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RECEIVED 15 June 2024

ACCEPTED 04 March 2025

PUBLISHED 02 April 2025

CITATION

Hashimoto H, Naganobu K, Maeda K and
Tanida S (2025) Reluctance to initiate
cooperation: the trade-off between
effectiveness and hesitation in the sequential
one-shot prisoner's dilemma.
Front. Behav. Econ. 4:1449488.
doi: 10.3389/frbhe.2025.1449488

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Reluctance to initiate cooperation: the trade-off between effectiveness and hesitation in the sequential one-shot prisoner's dilemma

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Previous research suggests that initiating cooperation in a sequential one-shot prisoner's dilemma fosters mutual cooperation. We hypothesized that sense of control, defined as the belief that one's cooperative decision will be reciprocated, plays a crucial role in fostering mutual cooperation. To test this, we conducted two experiments comparing three conditions. In the *simultaneous condition*, both players made their decisions at the same time. In the *self-first condition*, participants made their decisions first in a sequential setting. In the *other-first condition*, they made their decision after observing their partner's choice. The results indicate that initiating cooperation increases the likelihood of mutual cooperation. However, participants were reluctant to be the first to cooperate, despite its effectiveness. Our paper discusses these findings from a cross-cultural psychological perspective, highlighting potential differences in cooperative behavior across cultural contexts.

KEYWORDS

cooperation, sense of control, simultaneous one-shot prisoner's dilemma game, sequential one-shot prisoner's dilemma game, self-reported willingness

1 Introduction

In one-shot prisoner's dilemma games (PDG), many players choose to cooperate even when it is economically rational to defect. One possible explanation for this behavior is that players are affected by their sense of control (Hayashi et al., 1999; Watabe et al., 1996; see also Karp et al., 1993). Sense of control is the belief that other players will reciprocate one's cooperative decision, which, in turn, leads to the decision to cooperate. Watabe et al. (1996) examined cooperative behavior in a one-shot PDG in terms of sense of control. Their findings suggest that, if one player cooperates first, the other player is likely to reciprocate. In a one-shot sequential PDG, where two players make decisions in a clear sequence, the first player should be more inclined to cooperate if they have a strong sense of control over the second player's decision. By doing so, they increase the likelihood of mutual cooperation. If a player acts purely out of self-interest, they will choose to defect in both sequential and simultaneous one-shot PDGs. However, in sequential PDGs, the second player's decision depends on the first player's action. From this perspective, it is reasonable to expect that the first player's cooperation will encourage cooperation from the second player.

A substantial body of research in behavioral economics and social psychology supports the idea that the first player's initial action influences the second player's decision. For example, [Clark and Sefton \(2001\)](#), who employed sequential PDGs, and [Steiger and Zultan \(2014\)](#), who utilized four-player PGGs, demonstrated that second players respond to the actions of the first player (see also, [Shafir and Tversky, 1992](#)).¹ Furthermore, [Schneider and Shields \(2022\)](#), who conducted a comparative analysis of sequential and simultaneous PDGs, found that second players' cooperation rates increased when the first player cooperated, compared to those in simultaneous PDGs. Similarly, the results of [Watabe et al. \(1996\)](#) suggest that the expectation of reciprocity influences cooperation. Specifically, they found that, when the first player cooperated, the second player also cooperated 75.0% of the time, compared to a 55.6% cooperation rate in the simultaneous condition. Conversely, the cooperation rate dropped to 12.0% when non-cooperation was observed. This pattern suggests that players exhibit a tit-for-tat strategy even in a one-shot sequential PDG ([Axelrod and Hamilton, 1981](#)). Interestingly, when participants were assigned the first player role, the cooperation rate was 82.6%. These findings indicate that a sense of control influences cooperation in a one-shot PDG—when one player cooperates, the other tends to reciprocate.

