Experimental investigations on information transmission and cooperation in an indefinitely repeated dilemma game

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To Anna, Tim, and parents.

Abstract

This thesis experimentally explores how people create reputational information through reporting a partner's past behaviour — and whether the various forms of endogenous information transmission help sustain cooperation — using an indefinitely repeated Prisoner's Dilemma game. The research is based on two sets of laboratory experiments, one in 2018 and the other in 2021. Both are based on an infinitely repeated Prisoner's Dilemma game with random matching. Chapter 1 briefly introduces the stage game and selective literature on reputation, and it also discusses theory that informs our experimental setups in subsequent chapters. Chapter 2 experimentally discusses the transmission of objective information, such as truthful information about one partner's past choice in various settings. We consider short-lived and long-lived information with both free and costly natures. The chapter is based on the 2018 experiments at the University of York. We show that subjects rarely use costly reporting, even when there is a public record, but groups can foster cooperation norms by accumulating reported information over time. Chapter 3 extends the discussion to subjective ratings, as well as free-form word-of-mouth reviews, by considering the long-lived costly case. The chapter is based on 2021 experiments at the University of Durham. The results show that both rating and review treatments lead to higher levels of cooperation than the baseline, with the review treatment interestingly exhibiting significantly greater levels of cooperation, than those of rating-only treatment. Additionally, similar rating habits were observed in laboratory and field experiments.

Declaration

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, this has been indicated clearly. No part of this thesis has previously been submitted elsewhere for any other degree. Chapter 2 is based on a joint research project with my supervisor, Dr. Kenju Kamei, titled "Endogenous Monitoring Through Gossiping in an Infinitely Repeated Prisoner's Dilemma Game: Experimental Evidence". Both of us contributed equally to the project. Chapter 3 is based on my solo project.

12.09.2023

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My family has played a special role in my journey. My wife, Anna, has been an incredible support, cheering me on during late nights spent writing and revising. Our son Tim was born while I was completing my PhD. His presence renewed my sense of purpose and joy during this time. My parents' encouragement gave me strength when things were difficult, Liuba and Yura, I am thankful that your love kept me going no matter what.

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1. Introduction and Theoretical Discussion

1.1. Prisoner's Dilemma

The Prisoner's Dilemma (Tucker, 1983) is commonly employed in economics, in both one-shot and repeated form, to mimic issues like oligopoly quantity-setting (Mailath and Samuelson, 2006), trade wars (Maggi, 1999), R&D races (Cockburn and Henderson, 1994), and labour negotiations (Kahn, 1993). Economists have made extensive use of this simple yet elegant game since its invention. In particular, it has been used as an effective means of analysing how people behave in competitive markets where self-interest may lead them into conflict over resources or profits (Rapoport and Dale, 1966). Insights gained from studying games like the Prisoner's Dilemma have also helped to explain why some forms of collusion persist in spite of potentially negative societal consequences (Kofman and Lawarree, 1996).

The beauty and the curse of the Prisoner's Dilemma game is that game-theoretical predictions are not always plausible in the real world. Consider a payoff matrix for a hypothetical one-shot game in Figure 1.1.

Figure 1.1: *Example of a Prisoner's Dilemma game*

		Player 2	
		A	B
Player 1	A	£1, £1	£1001, £0
	B	£0, £1001	£1000, £1000

The unique Nash equilibrium in pure strategies is (A, A), but whether this is plausible is another matter entirely. One would expect human participants to try B. Due to equilibrium payoffs, which are irrelevant to the theory, real behaviour does not always conform to game-theoretic behaviour. For this reason, it is crucial to challenge theoretical predictions in the laboratory.

1.2. Repetitions and Reputations

In repeated Prisoner's Dilemma games, players have the opportunity to learn from their opponents and develop strategies for future interactions. For example, after observing their opponents' choices in previous rounds of the game, players might develop trust or distrust, which could lead them to either cooperate or defect in future rounds. Humans have developed a high degree of cooperation that makes life as we know it possible. One way to support and encourage collective cooperation is indirect reciprocity: individuals who are seen to be cooperative can build up good reputations, allowing them to receive help in future. This goes some way to explaining why even strangers may cooperate with one another in society. The Prisoner's Dilemma has been used to study the impact of reputational information on decision-making. Some studies focus on exogenously given reputational information, others on endogenously formed reputation.

In the economics literature, the concept of reputation has been studied widely in relation to asymmetric and incomplete information, as well as repeated games. It has long been acknowledged (e.g. see Akerlof, 1970) that successful markets require a certain level of trust between parties, in large part because contracts are necessarily imperfect (Hart and Moore, 1988; Klein and Leffler, 1981). In the context of repeated games, reputation is an important factor influencing beliefs about an agent's trustworthiness and it can affect future options. Theoretically, it follows from Folk Theorems that if future interactions with trading partners are sufficiently likely or significant, this should lead to the development of reputation. Kreps and Wilson (1982) and Milgrom and Roberts (1982) were the first to explore this in depth. They demonstrated how Bayesian uncertainty regarding agents could be mitigated through reputational considerations. Since this early work, numerous studies of the topic have been undertaken within management science and economics.

