

# Gender Identity Within the Prisoner's Dilemma

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## ABSTRACT

Understanding all sorts of factors that play into social and moral dilemmas such as the prisoner's dilemma is necessary to understand decision making on all fronts. These dilemmas are manifestations of many decisions from every-day (deciding what to eat for dinner) to life-changing (a nuclear war treaty). To identify if there is a link between gender identity and levels of cooperation and the expectations of a partner in the prisoner's dilemma, this study uses quantitative data collected from high school students taking the AP English Language and Composition course at a small high school in the Midwestern United States. Using a game-like replication of the prisoner's dilemma using point values instead of jail time, this study examines the relationship between gender and the decision of an individual to either "share the points" (cooperate) or "steal the points" (defect) in two environments, one with face-to-face interaction with partners and another with total anonymity. This study also tests the relationship between gender of the assigned partner and the decision of an individual to "share" or "steal" in the environment of face-to-face interaction. The study shows that females have significantly higher rates of cooperation in both environments (with interaction and without), and that players have a significantly higher rate of cooperation when partnered with a female player.

## Literature Review

### Introduction:

On average people make upwards of 35,000 decisions per day (CNN). While the severity and consequences vary largely, it is vital to understand as much as we can about what goes into them. Game theory is becoming more and more present in today's society, especially when talking about business strategy and economics. To help businesses understand the factors that go into making decisions, competitive scenarios are given to participants to find any evidence that can help predict the movement of a competitor. One of these scenarios is the prisoner's dilemma. Gender is a large part of society, especially in business where individuals often discriminate against women or tempt to take advantage of them. When referring to women in the workplace, one researcher states, "Descriptive stereotyping should translate into discrimination when traits associated with that stereotype are incompatible with the traits needed for the job or task at hand" (Bobbitt-Zeher 766). A scenario recreating that environment is almost necessary for a better understanding. Stereotyping is harmful, especially if it unfairly discriminates against an individual. Many other researchers have conducted experiments to look at the prisoner's dilemma and how the gender of players influences their rate of cooperation. An experiment conducted by Albert Molina concluded that men cooperated at a rate of 28% and women cooperated at a rate of 51%. He found this data to be statistically significant, whereas the experiment done by Victor Romano showed no statistical significance in the cooperation rates of men and women. Another study, done by Andrew M. Colman, et al. showed statistical significance that women cooperated at a lower rate than men. While there is a copious amount of contradictory data, these three sources give a representation for all of the different conclusions, that men cooperated more, women cooperated more, or there was no real difference. I am planning to conduct a prisoner's dilemma experiment to test how gender can influence cooperation levels. My experiment attempts to clear up some of this contradictory evidence. It is also a population where this study hasn't been conducted yet, a Midwest American high school. From my findings, a study was done studying the presence of gender within the prisoner's

dilemma in a high school environment in Mexico, but none so far in the Midwest of the United States of America.

### Definitions:

*Socially Optimal:* The choice that yields the most overall benefit to both players. The “morally correct” choice.

*Cooperation:* When players choose to “share” the points with their opponent.

*Defection:* When players choose to “steal” the points from their opponents.

*Payoff Matrix:* A table that shows the payoffs of certain choices that players can make in the Prisoner’s Dilemma compared to their opponent’s choice.