The present study builds on these findings through a series of exploratory studies examining the effectiveness of initiating cooperation and the hesitation to do so. Specifically, we aim to replicate the study by [Watabe et al. \(1996\)](#).² Additionally, we investigate participants' inclination to initiate cooperation in a one-shot PDG. Study 1 involved a conceptual replication of [Watabe et al. \(1996\)](#) using a scenario-based approach to test two key hypotheses. Study 2, which incorporated monetary incentives, involved an experiment with Japanese participants across a wide age range in order to examine the robustness of Study 1's findings. The main hypotheses of this study, which involves one-shot simultaneous and sequential PDGs, are as follows:

Hypothesis 1: In a sequential one-shot PDG, the first player's decision will influence the second player's cooperative behavior in the other-first condition (where they decide after knowing their partner's choice). In other words, if the first player cooperates, the second player will also cooperate, and vice versa.

Hypothesis 2: In a sequential one-shot PDG, cooperation in the self-first condition (where the participant decides first, and

their choice is revealed to the partner)—where the participant is expected to experience a greater sense of control—will be more prevalent than in the simultaneous condition.

While Hypothesis 1 may appear self-evident, it is important to emphasize that, from the perspective of economically rational behavior, there is no strategic incentive to reciprocate cooperation (or non-cooperation) in a one-shot sequential PDG. Despite this, drawing upon previous findings ([Bolle and Ockenfels, 1990](#); [Kiyonari et al., 2000](#); [Watabe et al., 1996](#)), the present study posits that individuals will exhibit reciprocity as a default behavioral principle, even in a one-shot game. In summary, we hypothesize that cooperative actions will be reciprocated. Hypothesis 2 is based on the assumption that the behavior of the second player, as described in Hypothesis 1, is somewhat generalizable. If there is a basis for experiencing a sense of control, then when the first player (who has a high sense of control) takes the lead, their cooperative behavior should be more pronounced.

Beyond testing these hypotheses, this study explores an overlooked aspect of previous research: the conditions under which participants are inclined to make decisions in PDGs. The tendency to initiate cooperation is crucial in social psychological research; however, few studies have examined players' subjective willingness in one-shot PDGs. Therefore, the secondary goal of this study is to investigate the relationship between cooperative behavior and decision-making tendencies by measuring both simultaneously.

2 Study 1

2.1 Materials and methods

Study 1 attempted to conceptually replicate [Watabe et al.'s \(1996\)](#) pioneering work on sense of control. To test the two abovementioned hypotheses, a scenario-based experiment was conducted under three conditions: Simultaneous, self-first, and other-first (i.e., within-participant factors).

2.2 Participants

Seventy-six Japanese undergraduates (mean age = 20.14) participated in this study. Participants were asked to think about and respond with regard to what they would do if they actually participated in the experiment; this study did not utilize any monetary rewards to incentivize the participants.

2.3 Procedure

Upon arrival at the laboratory and after completing the consent form, the participants completed one of two types of questionnaires: one in which participants made a choice in the self-first condition and then in the other-first condition and another vice versa condition in which participants made a choice in the other-first condition and then in the self-first condition.

¹ One potential explanation for the discrepancy between the cooperation rates observed by [Shafir and Tversky \(1992\)](#) and those in our study is the 'realistic sense of exchange' (see [Kiyonari et al., 2000](#)). The use of a one-shot prisoner's dilemma game rather than a repeated game in our study was intended to simulate a realistic exchange environment, as suggested by [Kiyonari et al.](#) This methodological choice is a key feature of our study.

² In this study, we aimed to investigate how players experience a sense of control. To this end, it is important to underscore the importance of informing the partner about the player's decision-making process in sequential PDGs. In contrast to the research approach taken by [Watabe et al. \(1996\)](#), who manipulated the level of information provided to one player, this study focused exclusively on the condition where the partner is fully informed about the decision-making process.

