In the control condition, participants played the same finitely repeated VCM. Just like in the experimental condition, participants were randomly assigned into groups of four, given an endowment of 20 tokens for each round, see the average contribution to the group account, how much each player in the group contributed, as well as their income from the group project. Unlike in the experimental condition, however, participants in the control condition will not get the chance to return any part of their group project income at the end of every period.

Participants were given a demographic and personality questionnaire after playing the game.

IV. Results

Consistent with previous research on group cooperation using the VCM, mean contributions to the group project declined over time in the control condition. In the first period, mean contribution was 76 percent of the endowment, but it began to decline steadily in subsequent periods. By the last period, mean contribution was only 25 percent of the endowment. In the experimental condition, contribution to the group project also saw a substantial decline. The average first period contribution was 56 percent of the endowment, but was only 22 percent of the endowment in the final period. The mean contribution in every period for both the control condition and the experimental condition are illustrated in Figure 4.1.

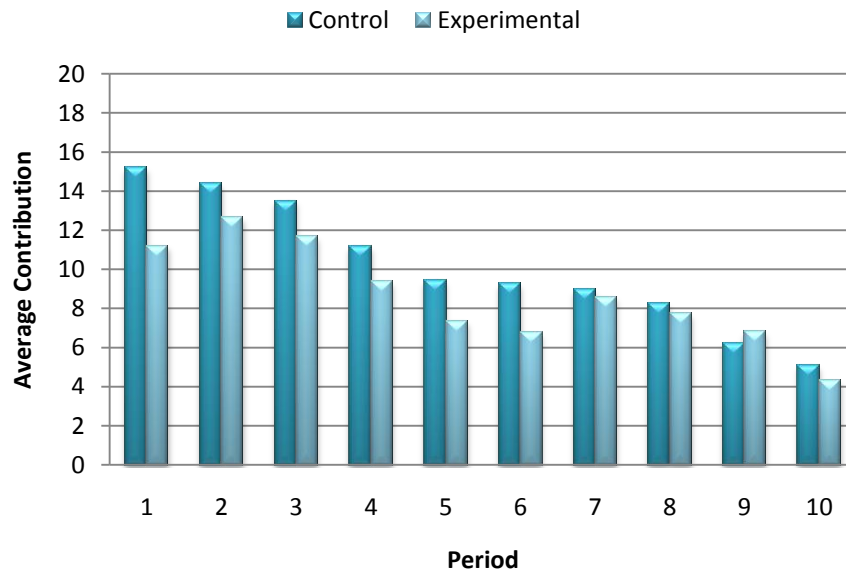


Figure 4.1 Mean contribution in every period for both the control and experimental conditions.

Interestingly, in the experimental condition, the contribution in the first period was lower compared to the first period contribution in the control condition. An independent samples *t* test

comparing the first period contribution levels in both conditions shows that the difference between the two is significant, $t(42) = 2.28$, $p = .027$. This suggests that having the option to return money influenced how much individuals contributed in the very first period. This is intriguing because when participants decided how much they wanted to contribute in the first period, they have not had the chance to return or receive earnings from their group members.

Although the difference in the first period contribution was significant, comparing the mean contribution of participants in the control condition with the mean contribution in the experimental condition reveals that the overall mean contributions in both conditions were not significantly different from each other. Because the majority of the participants, however, did not use the option to return tokens, this finding does not rule out the possibility that expressing guilt by returning tokens can affect contribution level because the negative effect on group contribution of not returning tokens might have counterbalanced the positive effect of returning tokens.

To test this, the level of cooperation in groups in which under-contributors returned tokens (expressing guilt) should be compared with the level of cooperation in groups in which under-contributors did not return a lot of tokens (expressing low guilt). Because only a handful of participants used the opportunity to return tokens to signal guilt, I did not have enough observations to analyze if overall contribution was higher in groups where low contributors showed high levels of guilt compared to groups where the low contributors did not express much guilt.

