The Influence of Others on a Prisoner's Dilemma

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Does an individual change their decision making process when they represent others who are silent? If an individual is forced into a role of leadership (or representative), are they more likely to cooperate or defect? The responsibility of deciding the fate of others can be a burden to some, while irrelevant to others. The effect of representing others is tested here using the Prisoner's Dilemma experiment, which has been used to study cooperative behaviors for decades. Forty-one participants were divided into two groups: a control (the generic Prisoner's Dilemma), and a scenario in which the subject decided the fate of four unknown individuals. In the control scenario 71% of subjects chose to cooperate decreased to 45%. The experiment revealed that when representing others, the participants were more likely to defect.

In 1984, Robert Axelrod popularized the Prisoner's Dilemma experiment in his book "The Evolution of Cooperation". The prisoner's dilemma game is a non-zero-sum game, or an experiment in which two participants do not necessarily have inverse outcomes depending on their choices. Simply put, in a non-zero-sum game there is not necessarily a winner and a loser, there is also the option of a mutual outcome. Axelrod designed a tournament to determine the ideal strategy for the iterated prisoner's dilemma. It was determined that the "tit for tat" strategy was the optimal strategy over a certain period of time[2]. While Axelrod's experiment tested various established strategies, it gave a new perspective on social dynamics. It also prompted other scientists to begin their own research, popularizing the field of game theory and non-zerosum games to study social behavior. Following the newfound popularity of game theory, many scientists, building upon Axelrod's foundation, extended the study and scope of game theory and social behavior to what it is today.

The study of social behavior over time was also studied by Xin Yao and Paul J. Darwen in their paper, "An Experimental Study of N-Person Iterated Prisoner's Dilemma Games". Yao and Darwen found that group size was inversely correlated to the degree of cooperation within said group. Their findings exposed the fact that group size plays an important role in group behavior [10]. As a result, it is important to consider group size in any experiment studying social dynamics. Further experiments have been conducted to observe and study the individual's perspective from within a group. An individual's allegiance to a group was initially investigated by Mancur Olson in his "Logic of Collective Action", in which he determined that external incentives could deter an individual from acting with the group's best interests in mind [8]. Olson's finding's prompted the question of how incentives affect behavior and the forms they could take. The power of incentives was further studied by Dan Kahan, in his paper "The Logic of Reciprocity: Trust, Collective Action, and Law". In which he determined that, while external incentives could be detrimental, the decision making process could be affected by emotional triggers as well. This became a social dynamic he called "logic of reciprocity" in which individuals are affected by their emotions more so than their materialistic drives [4].

The pressure of responsibility or leadership has also been examined in various studies. Erling Moxnes and Eline van der Heijden investigated the importance of responsibilities in their experiment, "The Effect of Leadership in a Public Bad Experiment". Their findings show that a leader is effective at influencing his followers, however the benefits of being a leader do not equal the costs. As a result, forced leadership could prompt the individual to purposefully act against the group [7].

While many scientists have examined different aspects of social behaviors and group influences, a question still remains that has yet to be answered: Does the responsibility of representing a large group of people influence the independent decision of an individual to either cooperate or defect? Studies have shown the effects of a leader within a group as well as how individuals interact with each other, however the influence of representing a larger group of people has yet to be studied. To answer the aforementioned question, there are three potential hypotheses to consider: 1. People are more likely to cooperate when they represent a group of people because the repercussions of their decisions affect more than just themselves. If an individual is more likely to cooperate when he/she represents a larger group of people, then I should observe subjects deciding to share the candy with the participant. 2. People are more likely to defect when they represent a group of people because the punishment is divided evenly amongst the group, therefore less of an individual loss. If an individual is more likely to defect when he/ she represents a larger group of people, then I should observe subjects willing to risk defecting and either losing all of their candy or doubling it. 3. People are not influenced by the responsibility of representing a group of people. If an individual's response is unchanged by the responsibility of representing a group of people, then I should observe no discernible differences between the responses of subjects in the control group and the experimental group.