### The Prisoner’s Dilemma:

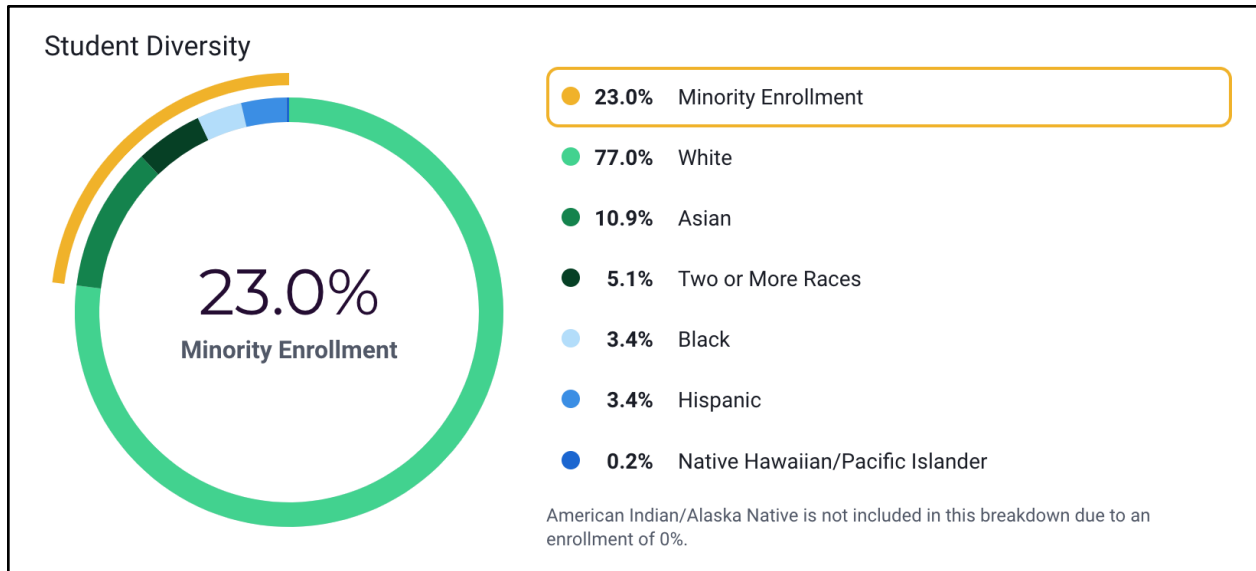
To understand the question in its entirety, I first have to explain the prisoner’s dilemma. The Prisoner’s Dilemma is a social experiment in decision analysis in which two individuals can choose to either do the socially optimal decision, cooperate, or act in their self-interest and defect. It is called the Prisoner’s Dilemma due to its first form: “Two bank robbers are jailed and each bank robber is faced with the choice to cooperate with their accomplice and remain silent or to defect and testify for the prosecution. If they both cooperate and remain silent, then the authorities will only be able to convict them on a lesser charge resulting in one year in jail for each (1 year for Elizabeth + 1 year for Henry = 2 years total jail time). If one testifies and the other does not, then the one who testifies will go free and the other will get five years (0 years for the one who defects + 5 for the one convicted = 5 years total). However, if both testify against the other, each will get three years in jail for being partly responsible for the robbery (3 years for Elizabeth + 3 years for Henry = 6 years total jail time)” (Investopedia). Here is it laid out in a payoff matrix.

Possible Outcomes of Prisoner's Dilemma		
Outcome	Henry Cooperates	Henry Defects
Elizabeth Cooperates	(1,1)	(5,0)
Elizabeth Defects	(0,5)	(3,3)

*Penalties for (Elizabeth, Henry)*

**Figure 1.** Payoff matrix showing the results of each outcome in the theoretical scenario from Investopedia.

While I looked at many different sources, and what they tested, the constant was the use of a prisoner’s dilemma-like scenario. Some studied different demographics like race or religion, but I figured asking questions about religious identity or economic class may have been too personal for the nature of the experiment, especially within a high school. Gender is a very visible trait which makes it perfect for studying. Race is also similar to gender in that way, but the population at the high school where I studied is not the most diverse. Data from the U.S. News Report is shown below:



**Figure 2.** Pie chart with percentages showing the racial makeup of the school where the study was done by U.S. News Report.

With only 23% minority enrollment, testing the presence of race would not have been plausible. Another reason I chose to study gender is that I felt its relevance to society was too important to overlook. The prisoner’s dilemma holds a direct application to business environments. A study by the Pew Research Center showed that 44% of working women claim to have experienced gender discrimination within the workplace at some point. It’s a clear issue that must be studied and dealt with. Gender on the other hand is a more representative factor and within my study there was a split of around 54% male participants and 46% female participants.