Using linear regression analysis, however, I evaluated whether or not the act of returning tokens in the current period could increase the contribution level of one's group mates in the following period. The scatterplot shown in Figure 4.2 indicates that the amount of tokens

returned to an individual is linearly related to that individual's level of contribution in the following period such that as the number of tokens an individual receives from his or her group mates increases, the contribution of that individual to the group project in the following period increases, $B = 1.12$, $t(178) = 5.47$, $p < .001$. The correlation between the two variables was .38. The regression equation for predicting an individual's contribution level in the next period is

$$\text{Contribution in the next period} = 1.12 \text{ Tokens received from group mates} + 6.24$$

The 95 percent confidence interval for the slope, .71 to 1.51, does not include the value of zero. Thus, the contribution in the following period is significantly related to tokens received in the preceding period. As hypothesized, receiving tokens from group mates will have the effect of increasing an individual's contribution in the following period.

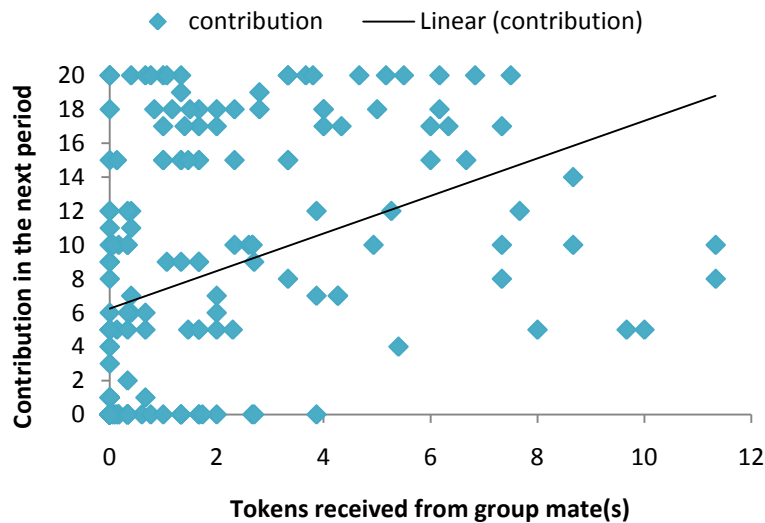


Figure 4.2 Scatterplot showing the relationship between others' returned money last period and one's current period contribution.

Standard regression analysis assumes that each observation is independent of all the other observations. Because the data analyzed, however, contain multiple observations from the same periods, the assumption of independency of the error terms was not met. To handle the correlation of errors within periods, I added period fixed effects to the regression. The result of the linear regression that included period fixed effects show that there is still a linear relationship between the two variables of interest, $B = .92$, $t(178) = 4.33$, $p < .001$. The revised regression equation is

$$\text{Contribution in the next period} = .92 \text{ Tokens received from group mates} + 9.91$$

The coefficient decreased slightly from 1.12 to .92, but it was significant. The correlation between the tokens received from one's group mates and one's contribution in the next period was .38. Once again, this supports the hypothesis that contribution will increase in response to an increase in amount of tokens that other group members returned in the previous period.

To account for the correlation of errors within the same person, I also added person fixed effects to the regression. The coefficient dropped to .11, and the 95 percent confidence interval for the slope, -.25 and .48, includes 0, which means the result was not significant. Because I only have ten observations per subject, it is not surprising that the estimates for the coefficient would be imprecise.

In addition to analyzing the data using ordinary linear regression, the data was analyzed using Hierarchical Linear Modeling, which took into account the fact that the observations were nested and were not independent. The model took into account, for instance, that the responses of a participant during different periods will be correlated in a way that that participant's and another participant's responses will not, because in the former case, the responses come from the

same person. Using HLM, the regression equation for predicting an individual's contribution level in the next period is

$$\textit{Contribution in the next period} = .80 \textit{ Tokens received from group mates} + 6.96$$