In accordance with the study by Watabe et al. (1996), participants were given the following instructions under all conditions. First, they were paired with a partner in a situation where anonymity was guaranteed and played an experimental game. They were then asked whether they would give the JPY 500 they received from the experimenter to their partner. The amount of money given to the partner would be doubled by the experimenter and given to the partner as a reward. The money left in the participant's hands, which was not given to the partner, would be their own reward but would not be doubled. The partner would make the same decision.

Subsequently, participants were asked to record their decisions regarding the allocation of the JPY 500 to the partner in three distinct scenarios: simultaneous, self-first, and other-first conditions. In the self-first condition, participants were asked to make decisions before their partners. In the other-first condition, they were asked to indicate what they would do if their partner gave them the full JPY 500 or did not give them the full amount, respectively.

Finally, after once again explaining this study's three established conditions, we asked participants to rate which type of decision-maker they would be willing to be—simultaneous, self-first, or other-first—with regard to the three conditions by using a seven-point Likert scale that ranged from 1 (I definitely don't want to be) to 7 (I definitely want to be).

2.4 Results and discussion

First, by comparing the average rate of cooperation in the other-first condition, we tested Hypothesis 1, which stated that the second player's rate of cooperation in the sequential one-shot PDG would vary according to the amount offered by the first player. The results showed a significant difference between the two cases, supporting Hypothesis 1. Specifically, the proportion of participants who cooperated when their partner indicated cooperation was 76.3%, whereas the proportion who cooperated when their partner indicated non-cooperation was 1.3%, a statistically significant difference [McNemar test: $X^2(1) = 57.00, p < 0.001$]. This finding indicates that, when the other party demonstrates cooperation, they are also willing to reciprocate.

Furthermore, the average cooperation rate in the self-first condition (55.3%) was significantly higher than that in the simultaneous condition [42.1%; McNemar test: $X^2(1) = 4.17, p < 0.05$], which supports Hypothesis 2. These findings indicate that participants can recognize the function of demonstrating cooperation in advance (left panel of Figure 1).

The left panel of Figure 2 shows the mean scores of the degree to which participants would like to be decision-makers in each condition. A one-sample *t*-test was conducted to analyze the difference from the neutral point (4) of the means in the simultaneous, self-first, and other-first conditions. The results show that the mean for the other-first condition was significantly above the neutral point; conversely, the mean for the self-first condition was significantly below the neutral point ($t_s > 4.61, p_s < 0.001$). The results indicated that, although the participants recognized the function of extending cooperation first, they preferred being in the other-first condition than in the self-first condition.

3 Study 2

The findings of Study 1 indicated that individuals exhibited high cooperation rates in the self-first condition and recognized the function of demonstrating cooperation first in eliciting cooperation from others. Nevertheless, the findings indicated that individuals were reluctant to make decisions under the self-first condition, suggesting that they may be hesitant to “show cooperation first,” which is presumed to be an effective strategy for mutual cooperation. These results are suggestive; however, two shortcomings can be identified as potential problems. The first is the lack of monetary incentives for decision-making regarding PDGs. Second, the target population was limited to Japanese university students. To address these issues, Study 2 involved conducting an experiment with a broader age range and emphasized financial incentives based on the results.

3.1 Participants

Study 2 utilized a nationwide web-based experiment. The participants who were recruited for the study had registered through an online panel maintained by a marketing research firm (MyVoice). The research firm sent e-mail messages to potential participants across Japan, solicited their participation with monetary incentives, and sampled the participants to avoid age group or gender bias. A total of 180 participants were randomly assigned to each of the three conditions. However, 19 participants who were unable to comprehend the underlying principles of the prisoner's dilemma were excluded from the subsequent analysis; in total, 161 individuals ($M_{age} = 43.8$) were analyzed. All participants received the actual pay based on their decisions in the experiment.

3.2 Experimental design

We set the three conditions based on between-participants factorial design. The details of the three conditions are as follows.

3.2.1 Simultaneous condition

As in Study 1, the standard one-shot PDG rules were explained, and participants were then asked whether they would give JPY 500 and whether they thought their partner would give JPY 500.