The corporate reputation literature has been an area of increasing interest since the 1980s, with growing evidence of its positive effects on organisational performance (e.g. Brown and Perry, 1994; Deephouse, 2000; Fombrun and Shanley, 1990). It is suggested that a good reputation can bring strategic benefits to firms, such as lowering costs (Deephouse, 2000; Fombrun, 1996), allowing them to charge higher prices (Deephouse, 2000; Rindova et al., 2005), and attracting workers (Turban and Greening, 1997), investors, and customers (Fombrun, 1996; Srivastava et al., 1997). Furthermore, it has been argued that a strong reputation is especially important in competitive markets because it can increase profitability while also creating competitive barriers against other players in the market (Fang 2005; Milgrom & Roberts, 1982). Fang (2005) has highlighted the incentive for maintaining a good reputation due to its repeated game character of interactions.

1.3. Thesis outline

We will explore experimentally the various forms of endogenous information transmissions, i.e. those from within a system or environment, to assess their effectiveness in sustaining cooperation. Section 1.4 of this Chapter delves into the theoretical aspects of cooperation and defection in experimental contexts, specifically focusing on the impact of strategic choices and informational conditions on achieving equilibrium. Section 1.5 further expands on this and discusses the results of computer simulation exercises on possible evolutions of cooperation. Chapter 2 experimentally examines the issue of reporting truthful information about your partner's action choice (i.e. objective information) using a 2x2 factorial design. The first factor varied whether the reporting partner's action choice was free or costly; the second considered whether the reported action choices were revealed to the partner's next interaction partner only or to all future partners.

The experiment results of Chapter 2 show that most subjects report their opponents' action choices — thereby successfully cooperating with each other — when reporting does not involve a cost. Subjects are strongly discouraged from reporting when doing so is costly, however. In consequence, they fail to achieve strong cooperation norms when the reported information is privately conveyed only to their next-round interaction partner. Costly reporting seldom occurs, even when there is a public record whereby all future partners can check the reported information. However, groups can then foster cooperation norms aided by the public record, because reported information accumulates gradually and becomes more informative as times goes on. These findings suggest that the efficacy of endogenous monitoring depends on the quality of platforms that store reported information.

Further, we extend the setup to include subjective rating and information. A recent trend in many industries is to provide reputation mechanisms to help agents identify potential fruitful interactions. Well-known companies such as Boeing, Walmart, and P&G (e.g. Doolen et al., 2006; Grean and Shaw, 2002) use 'score cards' to compare the performance of their suppliers. Many online marketplaces use rating systems, subjective or objective. For instance, Amazon provides the percentage of positive feedback received by a seller. Airbnb, TripAdvisor, and Etsy use a five-star average rating from past user scores. Declaring its attempt[1] to shift from subjective user scores towards objective measurements, eBay reduced the number of rating options to three

[1] For example, see: http://pages.ebay.com/sellerinformation/news/fallupdate2015/index.html

(positive, neutral, negative). Feedback on many online platforms commonly contains word-of-mouth communication which, despite its obvious benefits, has several shortcomings. Storing and distributing such information may involve additional costs, and the processing of such information can be more demanding in cognitive terms. There is an intuition about the importance of subjective ratings and word-of-mouth communication in the real economy, such as online platforms. Chapter 3 investigates the issue experimentally, again using a repeated Prisoner's Dilemma game. It aims to discover whether cooperation can be sustained at a higher level with, rather than without, the presence of subjective ratings. It also seeks to determine whether the addition of word-of-mouth message to the subjective rating could increase cooperation rates further. In theory, neither reputation mechanism plays a role in sustaining a cooperative equilibrium. Our results demonstrate that both Rating and Feedback treatments yield significantly higher levels of cooperation compared to Control, and that allowing written reviews in the Feedback treatment sustained even higher levels of cooperation than ratings alone. Finally, we found evidence for similar rating habits across laboratory and field experiments.

The formation of organisational reputation, particularly in the context of business-to-business interactions, has — relatively speaking — received scant attention from scholars. Further research into how reputation forms in social systems could better our understanding and help to manage organisational performance.

1.4. Theoretical Discussions on Subjects' Behaviours

This section delves into the theoretical underpinnings of cooperation and defection behaviours in experimental settings, focusing on the impact of strategy choices and information conditions on equilibrium outcomes. One instance of defection can quickly spread across a given group under random matching if members act according to certain trigger strategies (e.g., Kandori, 1992; Ellison, 1994). This contagious process makes it difficult for cooperation to evolve unless the continuation probability is sufficiently high. In the present experimental environment, no strict equilibrium exists regardless of the information condition, as explained below. Considering that the group composition is fixed in the experiment, contagion and a possible evolution of cooperation can be studied theoretically using a Markov transition matrix in the N treatment, assuming that all members act according to the grim trigger strategy (see Camera and Casari (2009) when the group size is four, also see Duffy and Ochs (2009)). The definitions of Always Defect and Grim Trigger are the same as those in Dal Bó and Frechétte (2011). Appendix

A.1.1 derives the transition matrix and describes the harmful contagion process when the group size is eight in the N treatment. As is usual for this area of theoretical work (e.g., Kandori 1992; Camera and Casari 2009), the strategy set is restricted to only two: the "grim trigger" strategy and the "always defect" strategy. Appendix A proves that there are no material incentives for any member of the group to deviate from the grim trigger strategy provided that all other members follow the same trigger strategy. The threshold probability above which players have no profitable deviation from the grim trigger strategy, δ^*, is 0.574 (Appendix A.1.1), whereas the continuation probability used in the experiment is 0.95. Thus, under this assumption, not only mutual defection but also mutual cooperation holds as an equilibrium outcome in the N treatment (even when reputational information is unavailable).