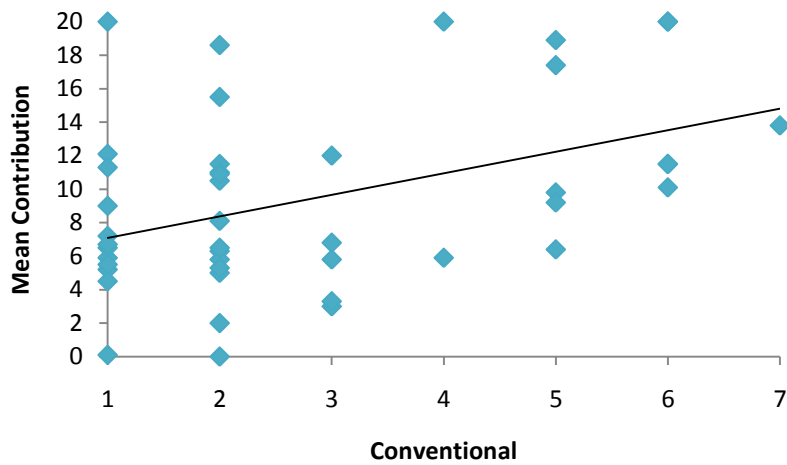
The estimates for the intercept, 6.96, and the coefficient, .80, were significant. Also, the coefficient estimate, although slightly lower, did not differ very much from the estimates using ordinary linear regression with or without period fixed effects. The slope of .80 indicates that for every token an individual receives from the previous round, that individual will increase his or her contribution in the next round by four-fifths of a token. This result, therefore, once again shows that an individual's contribution would increase if he or she received tokens from his or her group members from the preceding period.

After playing the game, participants had to answer demographic and personality questions. No sex difference in cooperative behavior was found. Correlational analyses using participants' responses to the Ten-Item Personality Inventory show that there is a significant positive correlation between participants' average contribution to the group project and self-reported ratings of being conventional, $r(43) = .43, p < .01$. The scatterplot on Figure 4.3a plots the relationship between contribution and being conventional. The more a person considers himself or herself to be conventional, the more likely that person will contribute to the group project.

In addition, a significant negative correlation was found between participants' self-reported ratings of being critical and quarrelsome and the average amount of tokens that they returned to the group when given the option, $r(19) = -.49, p < .05$. This relationship is shown in Figure 4.3b. The more critical or quarrelsome a person is the less likely he or she will return

tokens to the group after every period. On the other hand, participants' ratings of extroversion, dependability, anxiousness, openness to new experiences, quietness, warmth, carelessness or calmness did not predict their average level of contribution or the average amount of tokens they gave back to the group.

a.



b.

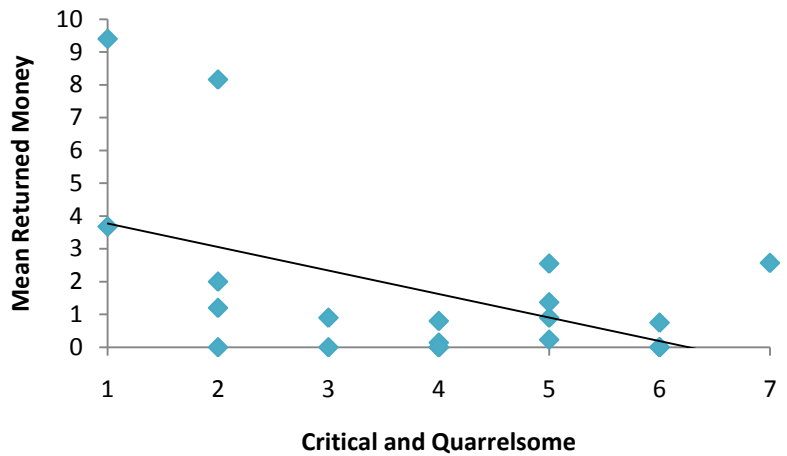


Figure 4.3 a) Relationship between being conventional and mean contribution and being critical and quarrelsome and mean money returned.

V. Discussion

Although the mean contribution in the experimental condition was not different from the mean contribution in the control condition, it was found that the difference in the mean contribution in the first period for both conditions was significant. Participants in the experimental condition on average contributed 20 percent less in the first period than those in the control condition. A possible explanation for the lower initial contribution of the participants in the experimental condition is that those participants could have contributed a low amount at the beginning knowing that they would have the option to return tokens to their group mates if their initial contribution happened to be lower than the others' contribution. If group members offered a low level of contribution in the first period, however, each member might think that their group mates are not the cooperative type. This could negatively impact subsequent contributions to the group project.