### Other Studies:

Other studies not only tested gender but other factors that alter responses. I can look to them in understanding the potential limitations of my data. One demographic that could make my data differ from other research is because of nationality. One source states that “decisions to cooperate, and beliefs that the partner will cooperate in the PD (Prisoner’s Dilemma), were higher when paired with an own-nationality partner. By contrast, there was no consistent gender in-group bias across these measures” (Kumar 15). My whole study has people paired with others of the same nationality which may increase cooperation rates overall compared to multinational studies. Because the participants for my research are in the same class as one another, they will have prior relationships with one another, which may influence the data. One study looked at gender and friendship levels, and concluded that “Women were more inclined to cooperate in interaction with strangers” (Peshkovskaya 49). The same study also found that men cooperated more than women if they were friends with their opponents. When the prisoner’s dilemma was repeated with the same people, cooperation rates often went up. Given that I am working with a younger demographic, high schoolers, it is important to know how cooperation varies among different ages, one source found “The first conclusion of this study is that people develop a prosocial behavioral pattern as they age” (Matsumoto 12). On average, younger people will defect more than older people because those who are older get less satisfaction out of manipulating others. Another study shows, “Women cooperate on average 23% of the time in the stranger setting (33% in the repeated game) and men 22% of the time in the stranger setting and 30% in the repeated game. Neither of these differences is statistically significant” (Mengel 27). I am planning on repeating the prisoner’s dilemma game 5 times, so this increase in cooperation over time is something that I am aware of.

## Real World Application:

The prisoner's dilemma reflects many modern-day issues. Many sources applied their findings to the typical gender roles in society in different ways. Some saw women as having better social skills and thus were able to play the game more efficiently, whereas others saw men to have better reasoning skills as they often are higher up in the workplace. One researcher believes that the differences in cooperation come down to the fact that "Men might develop more agentic skills while women develop more interpersonal skills, and both include their gender stereotype into their self-concept and self-regulate their behavior according to these standards" (Cigarini et al. 5). Another study states, "There is strong evidence that women are more prone to empathy than men... this seems to have significant implications for morality." (Prinz 12). As I stated before, there is a lot of contradicting evidence, but also contradictory reasoning. The prisoner's dilemma doesn't stop at gender though. Other factors have been studied, like race, political party, income, nationality, and many more. The prisoner's dilemma has been replicated many times because, like perceptions and social issues, it is ever-changing.

## Gap:

There is a clear gap in knowledge for studies conducted about the relationship between gender and responses in the prisoner's dilemma, one being a contradictory evidence gap. For example, one source concluded that "We find that being male is negatively associated with the level of cooperation" (Molina), whereas another study concluded that women cooperated at a lower rate than men (Romano). I hope my research will provide greater context and a reliable conclusion. From my findings, there has also not been a study done with the same population that I plan to use, high school students from a small Midwest high school. The goal of my research is: how does a participant's gender, and knowing the gender of one's opponent in the prisoner's dilemma affect students' responses at a Midwest high school? This goal has two parts to it: first how cooperation will differ depending on the gender of the player and second how willing players are to cooperate when paired up with either a male or a female player.

## Hypotheses

My hypotheses are that:

1. Female players will cooperate at a rate higher than male players.
2. When paired up, players regardless of gender will cooperate more often when paired up with female players.

## Method

### Purpose:

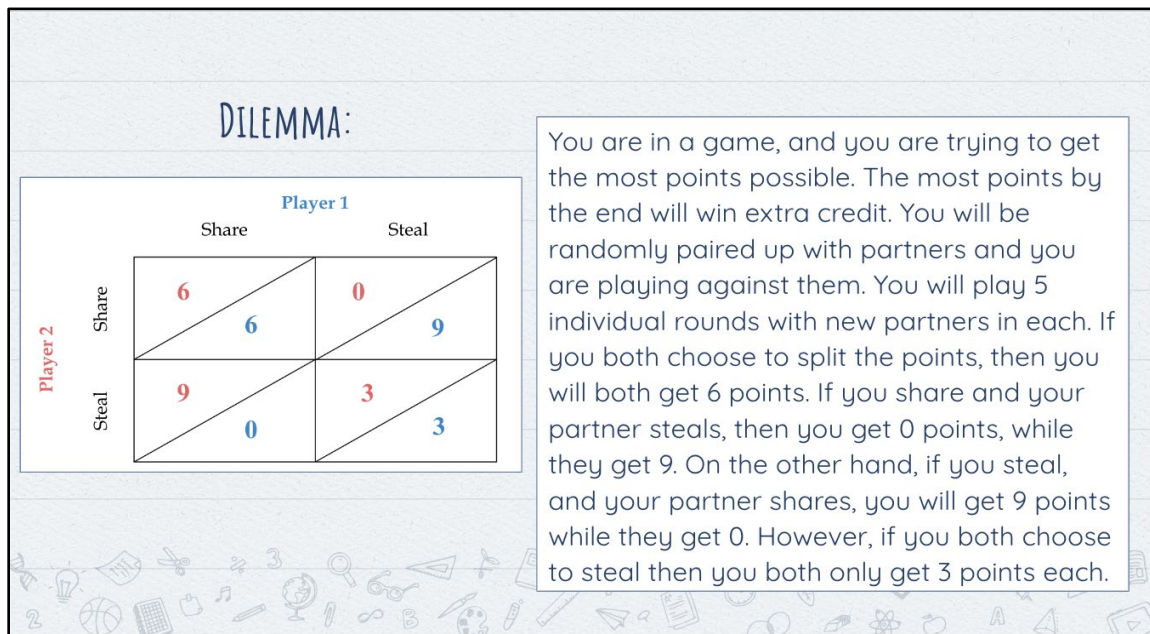
The best way to answer my research question was through an experiment where students interacted with each other in the prisoner's dilemma. I chose to use participants from the AP English Language and Composition classes. There were 6 periods with around 20 students in each, making up a total sample size of around 120 students. These classes provided me with a large enough sample to see results. Another reason I chose the AP English Language classes is that they were at the beginning of their morality unit and I thought a moral dilemma game could be a good transition into their learning. It is important to note that most students in AP Lang are juniors, but there are some seniors.