However, once we allow players to select any strategy (other than the grim trigger and always defect), the off-equilibrium condition is not met in the N treatment. As shown in Appendix A.1.2, a cooperator who was defected in a given round would refrain from engaging in punishment if allowed, unlike the grim trigger strategy (i.e., would deviate by choosing cooperation in the next round under certain conditions), because such a deviation helps delay the propagation of defection to other group members. A calculation finds that δ must be less than 0.84 to avoid such a deviation in the off-equilibrium path (see Appendix A.1.2 for details). Therefore, acting according to the grim trigger strategy is not an equilibrium in the N treatment if players are allowed to select any strategy. Note that the number of possible strategies in an infinitely repeated environment is not finite.

The presence of reputational information does not change the existence of strict equilibrium. Theoretical analysis with information on partner's past play available is a challenging task, but Takahashi (2010) successfully derived the condition in which strict equilibrium exists when information on the partner's past play is available. Based on the pairwise grim trigger strategy (page 48), Proposition 1 of his paper explains that $g < l$ and $\delta > g(1 + l)/[(1 + g)l]$ must hold for cooperation to evolve as an equilibrium outcome, where g and l are normalized payoff parameters. There is no requirement for the memory length of the reputational information in this proposition. This means that, according to his theoretical result, the memory length of 1 (Min condition), 6 (Camera and Casari, 2018), or ∞ (Full condition) does not make any difference in subject cooperation behavior for as long as reputational information is available. However, this condition for g and l does not hold in the present experiment because

$$g = (30 - 10)/(25 - 10) - 1 = 1/3, \text{ and } l = -(5 - 10)/(25 - 10) = 1/3.$$

Thus, a strict equilibrium does not exist. In summary, no treatment differences are predicted in terms of strict equilibrium (Table 1.4).

Table 1.4: *Cooperation and Information on Partner's Past Play*

Method	**Without** information on partner's past play	**With** information on partner's past play
a. Strict equilibrium based on grim trigger	do not exist[a]	do not exist[b]
b. Independent and indifferent equilibrium (Takahashi, 2010)	do not exist	exist if $\delta^* > 0.250$; the memory length does not matter for its existence

Notes: [a] Calculation results based on the method of Kandori (1992) and Camera and Casari (2006) – see Appendix A. [b] The theoretical suggestion based on a pairwise grim trigger strategy (Proposition 1 of Takahashi [2010]).

However, there are at least three reasons to expect information on partner's past play to have a positive effect. The first reason is the difference in the speed at which defection spreads in the community. Uncooperative actions are more contagious in the reporting treatments than in the N treatment if (a) some members engage in reporting and (b) group members act according to a strict form of the grim trigger strategy (e.g., members start to defect unconditionally in all future rounds as soon as they learn from reported information that their matched partners defected in the past or the partners defect toward them now). As Camera and Casari (2009) and Kamei (2017) discussed, in the *equilibrium path*, δ^* (the threshold value for the continuation probabilities that induce players to select the trigger strategy) is not greater in the reporting treatments than in the N treatment. A quicker contagious process with the reputational information available means that players have more material incentives to refrain from behaving uncooperatively with than without endogenous monitoring.

Second, Takahashi (2010) proved that, with the information on partner's past play, cooperation can hold as what he calls the "independent and indifferent equilibrium" (i.e., "players choose actions independently of their own records of play, and they are indifferent between cooperation and defection at all histories;" page 43). Proposition 6(2) of his paper provides the existence condition: $g = l$, $\delta^* > g/(1 + g) = 0.250$, and the memory length of one suffices. This equilibrium concept is more restrictive than the strict equilibrium discussed above. Equilibrium may also be constructed in other ways and by different strategies, but a full characterization of all possible equilibria is not possible and beyond the scope of this study because, as already noted, the number of possible strategies is infinite in an infinitely repeated setup. Similar to the case of strict equilibrium, the memory length (1 [Min condition], 6 [Camera and Casari, 2018], ∞ [Full condition]) does not make any difference in player's behavior. This type of belief-free equilibrium does not exist in the N treatment (see Takahashi (2010) for details). Row b of Table 1.4 summarizes this prediction.

Third, Heller and Mohlin (2018) mathematically proved that in the absence of history information, the contagious equilibrium by Kandori (1992) and Ellison (1994) fails if a small percentage of people do not maximize their payoffs, for example, due to idiosyncratic preferences. However, they argue that full cooperation can be sustained as an equilibrium outcome when people observe a randomly selected sample of their opponents' past behaviors. These three theoretical suggestions imply that there would be substantial reporting when reporting does not involve costs, as reputational information helps sustain cooperation, thereby increasing lifetime payoffs.

