

Demographic Influences on Cooperation in One-Shot, Anonymous Prisoner's Dilemma Games

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ABSTRACT

The Prisoner's Dilemma examines decision-making in situations in which there is discord between individual incentives and cooperation. Theory predicts that rational individuals, working to maximize their own individual payoff, will act non-cooperatively in their own self-interest. However, prior research proposes that cooperation may vary across demographic groups. A total of 184 individuals were surveyed using Google Forms to collect demographic information and were presented with a modern adaptation of the Prisoner's Dilemma. Associations between age, race, gender, religiosity, and likelihood of cooperation were explored. Results indicated that female participants demonstrate significantly higher rates of cooperation than their male counterparts. Additionally, younger individuals (18-34) were also significantly more likely to defect than older individuals (35+). Unexpectedly, there were no significant associations found between race, religion, and cooperation despite expectations. The findings suggest that gender and age may have some influence over variation in cooperative decision-making while other demographics such as race and religiosity have limited influence. Theory provides a guideline for what to expect, but human behavior is not fully predictable. This research provides insight into the nuances of cooperation and how individual characteristics and their corresponding life experiences can cause deviation from theoretical expectation.

KEYWORDS

Cooperation; Prisoner's Dilemma; Game Theory; Demographics; Decision-Making; Behavioral Economics; Chi-Square; Experimental Economics; Economic Psychology; R Programming

INTRODUCTION

The Prisoner's Dilemma and its Social Implications

The Prisoner's Dilemma game models a situation in which two individuals are in a conflict where they have the choices to either cooperate with their opponent or defect with various payoffs correlating to the decisions made.¹ An individual who cooperates is benefiting the opponent while they themselves pay a cost.² On the other hand, an individual who defects would be working to benefit themselves. Within the canonical Prisoner's Dilemma, the best outcome is the one in which there is no other payoff in which both players would do better. This payoff lies where both players cooperate with one another. However, should a player choose to defect while the other cooperates, the defector receives the highest payoff. If both players choose to defect, however, they are both worse off and thus experience the worst outcome.¹ While standard game theory predicts that rational individuals will act in their own self-interest, researchers have explored how cooperative behavior changes when Prisoner's Dilemma scenarios are adapted to reflect modern social contexts.

Dorrough and Glöckner³ establish that cooperation is considered an inherently friendly act while defecting is inherently selfish and unfriendly. There is a societal expectation that individuals act in a particularly socially acceptable way. Individuals are often motivated to be perceived as kind and altruistic. People look down on those who act selfishly while praising those who always put others first. However, Brañas-Garza and Morales-Siles⁴ suggest that in these anonymous Prisoner's Dilemma games only about 20% of people tend to choose the altruistic approach. There is a conflict of interest between working in self-interest and succumbing to societal norms. Defection will ensure the best payoff for the individual each time; however, cooperation is often viewed as the more socially desirable option. This raises the question as to who would choose to defect or cooperate and why. Gender, age, race, religiousness, and other demographics may play a part in this phenomenon.

Gender in Cooperation

The world has long assumed that women are more cooperative and docile than men. The expectation of women to be less competitive and magnanimous is, at the end of the day, based in common stereotype rather than fact.⁵ Even though stereotypes

like these can be harmful, they may not always be untrue as Capraro⁶ found that women are statistically more likely to cooperate than men. On the other hand, Dorrough and Glöckner³ found that, conversely, men were more likely to cooperate. However, regardless of whether or not cooperation is involved, when presented with choices, women are more likely to pick the “socially respectable” choice than men are.⁵ When looked at concurrently, the variety in these studies implies that gender differences are not only shaped by behavior, but another variable as well.

Beyond the observed behavior, there is a phenomenon that makes itself evident. People, regardless of gender, are more likely to cooperate with a woman over a man as they expect women to provide reciprocity for their cooperation.⁵ This exposes an interesting paradox as despite being more likely to be cooperated with, women expect to be cooperated with less than men do.³ It can be theorized that this is due to the different life experiences and stereotypes placed upon each gender. Traditional gender-role stereotypes often characterize men as the providers while portraying women as the caretakers or dependents. These differing life experiences and perceived societal expectations may help to explain why these trends emerge. These findings suggest that not only gender itself that influences cooperation, but the experiences individuals face because of their gender.