It is important to note that most people did not return money to their group mates when they were given the option to do so. We should only expect them to return money if their contribution deviated a lot from the group's average contribution. It is also possible that there exists an endowment effect. Once they have received their earnings from the period, if there is an endowment effect, they might become less likely to return some of their earnings even if they originally planned to do so.

Research on "theory of mind," the ability to attribute beliefs, desires, and intentions to oneself and others suggests that individuals should have the ability to detect people's intentions (Baron-Cohen, 1995). Therefore, individuals should be able to distinguish between a person who is intentionally free-riding on a collective action and one who is not. But from a rational choice

perspective, even if the outcomes of two options are the same, the intentions of the agent that led to those outcomes should be irrelevant. It has been shown, however, that intentionality detection is an important aspect of economic behavior (McCabe & Smith, 2003).

If an individual does not want to be seen as intentionally free-riding, he or she can use guilt as a signaling mechanism. This study provides some evidence of this. The result of the regression analysis and the HLM analysis suggests that expressing guilt could increase cooperation in a future interaction with the same group of people. This is consistent with the view that one can express guilt to signal to others that he or she is not intentionally free-riding on a collective action. Also, if an individual does not show guilt, negative emotions might derail the possibility of cooperation in future interactions.

Guilt, however, is only one side of the issue. For cooperation to continue, others must be able to forgive under-contributors who have expressed guilt in their previous behavior. Axelrod (1984) theorized that in simulations, a more forgiving strategy like Tit for Two Tats that allows the first defection to go unchallenged might actually do better than the strategy Tit for Tat that will automatically defect when it encounters a strategy that defected in the last interaction. Thus, from an evolutionary game theoretic perspective, it might actually be better to allow for some leeway, so that retaliatory strategies will not continue defecting against each other causing both to reach an unsatisfactory outcome.

The responses to the Ten Item Personality Inventory showed that there was a positive correlation between mean contribution and self-reported measures of being conventional. Those who saw themselves as conventional were more cooperative than those who did not. This is a particularly intriguing finding because it is consistent with a large body of literature in cultural psychology that compares individualistic cultures with collectivistic cultures. Western cultures

tend to put an emphasis on the importance of the individual. Eastern cultures, on the other hand, highlight the importance of the group (Markus & Kitayama, 1991). These cultural differences are reflected in cross-cultural examination of public goods experiments. Cason, Saijo, and Yamato (2004), for example, looked at how Japanese subjects differed from American subjects. They found that the Japanese had a more efficient public good contributions than the Americans.

Another interesting finding uncovered from the personality data is that there was a negative correlation between self-reported ratings of being critical and quarrelsome and the mean tokens a person returns to the group. This finding suggests that the more critical and quarrelsome a person is, the less likely he or she will feel guilty. It is also possible that participants who were more critical and quarrelsome felt a higher sense of entitlement to the earnings they received and did not feel a need to return tokens.

VI. Conclusion

This experiment continued the mapping of evolved emotion programs by looking at the concept of guilt and its role in cooperation. In this experiment, participants played a modified Voluntary Contribution Mechanism that gave them the option to return all, some, or none of their earnings from the group project at the end of every period. To the extent that returning earnings to one's group members could be seen as an expression of guilt, the experiment estimated how the absence or presence of guilt influenced cooperation in groups.

Regression analysis of the data that included period fixed effects show that receiving tokens from group members may increase an individual's contribution in the following period. Doing a regression analysis with person fixed effects did not produce a significant result because of the low number of observations per subject. Analyzing the data using Hierarchical Linear Modeling, however, produced a result very close to the ordinary linear regression. An analysis of participants' responses to a personality questionnaire revealed that self-reported measures of being conventional predicted one's cooperativeness, and it was found the more critical and quarrelsome a person is, the less likely that person will return money to the group.

The present research has provided preliminary evidence on the role of guilt in cooperation. Further research will be needed to determine if cooperation will remain stable in groups in which under-contributors express guilt.