1.5. Simulations in the Presence of Conditional Cooperators

Despite the conclusions drawn from the frameworks of Takahashi (2010) and Heller and Mohlin (2018), recent experiments suggest that theoretical analyses based solely on strategies in which players never forgive defection, such as the grim trigger, may not be accurate. For example, Dal Bó and Frechétte (2011) estimated the distribution of subjects' strategy choices under partner matching, showing that the tit-for-tat strategy is the most frequently adopted cooperative strategy, whereas the grim trigger strategy is not common. Kamei (2017) experiment revealed that subjects' average behaviors are characterized by conditional cooperative strategies. For example, he showed that the higher fraction of cooperation his/her partner have in the reputational information, the more likely a subject is to choose cooperation. People's use of such discriminatory strategies is also an established phenomenon in finitely repeated dilemma games such as public goods games (Fischbacher and Gächter, 2010; Kamei, 2020b).

In order to accommodate the findings of these related studies and also to discuss possible treatment differences in great depth, a large simulation analysis was additionally performed by assuming that some group members engage in reporting and act according to a <u>c</u>onditional <u>c</u>ooperative strategy based on the information of the partner's reported records – CC players hereafter. This strategy is similar to what will be defined as the "Reps strategy" in the structural estimation of strategy choices in the experiment data (Section 2.5.3). The rest follow the "always defect" strategy – AD players hereafter. The "always defect" strategy—where the player selects defection unconditionally—is commonly observed even under partner matching. For example, Dal Bó and Frechétte (2011) estimated that the tit-for-tat and AD strategies together can account for 80 percent of all data. In our simulation, for simplicity, the AD players are assumed to always report when doing so is free, considering the high efficiency of reputational information seen in prior studies (Camera and Casari, 2009; Stahl, 2013; Kamei, 2017). However, it is assumed that the AD players do not engage in reporting when it is costly since they can free ride on others' reporting. Kamei and Putterman (2018), in a two-period prisoner's dilemma game environment, found that defectors are more selfish than cooperators in deciding whether to report: the former almost never engages in reporting when reporting is costly. An additional analysis is provided near the end of this section by alternatively assuming that a cooperative type decides whether to engage in reporting and whether to use the reputation record for their action choice. The aim of this exercise is to explore how reported information facilitates cooperation.

1.5.1. Simulation results

This section reports the simulation results regarding players' optimal strategy choices, assuming that they choose one of two strategies: (a) the Always Defect (AD) strategy, and (b) Conditional Cooperative (CC) strategy. These two strategies are defined in the context of each treatment, as discussed in the following subsections. The probability distribution for the average lifetime payoffs of a specific player *i* was estimated, given strategy choices of the other seven group members. The distribution was derived each when *i* acts according to the AD strategy and when s/he acts according to the CC strategy. A comparison of the distributions between the two strategies provides a nuance regarding the degree of stability of the cooperative equilibrium in a given treatment.

The simulations involve a large number of calculations. To reduce computer load, the distribution of the average lifetime payoffs was estimated based on 50 iterations. One observation (the average total payoff when *i* selects the CC or AD strategy) was calculated by repeating the following calculation 500 times and then taking the average of 500 simulated total payoffs:

1. Random matching: The computer randomly forms pairs in the group of eight individuals in each round.

2. The group has 100 rounds of interactions. Note that the payoffs after round 100 are negligible because of discounting: $0.95^{100-1} = 0.0062 < 0.01$.

3. The strategies of all seven other members of i's group are given. A member who is assumed to use the AD strategy (AD player) selects D in each round. A member who is assumed to use the CC strategy (CC player) selects C with a probability of 80% in round 1 and selects C stochastically in any other round, conditional on other members' cooperation. Additional simulations were also performed by alternatively assuming that the CC players select C randomly (i.e., with a probability of 50%) in round 1 when no reputational information is available. The simulation results were omitted because the predicted treatment differences are qualitatively similar to the case presented here. The specific rule that a CC player follows after round 1 is defined in the following subsections.

4. The simulated lifetime payoff of player i is calculated by: $\sum_{t=1}^{100} \delta^{t-1} \pi_{i,t}$, where $\delta = 0.95$ and $\pi_{i,t}$ is the payoff of player i in round t.

In other words, 100×500 rounds per average payoff × four pairs per group × 50 iterations = 10,000,000 rounds of pair interactions were simulated to obtain the probability distribution of his/her average lifetime payoffs when i selects a specific strategy. Simulations were performed for each treatment (see Sections 1.5.1, 1.5.2 and 1.5.3). All simulations were programmed and implemented using Python.

1.5.1. *The N Treatment*

As the subjects do not have any reputational information in the N treatment, the CC strategy can be defined based on their own interaction experiences as follows:

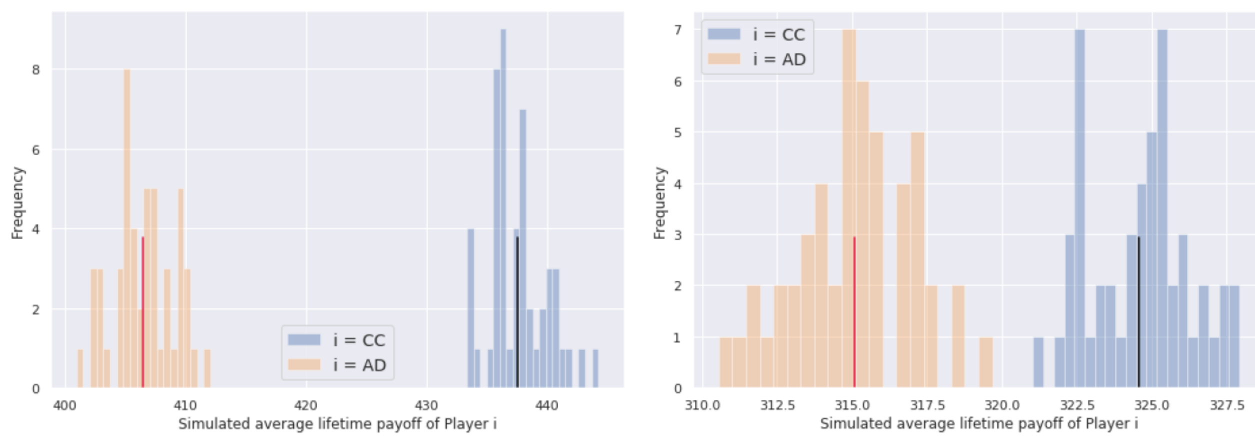
Assumption 1: *A CC player selects cooperation stochastically with a probability that his/her matched partners selected cooperation so far in a given supergame.*

By contrast, an AD player is defined as a player who always (unconditionally) selects defection.

Each panel in Figure 1.5.1 compares the distributions of a player i's average lifetime payoffs when s/he acts according to the AD strategy and when s/he acts according to the CC strategy, given the seven other members' strategy choices. Panel *a* first shows that i's optimal strategy choice is CC when all seven others do the same. Any other CC player also has no material incentive to switch to the AD strategy, meaning that a cooperative equilibrium exists. However, this equilibrium is volatile. Panels *b* to *h* suggest that (i) *i*'s incentive to select the CC strategy quickly declines as the number of AD players increases and (ii) the symmetric cooperation situation collapses when more than one player deviates from the CC strategy. As shown in panels *c* to *h*, any CC player exhibits a profitable deviation when more than one player deviates.

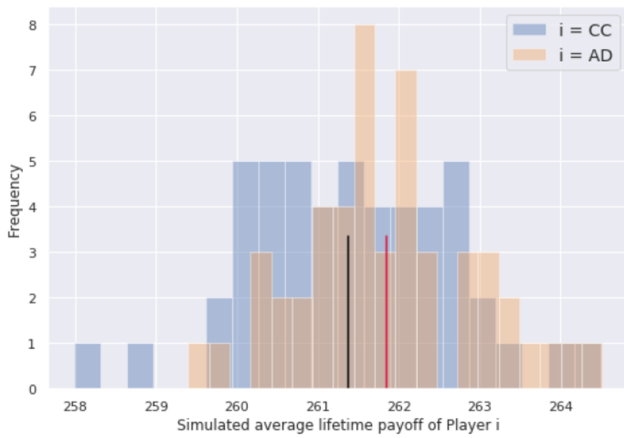
Figure 1.5.1. *Average Lifetime Payoffs Obtained by Player i, Conditional on the Seven Other Members' Strategy Choices* *<u>in the N treatment</u>*

The two distributions in each panel on the next two pages are significantly different according to a two-sided Mann-Whitney test ($p < .00001$), except for panel *c*. p (two-sided) = .059 for panel *c*. These test results suggest that *i* does not have a material incentive to act according to the CC strategy unless the number of players who act according to the AD strategy is less than or equal to one.

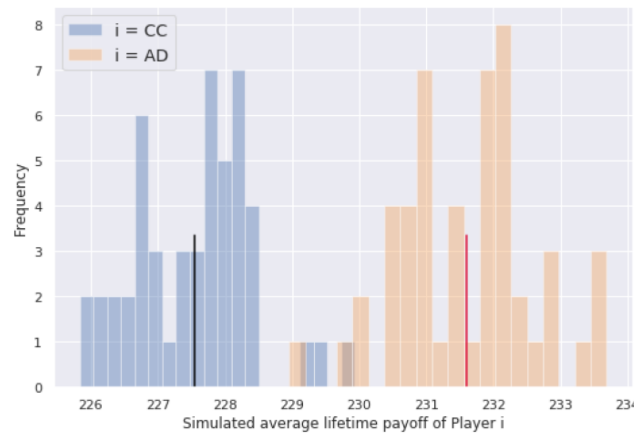


(*a*) When all the seven other members use the CC strategy

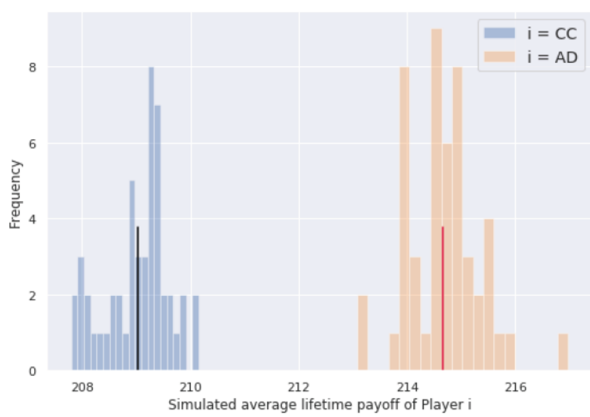
(*b*) When six use the CC strategy and one uses the AD strategy out of the seven other members