Age in Cooperation

Rebellious youth is a common stereotype that suggests younger individuals are more likely to challenge authority than their older counterparts. Despite the common perception that older adults are cooperative and obedient, it is natural to wonder if older adults really are simply more restrained and cooperative than their youthful counterparts. Romano et al.⁷ found that there is no significant difference in the levels of cooperation between young and old adults. This is consistent with the study by Mienaltowski and Wichman⁸ which came to the same conclusion. Despite being equally likely to cooperate, older adults are more likely to express generosity than younger generations.⁷ The imbalance of these two points implies that while generosity may be definitively age-dependent, there may be other factors that influence cooperation.⁷

Levels of one-shot cooperation are equal between older adults and younger adults but, when you keep the game going, a stark fact makes itself clear. Older adults are more forgiving and trustful while younger adults tend to be more vengeful. This nature may put these older adults at risk of being taken advantage of, but it also opens the opportunity for reconciliation which strengthens relationships.⁸ This may help to explain why individuals tend to believe that older adults are more likely to cooperate than younger adults. Due to their forgiving nature, older adults showed willingness to cooperate with younger adults despite believing that the younger adults would defect.⁷ While older adults are no more likely to initially cooperate with others than their younger counterparts, they do show a surprising level of compassion that leads them to make more cooperative decisions later down the line. This aligns itself with the “positivity effect” seen in older adults. Older adults unconsciously choose to spend their cognitive resources on positive over negative stimuli.⁹ With a natural inclination towards positivity, this may aid in explaining why older adults tend to display more forgiving and generous behavior.

Race and Religiousness in Cooperation

Race is more than just the color of your skin, but also a community you are a part of. There are daily obstacles and challenges each race of people must experience on a day-to-day basis that alter their view on cooperation. Romano¹⁰ established that black individuals have higher rates of cooperation than their white counterparts. Additionally, black individuals were also shown to have more trust and higher expectations in their opponent than did white individuals.¹⁰ Despite this, participants of all races felt more cooperative with those of their own race rather than those not.²

Religiosity is a big part of the culture of a lot of races and can also play a part in cooperation. In religion, the mantra of “love thy neighbor” and, in general, doing good to all is often emphasized as a moral duty. This idea correlates to the idea of cooperation, in that cooperation is the kind and just thing to do and as such would be the religious thing to do. Romano¹⁰ identified that black individuals are considerably more religious than white individuals. He also stated that religious individuals were more likely to believe their opponent would cooperate just how black individuals expressed the same feelings. Religiousness and race seem to go hand in hand when it comes to cooperation. The cultural experience one obtains with their racial identity seems to shape how people work with and trust other individuals.

Research Gap

Despite extensive research on cooperation, previous research has reported inconsistent findings regarding the influence of demographic characteristics in one-shot, anonymous Prisoner’s Dilemma settings. This study addresses this gap by examining how age, gender, race, and religiosity influence cooperation in a controlled survey-based modern workplace adaptation of the Prisoner’s Dilemma.

METHODS AND PROCEDURES

This study examined how demographic characteristics influence cooperation in anonymous, one-shot Prisoner's Dilemma games. The analysis focuses on identifying patterns of cooperative behavior across the demographic variables of age, race, gender, and religiosity.

Data were collected through an online Google Forms survey which garnered 184 participants. Participants were recruited through a combination of online platforms and personal outreach. The survey was distributed via SurveyCircle, online forums such as Reddit, and through outreach to university faculty who shared the survey with their students. Additionally, participants were recruited through personal networks, including friends, family members, and colleagues, who further distributed the survey within their own networks. This approach resulted in a convenience sample drawn from a range of backgrounds rather than a single institutional population. The first section of the survey collected participant demographic information including biological gender, gender identity, age, race, and level of religiousness. In this study, 'gender' refers specifically to biological sex, male or female, as self-reported by each participant. All demographic questions were optional, and as a result, response counts varied across variables.