References

- Axelrod, Robert.** *The Evolution of Cooperation*, 1984, New York: Basic Books.
- Axelrod, Robert and Hamilton, William D.** “The Evolution of Cooperation.” *Science*, 1981, 211, pp. 1390-1396.
- Baron-Cohen, Simon.** *Mindblindness: An Essay on Autism and the Theory of Mind*, 1995, Cambridge: MIT Press.
- Baumeister, R. F.; Stillwell, A.M., and Heatherton, T.F.** “Guilt: An Interpersonal Approach.” *Psychological Bulletin*, 1994, 115, 243-267.
- Canson, Timothy; Saijo, Tatsuyoshi, and Yamato, Takehiko.** “Voluntary Participation and Spite in Public Good Provision Experiments: An International Comparison.” *Experimental Economics*, 2004, 5(2), pp. 133-153.
- Charness, Gary and Dufwenberg, Martin.** “Promises and Partnership.” *Econometrica*, 2006, 74(6), pp. 1579-1601.
- Fehr, Ernst and Gächter, Simon.** “Altruistic Punishment in Humans.” *Nature*, 2001, 411, pp. 137-140.
- Fischbacher, Urs.** “z-Tree: Zurich Toolbox for Ready-made Economic Experiments.” *Experimental Economics*, 2007, 10(2), pp. 171-178.
- Fischbacher, Urs; Gächter, Simon and Fehr, Ernst.** “Are People Conditionally Cooperative? Evidence from a Public Goods Experiment.” *Economic Letters*, 2001, 71(3), p. 397.
- Gunnthorsdottir, Anna; Houser, Daniel and McCabe, Kevin.** “Disposition, History and Contributions in Public Goods Experiments.” *Journal of Economic Behavior & Organization*, 2006, 62(2007), pp. 304-315.

Hamilton, William D. “Genetical Evolution of Social Behavior I and II.” *Journal of Theoretical Biology*, 1964, 7, pp. 1-52.

Hidehiko, Takahashi; Yahata, Noriaki, Koeda, Michihiko, Matsuda, Tetsuya, Asai, Kunihiko, and Okubo, Yoshiro. “Brain Activation Associated with Evaluative Processes of Guilt and Embarrassment: An fMRI Study.” *NeuroImage*, 2004, 23(3), pp. 967-974.

Ledyard, J. O. “Public goods: A Survey of Experimental Research.” in Kagel, J. and Roth, A. eds., *The Handbook of Experimental Economics*, Princeton: Princeton University Press, 1995, pp. 94-111

Markus, Hazel and Kitayama, Shinobu. “Culture and the Self: Implications for Cognition, Emotion, and Motivation.” *Psychological Review*, 1991, 98(2), pp. 224-253.

McCabe, Kevin and Smith, Vernon. “Strategic analysis in games: What information do players use?” in Ostrom, E and Walker, J, eds., *Trust and Reciprocity: Interdisciplinary lessons from experimental research. A Volume in the Russell Sage Foundation Series on Trust.* New York: Russell Sage Foundation, 2003, pp. 275-301.

Sell, Aaron; Tooby, John and Cosmides, Leda. “Formidability and the Logic of Human Anger.” *Proceedings of the National Academy of Sciences*, 2009, 106(35) pp.15073-15078.

Tooby, John and Cosmides, Leda. “The Evolutionary Psychology of the Emotions and Their Relationship to Internal Regulatory Variables.” in Lewis, M; Haviland-Jones, M and Barrett, L.P. eds., *Handbook of Emotions*. 3rd ed. New York: Guilford, 2008, pp.114-137.

_____. “The Psychological Foundations of Culture.” in Barkow, J; Cosmides, C and Tooby, J, eds., *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*.

Oxford: Oxford University Press, 1992, pp. 19-136.

Trivers, Robert. “The evolution of reciprocal altruism.” *Quarterly Review of Biology*, 1964, 46, pp. 35-37.

Appendix

Appendix 1: Consent Form

You are being asked to participate in a research study pertaining to how individuals interact in groups. If you decide to participate, you will be placed in groups of four. Everyone will remain anonymous. For the entire experiment, you will use the computer to make decisions. Every decision you make will affect you and the other members of your group. When the experiment is over, you will be asked a few demographic questions. The data we will collect will not be linked to your identity in any way. The experiment will take around 40 to 50 minutes.