3.2.2 Self-first condition

As in Study 1, the sequential one-shot PDG rules were explained, and participants were then asked whether they would give JPY 500 to their partner and whether they thought their partner would give them JPY 500.

3.2.3 Other-first condition

As in the self-first condition, the sequential one-shot PDG rules were explained, and participants were then asked whether they would give JPY 500 if their partner gave it to them and what they would do with the JPY 500 if their partner did not give it to them.

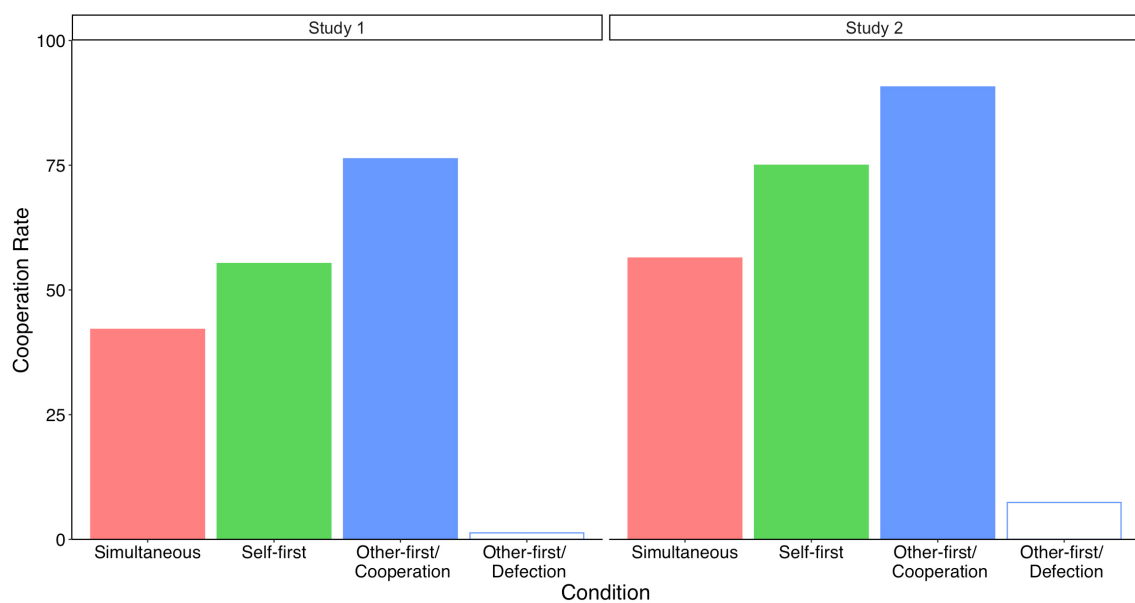


FIGURE 1
Conditional differences in cooperation rates in simultaneous, self-first, and other-first conditions in Study 1 (left panel) and Study 2 (right panel).