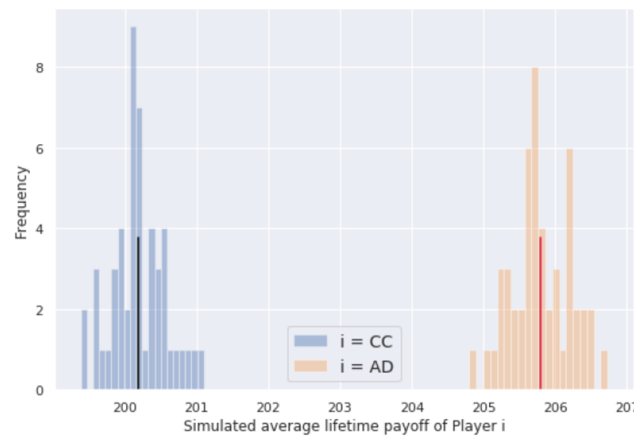
(*c*) When five use the CC strategy and two use the AD strategy out of the seven other members



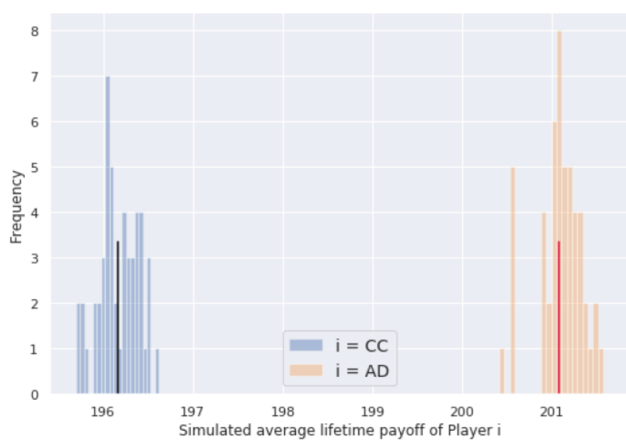
(*d*) When four use the CC strategy and three use the AD strategy out of the seven other members



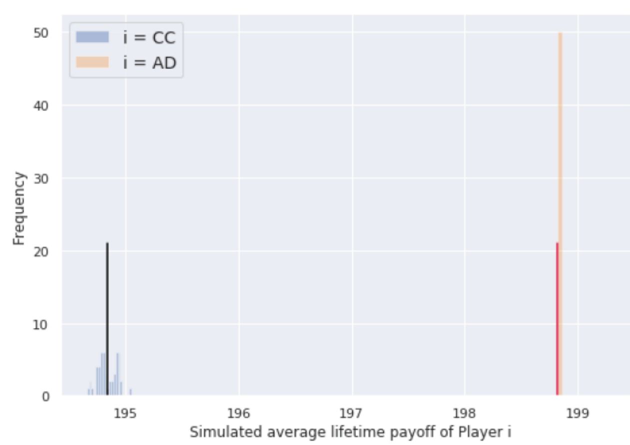
(*e*) When three use the CC strategy and four use the AD strategy out of the seven other members



(*f*) When two use the CC strategy and five use the AD strategy out of the seven other members



(*g*) When one uses the CC strategy and six use the AD strategy out of the seven other members



(*h*) When all the seven other members use the AD strategy

1.5.2. *The C-Min and F-Min Treatments*

In round t, subjects in the C-Min and F-Min treatments are aware of their matched partners' round $t - 1$ action choices, if the partners were reported in round $t - 1$. The simplest strategy that conditional cooperators can adopt is to condition their decisions *solely on their partners' last-round decisions*. This strategy is defined as follows:

Assumption 2: *(a) CC players always engage in reporting regardless of reporting costs.*[2] *(b) A CC player selects cooperation (defection) when his/her current-round partner's last-round action choice is cooperation (defection) and it is observable. When the partner has no history information, i.e., "masked" partner hereafter, the CC player selects cooperation stochastically with a probability that his/her previous partners who did not have any reputational information selected cooperation so far in a given supergame (as defined in Assumption 1 in the context of the N treatment).*

In other words, reputational information can serve as a coordination device for CC players. Notice that the CC players' conditionality toward unmasked partners (i.e., partners whose past play is observable through others' reporting) can be interpreted as similar to the tit-for-tat strategy if the CC players are assumed to believe that their partners would select the same actions as in the previous round.

AD players select defection unconditionally. However, an assumption is required for their reporting behaviors and can be set as follows, considering that AD players can free ride on their peers' reporting acts if they are selfishly motivated and want to avoid paying for reporting:

Assumption 2: *(c) An AD player does not report his/her partner's action choice when reporting is costly, but the player reports it always when reporting is cost-free.*[3]

Figures 1.5.2 and 1.5.3 summarize simulation results for the F-Min and C-Min treatments, respectively. Panel *a* of each figure first shows that *i*'s optimal strategy choice is CC when all