Following the demographic section, participants were presented with a modern adaptation of an anonymous, one-shot Prisoner's Dilemma in which they were faced with a situation involving a job promotion. This adaptation of the canonical Prisoner's Dilemma was designed to maintain the central conflict between cooperation and self-interest while altering the traditional payoff structure to increase the realism of the decision-making context through a workplace promotion scenario. Mutual cooperation does not guarantee both participants an identical payoff but rather ensures a fair chance at promotion solely based on merit. The situation was presented as follows:

You along with another co-worker are up for a promotion. You both have dirt on one another that could compromise the others chances of getting promoted.

During the interview process you as well as your co-worker have the opportunity to either spill the dirt on the other or stay quiet.

If one spills the dirt and the other doesn't, the one who spills the dirt guarantees the promotion. If both spill the dirt neither candidate gets the promotion. If neither candidate spills any dirt, the promotion goes to whichever candidate is more qualified.

Would you spill the dirt or stay quiet?

NOTE: You have no way of communicating with your co-worker nor do you know what they have chosen.

The participants chose whether or not they would "spill the dirt" (not cooperate) or "stay quiet" (cooperate). The question emphasized the anonymity aspect of the situation, ensuring participants knew that there was no known demographic information on the competitor, nor could any discussion happen with the competitor.

The data were compiled in Microsoft Excel and exported as a .csv file. This data was then imported into RStudio as a dataframe for statistical analysis using the tidyverse package. The data were cleaned to remove any incomplete responses. The data were subsequently sorted into separate dataframes corresponding to each demographic variable and associated decision. Data were analyzed using both original and aggregated groupings (white vs non-white and 18-34 vs 35+) to satisfy the expected cell count assumptions required for chi-square analyses.

To evaluate the relationship between cooperation and each demographic variable, chi-squared tests of independence were conducted. This method was selected due to the categorical nature of both the dependent and independent variables. Expected values were calculated using the table function, chisq.test function, and \$expected output in R. For each analysis, chi-square statistics and the corresponding p-values were computed and compared to a significance level of 0.05.

This methodology allowed for the clear identification of trends between cooperation and demographic data. Using an anonymous, one-shot format allowed for the study of biological and innate instincts rather than individual strategy based on outside variables. The survey data allowed for the collection of a broad range of demographic data efficiently while chi-squared testing permitted objective pattern recognition ideal for this study.

There were limitations to this study that are important to mention. While the use of a survey made collection of a large amount of demographic data convenient, self-reported responses may not reflect fully real-world behavior. Knowledge of response

collection and analysis may make participants more inclined to make the decision they see as more socially acceptable rather than truthfully reporting how they feel. Furthermore, since participants were responding to a hypothetical situation rather than one with real consequences, cooperation observed within this study may vary from behavior displayed in real-world, incentive driven situations. Additionally, the survey involved a small sample size and utilized convenience sampling. This resulted in small sample sizes for certain demographic groups necessitating the modification of data groupings as, in their original state, they were not an adequate representation of the broader population, which could lead to skewed results. Although biological gender and gender identity were collected from each participant, there was an insufficient number of responses from gender-diverse individuals. As a result, findings related to gender are limited to biological sex and may not generalize to broader gender identities. Despite these limitations, this methodology allowed for the measurement of observable differences in cooperation between demographic groups and provided a clear guideline for analysis.

RESULTS

A total of 184 participants completed the survey. Demographic information was collected on biological gender, age, race, and religiosity. Because demographic questions were optional, the number of responses varied slightly across demographic variables. Participant demographic characteristics are summarized in Table 1.