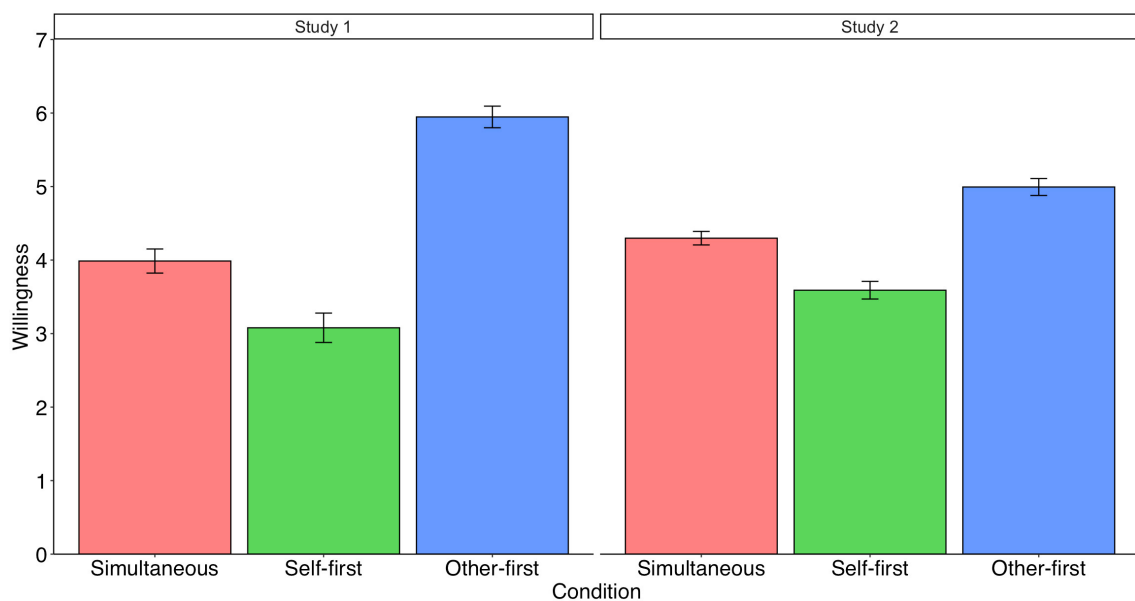


FIGURE 2
Conditional differences in self-reported willingness in simultaneous, self-first, and other-first conditions in Study 1 (left panel) and Study 2 (right panel).

The monetary incentive—that is, the payment of the amount of money that corresponded to the decision—was emphasized across all the conditions. After the participants made their decisions, the rules for all conditions were explained again; then, as in Studies 1, the participants were asked to indicate the extent to which they would like to be the decision-maker in each condition.

3.3 Results and discussion

3.3.1 Cooperation rates

As shown in the right panel of Figure 1, the second player's cooperation rate in the sequential PDG varied according to the first player's decision. By comparing the cooperation rate in the other-first condition, we found a significant difference between the

two cases [90.7 vs. 7.4%; $X^2(1) = 45.0$, $p < 0.001$], supporting Hypothesis 1. Furthermore, the cooperation rate in the self-first condition was significantly higher than that in the simultaneous condition [75.0 vs. 56.4%; $X^2(1) = 4.10$, $p = 0.043$], thus supporting Hypothesis 2.

3.3.2 Self-reported willingness

Using scores from a scale that we developed to measure self-reported willingness, we conducted a one way within-participants analysis of variance regarding the conditions. The results showed a significant difference between the conditions [$F_{(2, 320)} = 35.98$, $p < 0.001$, partial $\eta^2 = 0.18$]. The mean for the other-first condition ($M = 4.99$) was significantly above the neutral point; conversely, the mean for the self-first condition ($M = 3.59$) was significantly below the neutral point ($ts \geq 8.64$, $ps < 0.001$). As in Study 1, Study 2 yielded similar results, indicating a willingness to accept other-first decision-making and a reluctance to engage in self-first decision-making (the right panel of Figure 2). Furthermore, an additional multiple comparison analysis was conducted for each condition to ascertain any potential differences in mean self-reported willingness scores. This analysis revealed statistically significant differences between all comparisons [$ts(96) = 2.922$, $p = 0.004$]. This finding provides compelling evidence that the participants showed the greatest amount of willingness to engage in the other-first condition and the least amount of willingness to engage in the self-first condition. This phenomenon has not been previously elucidated, and the reasons underlying these robust differences in self-reported willingness warrant further investigation.

4 General discussion

The results from the two current studies are consistent with previous findings indicating that cooperation in a one-shot PDG is influenced by a sense of control (Watabe et al., 1996). This suggests that initiating cooperation promotes mutual cooperation driven by the expectation of reciprocity. However, our findings also suggest that Japanese participants may hesitate to initiate cooperation on their own. Our participants were not particularly motivated to exercise control, even though they could anticipate that other players would cooperate if they cooperated first. The hesitation revealed in this study may prompt us to reconsider whether the increased cooperation rate observed in previous studies among first players in sequential PDGs is truly driven by a sense of control. However, since this study did not conduct any manipulation or direct measurement of sense of control, future research must explore the factors influencing why the first player in a sequential PDG chooses to cooperate more.