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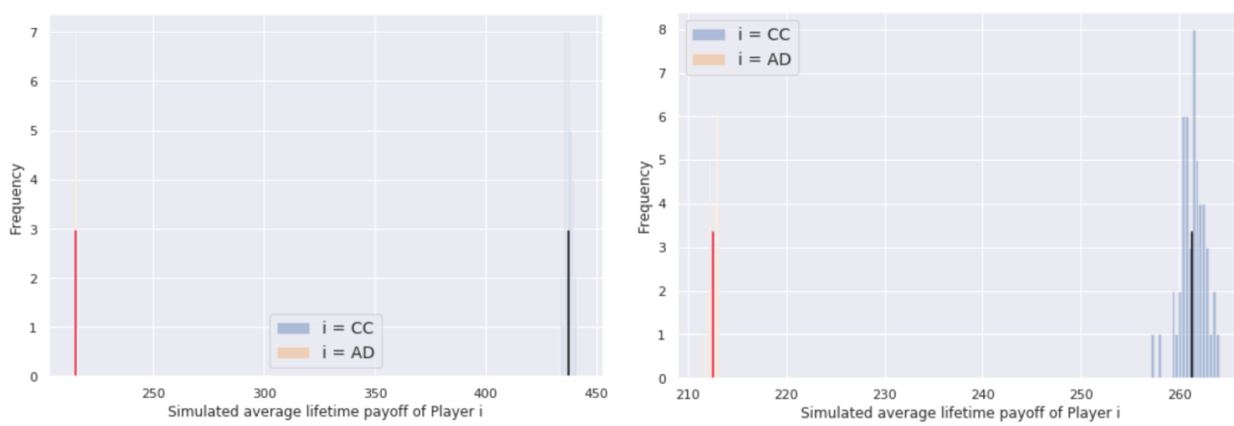
[2] This is a simplified assumption. However, a positive reporting cost may significantly keep CC players from reporting and behaving cooperatively if they overreact to the positive cost (e.g., Kamei, 2017, 2020b).

[3] As reputational information improves cooperation in infinitely repeated prisoner's dilemma games with random matching (Camera and Casari 2009; Kamei, 2017), one can assume that AD players report if reporting is cost-free.

seven others do the same. Notice that any other CC player also has no profitable deviation to switching to the AD strategy, whose pattern is the same as in the N treatment. This implies that a cooperative equilibrium exists, irrespective of whether reporting is free or costly. Panels *b* to *h* of the two figures, however, reveal different patterns from the N treatment. Specifically, while *i*'s incentive to select the CC strategy relative to the AD strategy declines as the number of AD players increases in his/her group, the symmetric cooperation situation is stable such that a CC player has no profitable deviation to the AD strategy unless the number of the AD players is more than or equal to six (four) in the F-Min (C-Min) treatment. This supports the idea that endogenous monitoring can help sustain cooperation, aided by the reputational information.

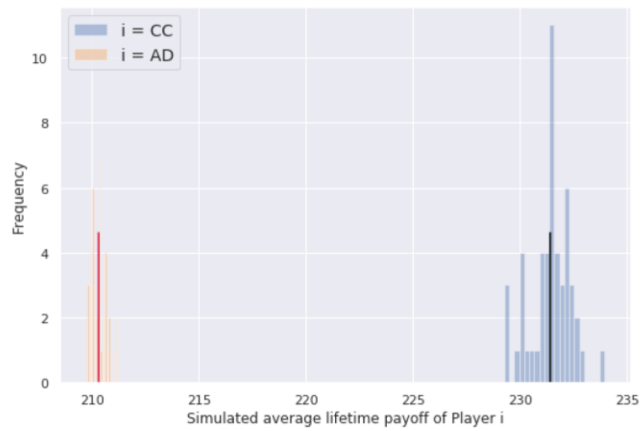
Figure 1.5.2. *Average Lifetime Payoffs Obtained by Player i* ***in the F-Min treatment*** *when CC players Select Cooperation solely based on Partners' Last-round Action Choices*

The two distributions in each panel below are significantly different according to a two-sided Mann-Whitney test ($p < .00001$). These test results suggest that *i* has material incentives to act according to the CC strategy unless the number of the players who act according to the AD strategy is more than or equal to six.

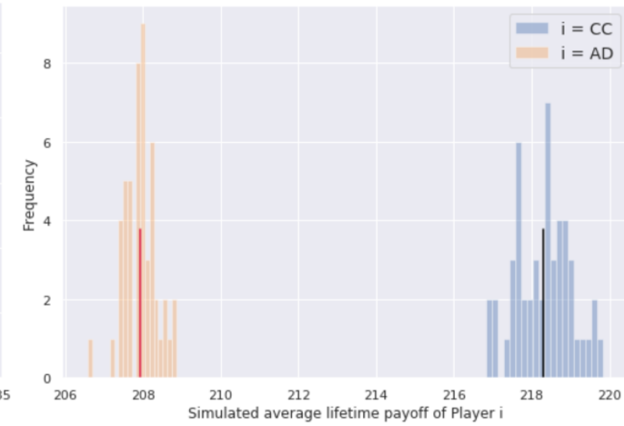


(*a*) When all the seven other members use the CC strategy

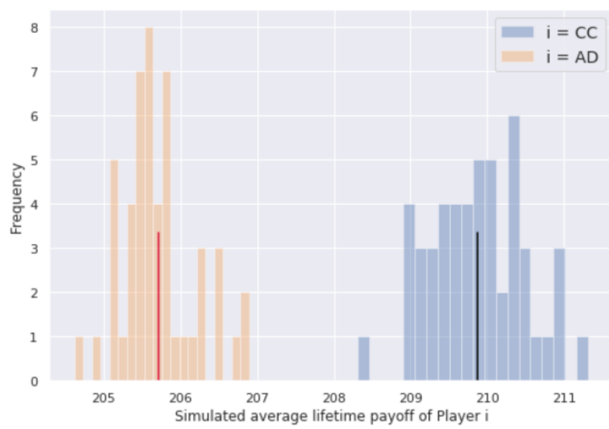
(*b*) When six use the CC strategy and one uses the AD strategy out of the seven other members