Characteristic	Spill the Dirt <i>n</i> = 22	Stay Quiet <i>n</i> = 161	χ^2 (df)	<i>p</i>
Biological Gender				
Female	9 (8.2%)	101 (91.8%)	$\chi^2(1) = 3.84$	.0499
Male	13 (17.8%)	60 (82.2%)		
Age				
18–34	16 (16.7%)	80 (83.3%)	$\chi^2(1) = 4.12$	.0420
35+	6 (6.9%)	81 (93.1%)		
Race				
White	11 (10.2%)	97 (89.8%)	$\chi^2(1) = 0.84$	.360
Non-White	11 (14.7%)	64 (85.3%)		
Religiosity				
Religious	9 (9.6%)	85 (90.4%)	$\chi^2(1) = 1.09$	.300
Non-religious	13 (14.6%)	76 (85.4%)		
<i>Note.</i> Values are presented as <i>n</i> (%). Percentages are calculated within each demographic category.				

Table 1. Participant characteristics according to participants' Prisoner's Dilemma decision.

Of the 184 participants, 87.4%, or 160 participants, chose to stay quiet while the remaining 12.6%, or 24 participants, chose to spill the dirt. Overall, participants were substantially more likely to cooperate than to defect in the workplace Prisoner's Dilemma scenario. To determine the association between specific demographic characteristics and cooperation, chi-squared tests of independence were conducted for each variable. Female participants were more likely to cooperate than male participants. A chi-squared test of independence indicated a significant association between gender and cooperation ($\chi^2_1 = 3.84$, $p = 0.0499$, Cramér's $V = .12$). An initial chi-squared test of independence indicated no significant association between age and cooperation ($\chi^2_5 = 8.25$, $p = 0.083$). Because several age categories produced expected cell counts below five, participants were regrouped into two age categories (18–34 and 35+) and the analysis was repeated. The second chi-squared test indicated a significant association between age and cooperation ($\chi^2_1 = 4.12$, $p = 0.042$, Cramér's $V = .13$). Older participants were more likely to choose to stay quiet than participants aged 18–34. An initial chi-squared test of independence found no significant association between race and cooperation ($\chi^2_3 = 4.04$, $p = 0.26$). Because several racial categories produced expected cell counts below five, participants were regrouped as White and non-White and the analysis was repeated. The second chi-squared test also indicated no significant association between race and cooperation ($\chi^2_1 = 0.84$, $p = 0.36$, Cramér's $V = .00$). A chi-squared test of independence indicated no significant association between religiosity and cooperation ($\chi^2_1 = 1.09$, $p = 0.30$, Cramér's $V = .02$).

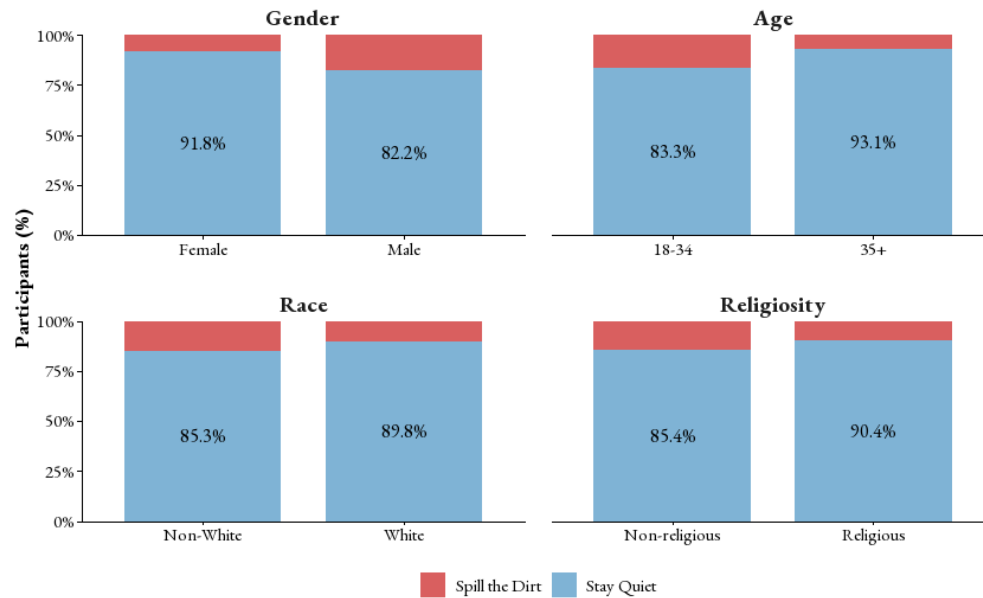


Figure 1. Proportion of participants choosing to stay quiet (cooperate) or spill the dirt (defect) across demographic groups.