There are no known risks or direct benefits associated with this experiment. You may, however, earn money by participating. The amount you will receive will depend on your performance in the game. For every twenty tokens you earn, you will receive one dollar.

Your participation in this experiment is voluntary. You are free to withdraw at any time without being penalized in any way.

The researcher in charge of this experiment is Marvin Guemo. Please ask him any questions you have before the experiment starts. If you have questions later, you may contact him at (858) 349-8782 or at mrguemo@umail.ucsb.edu. For questions regarding your rights as a research participant, you may contact the Human Subjects Committee at (805) 893-3807 or at hsc@research.ucsb.edu. You will be given a copy of this form for your records.

I have read the information above and consent to take part in the study.

Signature: _____ Date: _____

Name: _____

Appendix 2: Instructions for Participants in the Control Group

Instructions

Thank you for taking part in this experiment. By participating in this experiment, you will have the opportunity to earn money. The amount of money you will receive will depend on your performance in the game. You will make your decisions using tokens. For every 20 tokens that you earn, you will receive 1 dollar.

You will be placed in a group of four people, which means that you will be playing the game with three other participants in this room. Their identities will not be revealed to you, and similarly, your identity will not be revealed to them.

Please note that you are not allowed to communicate with other participants while the experiment is in progress. If you speak to anyone in this room aside from the experimenter, you will be excluded from the study, and you will not receive payment. If you have questions or concerns about the study, feel free to ask the experimenter.

The game you are about to play consists of 10 periods. At the beginning of every period, you will be given an endowment of 20 tokens. Your job as a participant is to decide how much of those 20 tokens to invest in a group project. The tokens that you do not contribute to the group project will automatically be added to your earnings. You will see the screen below when it is time for you to make your decision. The screen will show that you have an endowment of 20 tokens. You will also see a blank box where you will enter the amount you would like to contribute to the group project. When you have made your decision, press the OK button.

The screenshot shows a software interface for an experiment. At the top left, it says "Period" followed by "1 out of 10". At the top right, it says "Remaining time [sec]: TT". The main area of the screen displays "Your Endowment 20" and "Your contribution to the project" followed by a blue rectangular input box. In the bottom right corner of the main area, there is a red button labeled "OK". Below the main area, there is a "HELP" section with the text: "Please enter the amount of tokens that you would like to contribute to the group project. If you are finished, press the 'OK' button."

Once all the members of your group have made their decisions, you will see the screen below that shows the amount you contributed to the project, the sum of everyone's contribution to the project, your income from the tokens you decided to keep, your income from the group project, and your total income in the current period.

Period 1 out of 10	Remaining time [sec]: TT
<p>Your contribution to the project XX</p> <p>Sum of everyone's contribution to the project XX</p> <p>Income from retained tokens XX</p> <p>Income from the group project XX</p> <p>Your income in this period XX</p>	
<input type="button" value="Continue"/>	
<p><small>HELP</small> When you are done viewing the results, please press the "Continue" button.</p>	

Your income for each period consists of the tokens you decided to keep for yourself and your income from the group project. Your income from the group project is calculated by adding everyone's contributions to the group project and multiplying it by 0.4. Everyone's income from the group project is calculated the same way. This means that everyone in the group will receive an equal share of the income from the group project.

Your income for the period is calculated as follows:

$$\text{Income in period} = (20 - \text{Your contribution to group project}) + 0.4(\text{Total contribution to group project})$$

Let us consider a few scenarios.