## Research Design:

The data I collected was quantitative. Students had the choice to either share or steal. I asked other questions within my survey but they were for organization purposes. I decided in order to test the presence of gender in making these decisions to have a control group and an experimental group. The control group played the game not knowing the identity of any of their opponents, whereas, the experimental group sat right in front of each other. There were many aspects that I randomized to keep from affecting the data, some of them were player numbers, partnerships, and which periods I assigned the experimental and control groups to. The interaction between players served as my independent variable whereas the cooperation rate (rate of sharing) was my dependent variable.

## Procedure:

- A. I provided the AP Language teachers with consent forms [Appendix A] a week in advance to hand out to all students for them to bring back and participate in the experiment. There was an incentive of extra credit for the player with the most points so students were inclined to participate.
- B. Before class, I arranged the desks to be facing one another, so that one could not see another's computer screen, and labeled each desk A-Z with a notecard taped to the two desks. (Not applicable for the control group)
- C. I numbered slips of paper 1 to x where x was the number of students that were in a given class. I then shuffled them into a random order and passed them out. These were their assigned player numbers, to keep confidentiality from me as the researcher as well as each other whilst playing the game.
- D. I then explained the method by displaying the experiment information on the board and reading it out loud. I then answered any clarifying questions, though there were rarely any.



**Figure 3.** Screenshot of the google slide showed to students giving them information about the game they were going to play with the resulting payoff matrix.

- E. I then entered the player numbers into a random number partner generator which randomly paired the player numbers together.
- F. Each set of partners was assigned to a letter A-Z which told them which location (2 desks) they would be playing at. (Not applicable for the control group)
  - a. If a player was not given a partnership (if there are an odd number of participants), I had them sit at a designated desk and had them fill out the form, and put “none” as their partner. They received 3 points so as not to discourage participants when they were not selected.
- G. Players met at their designated desk spots and had the opportunity to talk before any final decisions were made (not done in the control group). Participants then filled out the Google form selecting if they wanted to share or steal. The questions in my survey were:
  - a. Who is your teacher?
  - b. What class period is it?
  - c. What number round is this?
  - d. What is your assigned player number?
  - e. What is your opponent’s assigned player number?
  - f. Given the information, do you choose to share or steal?
- H. I then repeated these steps starting from randomizing the partnerships until participants completed 5 rounds in total.
- I. Participants then filled out the follow-up survey. The questions in the follow-up survey were:
  - a. Who is your teacher?
  - b. What period is it?
  - c. What is your assigned player number?
  - d. What is your gender identity? (They had the option of Male, Female, Non-Binary, Prefer not to say, and Other)

It is also important to note that I did get some responses that did not fit the binary research that I was doing on men and women, so their individual values were disregarded, but their responses in the “Experimental Method (Responses Against)/Experimental 2” section were taken into account. To get an idea of how the experiment was laid out an image of the experiment being conducted is shown below:



**Figure 4.** Image showing students participating in the aforementioned prisoner's dilemma experiment.

### Justification:

I chose to conduct my method in this way for a few reasons. I looked at many other research projects that were studying similar factors within the prisoner's dilemma, and they were all experimental methods that functioned similarly to my own (Anna Cigarini, Julián Vicens, and Josep Perelló, Melissa Kumar, Alberto Molina, and Many More). Even the values used within the payoff matrix [Figure 3] can heavily influence the cooperation rate so I used the exact values used in the source of Romano because his cooperation levels averaged around 63% and I wanted to see similar values in my experiment. I used the aspect of face-to-face interaction as a way to introduce gender as a variable from research done by Turiegano and Sanchez-Pages. As for using the AP English Language and Composition classes, the large sample was the main reason for choosing this population. The ability to get voluntary participants to sign up for an experiment during the time after school would not have garnered me anywhere close to the number of participants I had. The timing was intended so that the experiment would take place right before the curriculum got to its philosophy and moral dilemma unit. Another aspect of my experiment is that I made it into a game. I tallied all the players' points over the five rounds and declared a winner for each period. These winners were given extra credit in these classes. Extra credit was given to first give people an incentive to fill out the consent forms and join my experiment and second, to give people more of an incentive to try to get the most points while in the game. This drive was an important aspect of my design to draw out players' true biases. This is an aspect I felt some other sources did not do as well. For example, in Colman (et al.)'s design, he only told participants what gender their opponent was and no other information. This played too much into the hypothetical of the experiment and I did not want the studied variable to be as obvious. My experiment was used as a fun and interactive way to get into that content. The teachers used it as a learning experience.

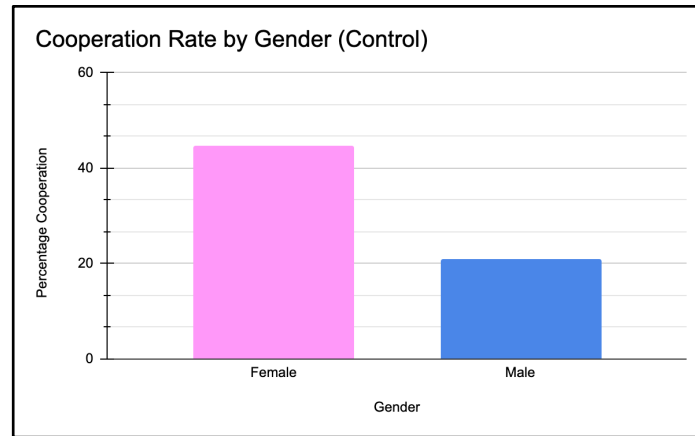
### Data Analysis

#### Data for Analysis:

1. The difference in cooperation rate between male and female players without interaction. Referred to as the Control Group Section.
2. The difference in cooperation rate between male and female players with face-to-face interaction. Referred to as the Experimental Group 1 Section.
3. The difference in cooperation rate between players who were partnered up with male and female players. Referred to as the Experimental Group 2 Section.

#### Control Group:

The control group tested how men and women would react in the prisoner's dilemma while limiting other potential variables that could be present with face-to-face interaction. The raw data can be found in Appendix B, which shows an example set of ten responses. It also shows the probability of cooperation by the individual genders. These totals came out to be around 45% for women and 21% for men. This difference is represented in the bar chart below.