To determine whether the observed demographic associations remained after simultaneously accounting for the other demographic variables, a multivariable logistic regression model was fitted with biological gender, age group, race, and religiosity as predictors of cooperation. After adjustment, none of the demographic variables remained statistically significant at the 0.05 level. However, the direction of the associations was consistent with the chi-square analyses, with male participants exhibiting lower odds of cooperation ($OR = 0.41$, 95% CI [0.16, 1.02], $p = .059$) and participants aged 35 years and older exhibiting higher odds of cooperation ($OR = 2.60$, 95% CI [0.99, 7.67], $p = .063$). Race and religiosity were not significantly associated with cooperation after adjustment.

DISCUSSION

This study indicates that demographic factors do not uniformly influence cooperative behavior. While gender and age were associated with significant differences in cooperation, race and religiosity were not associated with significant differences in cooperation. These findings highlight the importance of behavioral variation across specific demographic groups and suggest that cooperation cannot be fully explained by uniform theoretical assumptions.

Although the multivariable logistic regression provided weaker statistical evidence for the associations between gender and cooperation and between age and cooperation, the direction of these effects remained consistent with the primary chi-squared analyses, suggesting that gender and age may continue to play a role in cooperative decision-making. Because this study focused on a small number of pre-planned demographic hypotheses rather than exploring a large number of possible relationships, a multiple comparison correction was not applied. The consistency between the multivariable logistic regression and the primary analyses provides additional support for the robustness of these findings.

One of the most notable findings of this study is the exceptionally high rate of cooperation, with approximately 87% of participants choosing to cooperate despite theoretical predictions favoring defection. This substantial deviation indicates that factors such as lower stakes in the modern Prisoner's Dilemma in which the consequence involves not receiving a promotion rather than incarceration, the hypothetical nature of the situation, the perception of being judged when filling out a research survey, or the anonymous nature of the study influenced decision-making. An additional consideration is that the modified payoff structure of the modern workplace adaptation of the Prisoner's Dilemma may also have had an effect on cooperation rates. This scenario may have encouraged cooperation by preserving a fair opportunity for promotion when both individuals cooperate, reducing the tension between self-interest and cooperation. While these are all plausible explanations, further research would be necessary to determine the relative contribution of each individual factor.

Cooperation extends beyond theoretical models and plays a critical role in real-world social, economic, and organizational interactions. The present findings suggest that these behaviors cannot be fully explained by assumptions of rational self-interest alone. This study examined how demographic characteristics such as gender, age, race, and religiosity may lead to variations in cooperation and identified patterns of group behavior rather than focusing solely on the individual.

These findings are significant in a broader context, indicating that cooperation is not only driven by rational self-interest but by behavioral tendencies and group-level patterns. This contributes to a more nuanced understanding of cooperation and how, in the real world, it varies from theory. Collectively, these findings contribute to a more nuanced understanding of how to predict behavior in decision-making environments.

CONCLUSIONS

This study highlights the importance of understanding how demographics affect cooperative behavior when it comes to decision-making. Game theory predicts that rational individuals will choose to be uncooperative in one-shot Prisoner's Dilemma situations. However, this research demonstrates that human behavior does not always align with theoretical predictions. Instead, it suggests that cooperation in decision-making is influenced by behavioral tendencies as reflected in the patterns this study identified in cooperation across specific demographic groupings.