Materials and Methods:

In order to test my hypotheses, I will use a variation of the Prisoner's Dilemma. While the experiment is not a true non-zero-sum game, the rules explained to the subject will be the same. However, only the subject's response will be recorded. The experiment will consist of five individuals, four of them participating with the knowledge of the experiment, while the fifth individual is the subject. The experiment is set up as follows: the subject is shown a bag of individually sized M&Ms bag and told that they will have to make a choice. They are given one bag initially. One of the accomplices approaches and the subject is informed that they will have to decide how to divide the M&Ms. Each subject will be placed into the Control group or the Experimental group.

Control: The subject and accomplice each have two options: A. cooperate and share the bag (cooperate), or B. take the entire bag (defect). They make their decisions independently of each

other, not knowing the outcome. After the subject and accomplice acknowledge the rules, they are informed of the possible outcomes: 1. If both the subject and accomplice choose to take the entire bag, then both will give back the initial bag, 2. If both the subject and accomplice choose to share evenly, then they each receive another bag, 3. If, say, the accomplice decides to take all of it while the subject decides to share, then the accomplice will receive the both a new bag as well as the subject's initial bag. The participant and subject will make their decision and write it down onto a piece of paper.

Experiment: The subject and accomplice each have two options: A. cooperate and share the bag (cooperate), or B. take the entire bag (defect). They make their decisions independently of each other, not knowing the other's decision. The subject is informed that they will represent the decision of these four "participants" (actually accomplices), however, the subject cannot interact with them. The subject and accomplice are asked to wait for a second while the tester goes to grab something. During this time the original accomplice watches the subject and how he/she reacts to the four new participants. While these observations will not serve any direct purpose for the experiment, the forced proximity to the four participants may help establish a connection between them and the subject. The tester returns with four bags of M&Ms for each new participant, and asks both the subject and participant if they are ready. The tester repeats the instructions again, emphasizing that the subject and four silent participants will each receive the reward (another bag of M&Ms for each individual) or have to give back their initial bag. After verifying that the subject understands their responsibilities and the rules of the game, both the original participant and subject write their decisions on pieces of paper and hand them to the tester.

The data collected from this experiment were the decisions made by the subject; focusing primarily on whether or not the subject cooperated or defected when representing the group. The experiment was conducted forty one times over two weeks. As I alternated between the Control scenario, the generic prisoner's dilemma, and my experimental scenario, where the subject represented the voice of the participants, I ultimately conducted the control scenario twenty one times while I conducted the experimental scenario twenty times. Of the forty one subjects, twenty three were women and eighteen were men.

Results:

My results showed that in the control group, people were more likely to cooperate (*Figure 1a*). However, when representing the voice of the other participants, people were more likely to defect (*Figure 1b*). This difference is most clearly visible when comparing the percentage of red in *Figures 1a & 1b*.

While the difference between the control and the experiment scenarios showed a very significant increase, the gender breakdown of responses was also enlightening. Considering the sum total of responses from men in both scenarios, they were evenly split between cooperating and defecting, as seen in *Figure 2a*. However, the sum total of female responses in both scenarios displayed that they were more likely to cooperate (*Figure 2b*). While both men and women were more likely to cooperate in the control scenario as opposed to the experimental scenario, there was evidence of an overall gender bias towards cooperation in women in both scenarios.

Figure 3 depicts is a percentage breakdown of responses by gender as well as experiment treatment. For example, the first bar indicates that of the men in the control study, 60% of them chose to cooperate.