Suppose all four of you contributed all your tokens to the group project. What is your income in that period? What is the income of another person in your group?

$$\text{Your income} = (20 - 20) + 0.4(80) = 32$$

$$\text{Other's income} = (20 - 20) + 0.4(80) = 32$$

Suppose you contributed 15 tokens to the group project, and the other three members of your group contributed 10 tokens each. What is your income in that period? What is the income of another person in your group?

$$\text{Your income} = (20 - 15) + 0.4(45) = 23$$

$$\text{Other's income} = (20 - 10) + 0.4(45) = 28$$

Suppose you contributed 5 tokens to the group project, and the other three members of your group contributed 15 tokens each. What is your income in that period? What is the income of another person in your group?

$$\text{Your income} = (20 - 5) + 0.4(50) = 35$$

$$\text{Other's income} = (20 - 15) + 0.4(50) = 25$$

Suppose none of you contributed any tokens to the group project. What is your income in that period? What is the income of another person in your group?

$$\text{Your income} = (20 - 0) + 0.4(0) = 20$$

$$\text{Other's income} = (20 - 0) + 0.4(0) = 20$$

After looking at the summary, you will be directed to the screen below. It shows in detail what each person in your group contributed. Information about you is shown as **XX**. Information about the other members of your group is shown as AA, BB, or CC. When you are done viewing the screen, press Continue to proceed to the next period.

Period		1 out of 10			Remaining time [sec]: TT		
Endowment	20	20	20	20			
Contributions to the project	XX	AA	BB	CC			
Earnings in this period	XX	AA	BB	CC			
Your total earnings from all periods	XX						

HELP
 Displayed are the decisions of the other participants.
 If you are finished, press the "Continue" button.

The next 9 periods are exactly like the first period. The rules are the same, and the members of your group are the same as before. Your total earnings for the experiment will be the sum of your earnings from every period. After completing all ten periods, you will be asked to fill out a demographic and personality questionnaire.

Appendix 3: Instructions for Participants in the Experimental Group

Instructions

Hello. Thank you for taking part in this experiment. By participating in this experiment, you will have the opportunity to earn money. The amount of money you will receive will depend on your performance in the game. You will make your decisions using tokens. For every 20 tokens that you earn, you will receive 1 dollar.

You will be placed in a group of four people, which means that you will be playing the game with three other participants in this room. Their identities will not be revealed to you, and similarly, your identity will not be revealed to them.

Please note that you are not allowed to communicate with other participants while the experiment is in progress. If you speak to anyone in this room aside from the experimenter, you will be excluded from the study, and you will not receive payment. If you have questions or concerns about the study, feel free to ask the experimenter.

The game you are about to play consists of 10 periods. At the beginning of every period, you will be given an endowment of 20 tokens. Your job as a participant is to decide how much of those 20 tokens to invest in a group project. The tokens that you do not contribute to the group project will automatically be added to your earnings. You will see the screen below when it is time for you to make your decision. The screen will show that you have an endowment of 20 tokens. You will also see a blank box where you will enter the amount you would like to contribute to the group project. When you have made your decision, press the OK button.

The screenshot shows a software interface for an experiment. At the top left, it says "Period" and "1 out of 10". At the top right, it says "Remaining time [sec]: TT". The main area contains the text "Your Endowment 20" and "Your contribution to the project" followed by a blue input box. In the bottom right corner of the main area, there is a red "OK" button. Below the main area, there is a "HELP" section with the text: "Please enter the amount of tokens that you would like to contribute to the group project. If you are finished, press the 'OK' button."

Once all the members of your group have made their decisions, you will see the screen below that shows the amount you contributed to the project, the sum of everyone's contribution to the project, your income from the tokens you decided to keep, your income from the group project, and your total income in the current period.

Period		1 out of 10		Remaining time [sec]: TT	
<p>Your contribution to the project XX</p> <p>Sum of everyone's contribution to the project XX</p> <p>Income from retained tokens XX</p> <p>Income from the group project XX</p> <p>Your income in this period XX</p>					
<input type="button" value="Continue"/>					
<p><small>HELP</small></p> <p>When you are done viewing the results, please press the "Continue" button.</p>					

Your income for each period consists of the tokens you decided to keep for yourself and your income from the group project. Your income from the group project is calculated by adding everyone's contributions to the group project and multiplying it by 0.4. Everyone's income from the group project is calculated the same way. This means that everyone in the group will receive an equal share of the income from the group project.

Your income for the period is calculated as follows:

$$\text{Income in period} = (20 - \text{Your contribution to group project}) + 0.4(\text{Total contribution to group project})$$

Let us consider a few scenarios.