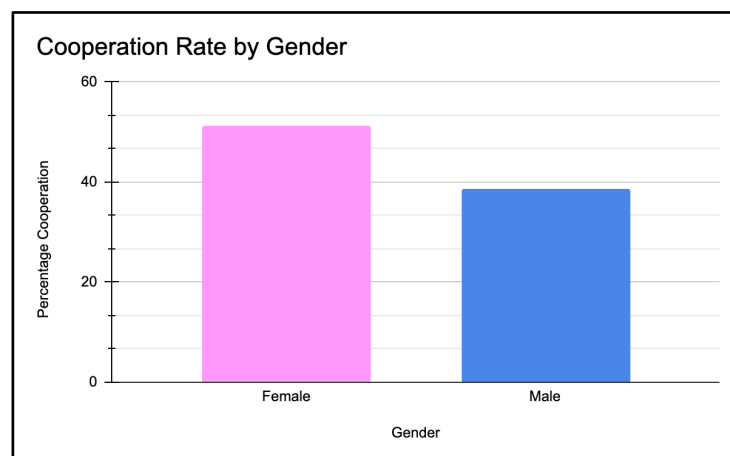


**Figure 5.** A bar chart showing the respective cooperation rates for male and female players in the control groups.

While this seemed to be a pretty drastic difference, I needed to check the significance of the data. I used a Chi-Squared right-tailed test of homogeneity to find a p-value. I used an alpha level of 0.05 and my test included a degree of freedom of 1. I used these values for all three sets of data. The null hypothesis stated that cooperation is distributed in the same way for both genders, and my alternative hypothesis was that they were not distributed in the same way for both genders. These calculations are shown in Appendix B. This test for the control had a p-value of 0.0211 which held statistical significance as it was under my alpha level. This means that male players, when not influenced by other variables, have a statistically lower distribution of cooperation than female players.

### Experimental Group 1:

The experimental group tested how men and women would react in the prisoner’s dilemma with face-to-face interaction, to see first if there was any difference from the control group, but also later on for the Experimental Group 2 Section. The raw data can be found in Appendix D, which shows an example set of ten responses. This data was used for both experimental groups and shows the addition of the responses against the players. I was able to match up the responses with their opponent’s choice through Google Sheets and by using their player numbers. It also shows the probability of cooperation by the individual genders with interaction. These totals came out to be around 51.2% for women and 38.5% for men. This difference is represented in the bar chart below.



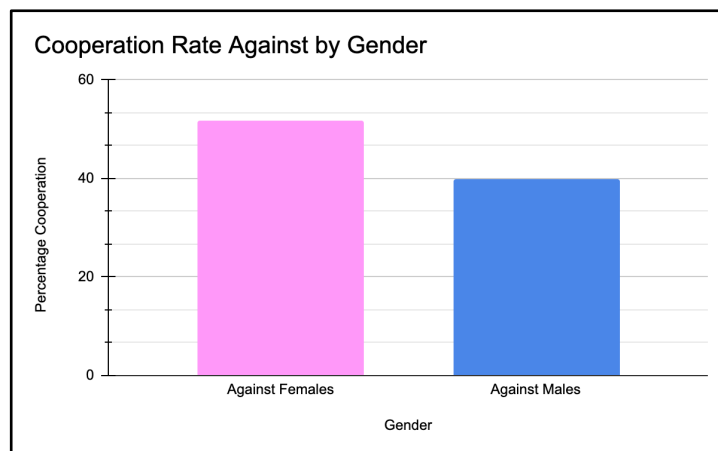
**Figure 6.** A bar chart showing the respective cooperation rates for male and female players in the groups with interaction.



To see if the data was significant, I used the same test as the control group with the same degrees of freedom and null and alternative hypotheses (except with interaction). All the calculations are shown in Appendix D. This test for the control had a p-value of 0.0136 which held statistical significance as it was under my alpha level. This means that men, with the presence of face-to-face interaction, have a statistically lower distribution of cooperation than that of female players.

### Experimental Group 2:

The experimental group tested how men and women would be cooperated with in the prisoner's dilemma with face-to-face interaction, to see if students were treating men and women differently. Data can be found in Appendix E. It also shows the probability of cooperation between the individual genders with interaction. These totals came out to be around 51.9% for women and 39.9% for men. This difference is represented in the bar chart below.



**Figure 7.** A bar chart showing the respective cooperation rates when partnered with male and female players in the groups with interaction.

Lastly, I needed to check the statistical significance of my final data set. I used the test and degrees of freedom as the first two. The null hypothesis stated that cooperation is distributed in the same way when playing against both genders, and my alternative hypothesis was that they were not distributed in the same way for playing against both genders. All the calculations are shown in Appendix E. This test for the control had a p-value of 0.0206 which held statistical significance as it was under my alpha level. This means that players, when playing against male players, have a statistically lower distribution of cooperation than when playing against female players, regardless of gender.

### Conclusions:

The data, which was all statistically significant, showed that female players cooperate at a rate higher than males, with and without interaction, and it also showed that people were more likely to cooperate when paired up with a woman than a man.

## Discussion

This experiment was designed to examine how the presence of gender within a prisoner's dilemma-like game affected the cooperation rates of players.