The most significant insight found from this study is the variation in cooperation presented in the age and gender groupings. The results indicated that women are more likely to cooperate than their male counterparts. Additionally, older individuals (35+) were more likely to cooperate than younger individuals (18-34). These results imply that there are certain groups that are more inclined towards cooperation in anonymous, one-shot Prisoner's Dilemma settings than others. This trend is not true for all demographic groupings however, as there was no statistically significant evidence to suggest that race or level of religiousness has any influence over likelihood to cooperate in those same settings. This reinforces that not all demographics have an equal level of influence over cooperation.

The importance of this study reaches beyond the Prisoner's Dilemma. Understanding the variation in cooperation across different demographic groupings can have a significant effect on social, workplace, and economic interactions. Cooperation is a fundamental component of many systems that have been established in the real world. By identifying these patterns, a better understanding of decision-making in cooperative situations across many demographic groups and how that affects risk-taking and trust can be developed. Focusing on group-level tendencies, rather than the individual, improves the ability to predict behavior across larger samples.

For those in business settings and client-facing roles, it is important to consider human behavior when it comes to variation in cooperation rather than assuming uniform, theoretical decision-making. Negotiation and collaboration are a major part of how society works, especially in the workplace. Understanding demographic variation in these situations may allow for the use of more effective strategies.

Cooperation, in the theoretical Prisoner's Dilemma, is measured by the assumption that every individual is working in their own self-interest. However, human behavior is more complicated than that. Traditional models do not fully account for behavioral tendencies and group-level behavioral habits that inform decision-making beyond selfish reasoning. Continuing to observe these trends will allow for a better understanding and improved predictions involving cooperative behavior in real-world and theoretical settings.

While this study provides valuable insight into the influence that demographic factors have on cooperation, there are several areas in which research on this topic can be explored. An important consideration is pursuing research on this topic with a larger sample size. A sample of 184 respondents was collected which limited the diversity of the results and lacked responses from smaller subgroups. A larger sample would provide a more representative study that would allow for results with more generalizability.

Future research could also consider larger and more in-depth demographic variables. While biological gender was studied, it would also be of interest to study gender identity as well. Additionally, for this study individuals had to self-identify as religious or non-religious but, it could be of interest to break that down into smaller more specific categories such as devoutly religious and slightly religious with clearly defined definitions of each. Other variables could include socioeconomic status and level of education as well. Cultural background is also an important factor that could be studied, and a comparison within racial groups of different cultural backgrounds and their likelihood of cooperation may lead to different results.

This study focused on anonymous, one-shot Prisoner's Dilemma games. Future research could use different variations of the Prisoner's Dilemma which would allow the study of repeated interaction and grudges as well as bias and assumptions of knowing who you are competing against. This could pave the way for analysis on how social factors affect cooperation rather than just biological or "in-group" factors.

While this study focused on adult participants, it may be interesting to expand the age range to include younger participants. With the ideals of sharing and teamwork being frequently thrust upon younger individuals, a cyclical trend might be seen in which around young adulthood, uncooperative behavior peaks while the beginnings and ends of life is where cooperation is maximized.

With this study being a survey, individuals provided self-reported responses while knowing that their choices would be collected and analyzed. This may cause people to choose what they see as the “best” or socially correct option rather than what they really would choose if they were faced with that situation. This opens the door to continue this study as a non-experimental, observational study in which data is collected on subjects in their natural environment purely by observation with no interference. This ensures that participants aren’t altering their behavior to make themselves look better.

This study serves as a solid foundation for further analysis of the effects that demographic characteristics have on cooperation. Future studies will aid in refining our understanding of human behavior and enhance the ability to predict outcomes in decision-making situations.

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PRESS SUMMARY

This study examines how demographic factors such as gender, age, race, and religiosity influence cooperation in decision-making situations using a modern variation of the Prisoner’s Dilemma. Traditional game theory suggests that rational individuals will choose to act selfishly; however, results show that real human behavior is more complex. Gender and age were associated with differences in cooperation while race and religiosity did not. These findings highlight how demographics influence cooperation beyond pure rationality. These patterns help explain decision-making in the real world and provide insight into how people behave in social and economic situations.