Suppose all four of you contributed all your tokens to the group project. What is your income in that period? What is the income of another person in your group?

$$\text{Your income} = (20 - 20) + 0.4(80) = 32$$

$$\text{Other's income} = (20 - 20) + 0.4(80) = 32$$

Suppose you contributed 15 tokens to the group project, and the other three members of your group contributed 10 tokens each. What is your income in that period? What is the income of another person in your group?

$$\text{Your income} = (20 - 15) + 0.4(45) = 23$$

$$\text{Other's income} = (20 - 10) + 0.4(45) = 28$$

Suppose you contributed 5 tokens to the group project, and the other three members of your group contributed 15 tokens each. What is your income in that period? What is the income of another person in your group?

$$\text{Your income} = (20 - 5) + 0.4(50) = 35$$

$$\text{Other's income} = (20 - 15) + 0.4(50) = 25$$

Suppose none of you contributed any tokens to the group project. What is your income in that period? What is the income of another person in your group?

$$\text{Your income} = (20 - 0) + 0.4(0) = 20$$

$$\text{Other's income} = (20 - 0) + 0.4(0) = 20$$

After looking at the summary, you will be directed to the screen below. It shows in detail what each person in your group contributed. Information about you is shown as **XX**. Information about the other members of your group is shown as AA, BB, or CC.

Period
1 out of 10
Remaining time [sec]: TT

Endowment	20	20	20	20
Contributions to the project	XX	AA	BB	CC
Earnings in this period	XX	AA	BB	CC

Earnings from the group project XX

How much of your earnings from the group project would you like to return?

Continue

HELP

Displayed are the decisions of the other participants.

If you are finished, press the "Continue" button.

In the same screen, you will have the opportunity to return all, some, or none of the tokens you earned from the group project. The tokens you earned from the group project in that period will be displayed in the screen. Enter your decision in the blank box. Tokens that you return will be divided equally among the three other group members. Once you have made your decision, click Continue.

You will see the screen below that shows how many tokens each player returned. It will also show your updated earnings from the period as well as the total number of tokens you have accumulated so far from the experiment. When you are done viewing the page, click Continue to proceed to the next period.

Period		1 out of 10			Remaining time [sec]: TT		
Endowment	20	20	20	20			
Contributions to the project	XX	AA	BB	CC			
Previous earnings in this period	XX	AA	BB	CC			
Amounts of tokens returned to group	XX	AA	BB	CC			
Amount of tokens received from others	XX	AA	BB	CC			
Previous earnings in this period	XX						
Revised earnings in this period	XX						
Your total earnings from all periods	XX						
<input type="button" value="Continue"/>							
<p>HELP</p> <p>Displayed are the decisions of the other participants.</p> <p>If you are finished, press the "Continue" button using the mouse.</p>							

The next 9 periods are exactly like the first period. The rules are the same, and the members of your group are the same as before. Your total earnings for the experiment will be the sum of your earnings from every period. After completing all ten periods, you will be asked to fill out a demographic and personality questionnaire.

Appendix 4: Ten-Item Personality Inventory-(TIPI)

Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

- 1 = Disagree strongly
- 2 = Disagree moderately
- 3 = Disagree a little
- 4 = Neither agree nor disagree
- 5 = Agree a little
- 6 = Agree moderately
- 7 = Agree strongly

I see myself as:

- _____ Extroverted, enthusiastic.
- _____ Critical, quarrelsome.
- _____ Dependable, self-disciplined.
- _____ Anxious, easily upset.
- _____ Open to new experiences, complex.
- _____ Reserved, quiet.
- _____ Sympathetic, warm.
- _____ Disorganized, careless.
- _____ Calm, emotionally stable.
- _____ Conventional, uncreative.

Appendix 5: Free Response Questions

Did you feel any particular emotion in instances where you found out that other members of your group contributed to the group project more than you?

If you did experience some emotion, please describe it in your own words.

Did you feel any particular emotion in instances where you found out that other members of your group contributed to the group project less than you?

If you did experience some emotion, please describe it in your own words.