### Findings:

After examining the results from my experiment, I found that those who identified as female cooperated at a rate higher than those who identified as male without knowing who they were playing against in my experiment. When studied in the experiment with interaction, the same conclusion was drawn, that women cooperate at a higher rate. When looking at this experimental set of data it can also be concluded that when paired up with a female player, players, regardless of gender, cooperated at a higher rate than when paired up with male players. These findings backed up both of my hypotheses that women would cooperate more than men, and that they would be cooperated with more. Colman comments on a common gender stereotype, "Women are generally expected to be less competitive and more altruistic than men". Competitiveness is perceived as "stealing" or defecting. Interestingly, this stereotype that women will cooperate at a higher rate is prevalent as players cooperated with female players more than men, which is backed up by the data that female players did cooperate at a higher rate than men. This shows that while stereotypes can be very harmful, especially stereotyping based on gender, they are not always incorrect.

### Implications:

There are some important implications to draw from my research. First, women cooperate and are cooperated with at a rate higher than men within the prisoner's dilemma. Thus, in prisoner's dilemma-like scenarios, people can use this data to have more information when going into a choice. Victor Romano comments on the applicability of the prisoner's dilemma saying, "Understanding the intricacies of social dilemmas in general and Prisoner's Dilemma in particular is important due to the myriad of social issues that are manifestations of such dilemmas. Macro and micro issues ranging from global warming and nuclear arms treaties to recycling and gun ownership are at the crux [of the prisoner's dilemma]" (Romano 8). The prisoner's dilemma can apply to many issues both large and small, from everyday small decisions like deciding what to eat for dinner to nuclear war treaties. In these social issues, having information can help to make the right choice through persuasion or even to disarm high-tense scenarios. From my data, women are more likely to choose the socially respectable choice when presented with two options than men are. People are also more likely to assume that women will choose the socially respectable choice and may try to take advantage of that generosity. This expectation of women to do so may affect the reason why they cooperated more often which then in turn contributes to the expectation of women. While these results are applied to the prisoner's dilemma, the prisoner's dilemma reflects a common scenario of decision making especially within a business environment. In this way, my findings can help individuals make better decisions by knowing more information about where an individual might want to make their choice just based on their gender identity.

### Fulfillment of Gaps in the Research:

#### *1. Filling the Contradictory Evidence Gap*

As for the contradictory evidence gap, given the statistical significance of my data, it backs up sources such as Blake, Molina, List and Ortmann, and Tichy. It contradicts evidence that there is no difference from sources Cigarini, Vicens, and Perello, Storey and Workman, Mengel, and directly contradicts evidence that men cooperate at a higher rate from source Colman et al. This data is only for the aspect of my research question that pertains to the question of which

gender cooperates more. As for which gender players were cooperated with more, there is not a ton of published evidence on that study which means that my research will naturally fill in that spot, and hopefully inspire more research to be done.

## 2. *Filling the Population Gap*

As for the population gap, studying the presence of gender within the prisoner's dilemma has not been done with the population of a small Midwestern American high school. This is important because there may be differences in results between different populations. These differences can help draw conclusions to or encourage research on possible confounding variables that could be apparent with the different populations.

### Limitations:

It is especially important to note some limitations of my data. For the scope of my research, the experiment was conducted with students at a small Midwestern school all enrolled in Advanced Placement English Language and Composition. It's important to note that although the sample was large and the makeup of the classes seem to be representative of the school, there is a basic level of intellect and grit to take this challenging course (AP English Language and Composition) that may not reflect all of the high school students. Because I used these classes, I was also confined to space. Ideally, I would've had players in singular rooms to eliminate some potential distractions and confounding variables that could be present by being in a room with the rest of the players. Another limitation is that even though extra credit was offered as a reward for individuals, this may not have been an effective incentive to get the most points for all players. Some students may have had good enough grades and did not need extra credit whereas others may have not cared about their grades at all. The extra credit would have had a limited effect on both of these groups.

### Areas for Further Research:

Going forward, many experiments could be carried out similarly with slight tweaks to test different demographic areas. Some preliminary ideas could include race, religion, age, nationality and so many more. Everyone grows up to be the person they are from a combination of many different factors which all play into their decision-making, the right factors just have to be tested. Some new insights could also be gained from using different populations than my own. Possibly a different geographic high school and size, like a large west coast high school. Or a different population like members at an elderly home or college kids. Some new studies that could be carried out could use different dilemmas other than the prisoner's dilemma, such as the dictator's game and many others.

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