A notable finding when comparing Studies 1 and 2 is that cooperation increased with the introduction of monetary incentives. At first glance, this may seem counterintuitive from an economic rationality perspective. However, Kiyonari et al. (2000) propose that cooperation in one-shot games may be driven by an evolutionary heuristic. Their “social exchange heuristic” hypothesis suggests that cooperative behavior is more likely to emerge in settings with tangible incentives rather than abstract

point systems. Our findings align with this perspective, offering a possible explanation for the observed cooperation rates.

The finding that participants recognize the potential effectiveness of initiating cooperation but are reluctant to do so can be interpreted in several ways. One possibility is that this hesitation is particularly characteristic of the Japanese. According to Yamagishi's (2011) theory of trust, East Asians, including the Japanese, typically avoid actively building trust with strangers and instead establish cooperative relationships based on security. Further, studies indicate that Japanese individuals tend to avoid negative evaluations in social contexts and adopt a “do not offend others” strategy, defaulting to meeting others' expectations (Hashimoto and Yamagishi, 2015, 2016; Yamagishi et al., 2008; Yamagishi and Hashimoto, 2016). Therefore, conducting more systematic cross-cultural research is essential, as the reluctance to cooperate may be linked to mental dispositions such as low general trust or a desire to avoid unfavorable social evaluations.

Several limitations must be addressed in future research. Participants were asked about their decision-making tendencies after making decisions in PDGs, which can lead to *post-hoc* interpretations. It would be more informative to examine participants' decision-making processes in situations where they can choose their game format based on their willingness. Furthermore, recent studies employing dual-process theory (Evans, 2008; Evans and Stanovich, 2013; Kahneman, 2011) have shown that individuals' decision-making can differ based on whether they use intuitive or deliberative processes (see also Capraro, 2024). A replication study that carefully considers the role of decision time would help address this aspect. Additionally, the current study does not clarify how participants perceive their partner in the one-shot PDG. Participants' decisions, especially their tendencies to cooperate, may vary considerably depending on their perception of their partner (e.g., Maeda and Hashimoto, 2020). Therefore, further research is needed to accumulate data on this topic. Lastly, this study does not fully explain why participants are reluctant to cooperate first. While we interpret this hesitation as a potential cultural difference, more detailed data must be required to address this issue.

Despite these limitations, this study is valuable as it highlights the trade-off between effectiveness and hesitation associated with initiating cooperation in the sequential one-shot prisoner's dilemma based on empirical data. Future research should focus on verifying the robustness of these findings and exploring the underlying factors in greater detail.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Ethics Committee at Osaka Metropolitan University. The studies

were conducted in accordance with the local legislation and institutional requirements. The Ethics Committee/institutional review board waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because the survey agency, MyVoice, sent e-mail messages to potential participants and encouraged their participation with monetary incentives. Those who did not agree to participate were unable to do so. Therefore, it was assumed that all participants agreed to participate in the survey. (Specifically, written informed consent was provided in Study 1, but not provided in Study 2).

Author contributions

HH: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Project administration, Resources, Supervision, Visualization, Writing – original draft, Writing – review & editing. KN: Conceptualization, Data curation, Formal analysis, Investigation, Resources, Visualization, Writing – review & editing. KM: Conceptualization, Data curation, Formal analysis, Investigation, Resources, Visualization, Writing – review & editing. ST: Conceptualization, Data curation, Formal analysis, Investigation, Resources, Visualization, Writing – review & editing.

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Funding

The author(s) declare that financial support was received for the research and/or publication of this article. This study received financial support from the Japan Society for the Promotion of Science in the form of Grants-in-Aid 21K02992 and from the 2023 Osaka Metropolitan University (OMU) Strategic Research Promotion Project (Priority Research).

Conflict of interest

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