Discussion:

The data supports the hypothesis that the responsibility of representing a group of people does influence an individual's decision towards defecting. One way to explain this result is to put the decision-making process in terms of which is considered safe and which is a risk. Initially, it would appear that cooperating would be the safest choice in both scenarios. When cooperating, both the subject and accomplice received an extra bag. As was demonstrated in the control results (Figure 1a), subjects were more likely to cooperate. This can be explained by the two individuals, the subject and accomplice, having the same amount of responsibility (in contrast to the experimental scenario). Both individuals solely represent themselves, therefore the outcome is equal for both. Thus, cooperating appears to be the safer choice. However, when an individual is representing a group of people, the subject has the responsibility of not only their outcome, but of the three silent individuals. This increase in responsibility can explain why subjects in the experimental scenario were more likely to defect (Figure 1b). By choosing to defect, the responsibility of the outcome is decided by the accomplice. If the subject chooses to cooperate, he/she allows the accomplice to potentially defect and take all of the bags of candy, which is a risk for the subject. As a result of this perception of risk and blame, defection becomes the safer option for the subject because the responsibility of representing the three individuals is no longer on them, but on the response of the accomplice. By defecting, the subject relinquishes the possible blame they would face if they lost by cooperating and the accomplice defecting.

This interpretation of these results contrast the findings of Moxnes' and van der Heijden's experiments regarding the role of leadership. While their experiment focused primarily on how a group reacts to a leader, they also noted that forced leadership (similar to the experimental scenario in this study) could prompt him/her to act against the group's best interests [7]. In my experimental scenarios, the subject (who would be akin to the forced leader) chose to defect in order to avoid the responsibility of leadership; not purposefully acting against the group due to the added responsibility. This begs the question of the importance of communication between the group and a leader in regards to influencing the decision-making process.

It is important to note that certain factors could have influenced the results of the experiment which should be mentioned. One of which could have been the psychological size of the reward in the experimental scenario. In the control scenario, the outcomes for defecting (and losing), cooperating, and defecting (and winning) were -1 (0 as they lost their initial bag), 2, and 3 respectively. In the experimental scenario, the outcomes for defecting (and losing), cooperating, and defecting (and winning) were -4 (0 as all four individuals lost their initial bags), 8, and 12 respectively. The psychological size discrepancy between winning a sum total of 3 and a sum total of 12 could have influenced responses. If, for example, a subject in the experimental scenario were extremely competitive, winning 12 bags of candy would seem like a bigger accomplishment than 8.

One aspect of the data which merits discussion is the increased probability of female defection in the experimental scenario. It is possible that this is a result of the group bond of a portion of the subjects tested. One of the locations used to conduct the experiment was in a

common room of a colleague's university, Colgate. While, as the experimenter, I tried to prevent friends from participating in the experiment together to eliminate bias, the possibility of this affecting the results can not be disregarded. The sibling-like bond students share at a school where Greek life is crucial to social structure could have influenced their responses. The relationship between students in this environment could be an example of unconscious group-based decision-making: participants who know each other attempted to gain the greatest outcome for all. Whereas when the subject only represented themselves, they were more likely to cooperate in order to maximize the mutual benefit of both the subject and participant. While any influence of this effect on the results may have had on the aggregate data cannot be accounted for, it still supports the hypothesis that subjects are more likely to defect when representing others.

Another factor that could have influenced the results was the value of the reward. An individually sized bag of candy is not worth a great deal. If the reward were of a greater value, a subject could have potentially been more inclined to weigh the outcomes of their decisions with greater thought. The importance of financial value in making decisions cannot be overlooked, however due to the financial constraints of a college student majoring in graphic design, it was not possible to include this variable into the experiment. A possible experiment which could build upon these findings would be to conduct the same experiment with four scenarios: two of them the same as in this study, and two the same structure but with a more valuable reward.

In summation: based on the results of this experiment, the responsibility of representing a large group of people does influence the independent decision of an individual to defect. While the data does suggest that there are certain gender biases, the data clearly shows that when representing the outcome of three other individuals, a subject is more likely to defect rather than cooperate.

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Appendix:



responses in Control study



Figure 1b: Percentage of all responses in Experiment study



Figure 2a: Percentage of all male responses in both studies



Figure 2b: Percentage of all female responses in both studies



Cooperation vs. Defection by Gender in Control Vs. Experiment