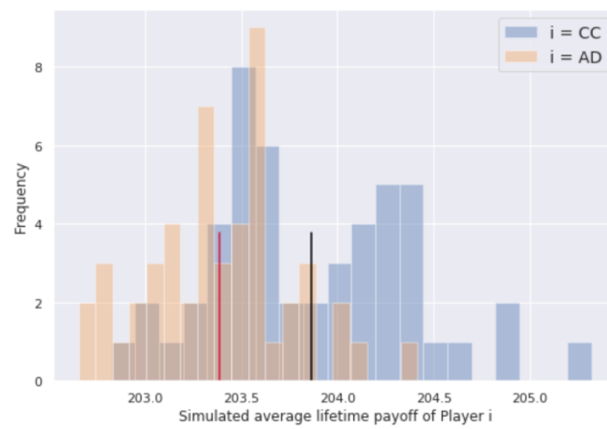
(*c*) When five use the CC strategy and two use the AD strategy out of the seven other members



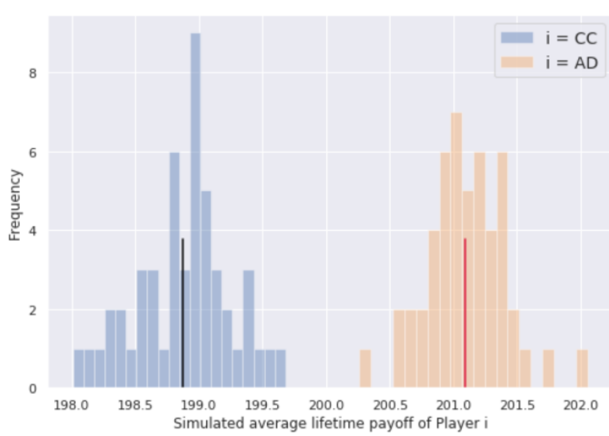
(*d*) When four use the CC strategy and three use the AD strategy out of the seven other members



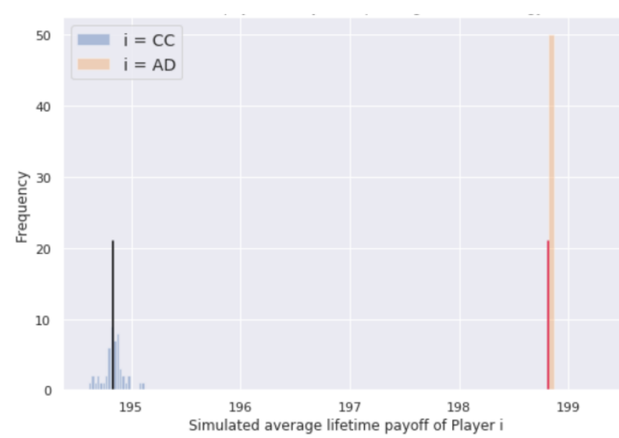
(*e*) When three use the CC strategy and four use the AD strategy out of the seven other members



(*f*) When two use the CC strategy and five use the AD strategy out of the seven other members



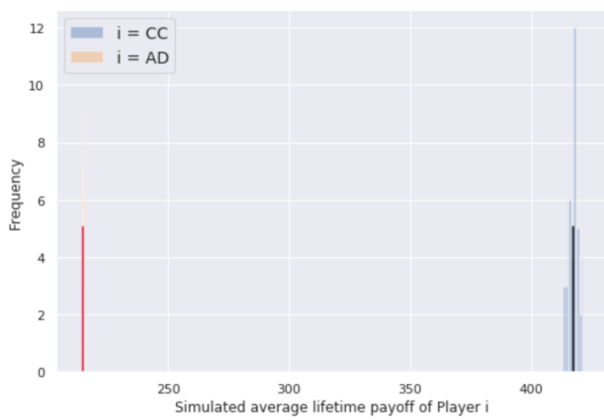
(*g*) When one uses the CC strategy and six use the AD strategy out of the seven other members



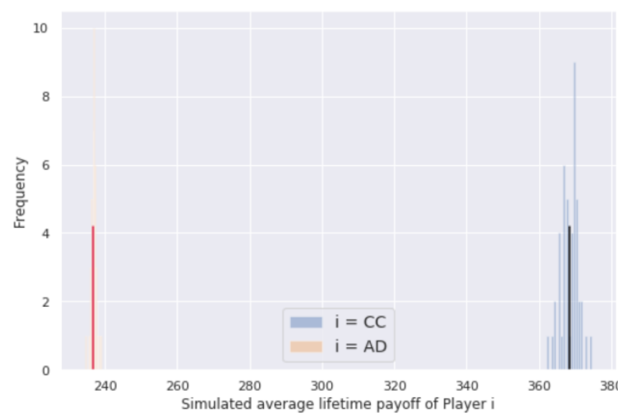
(*h*) When all the seven other members use the AD strategy

Figure 1.5.3. *Average Lifetime Payoffs Obtained by Player i <u>in the C-Min treatment</u> when CC players Select Cooperation solely based on Partners' Last-round Action Choices*

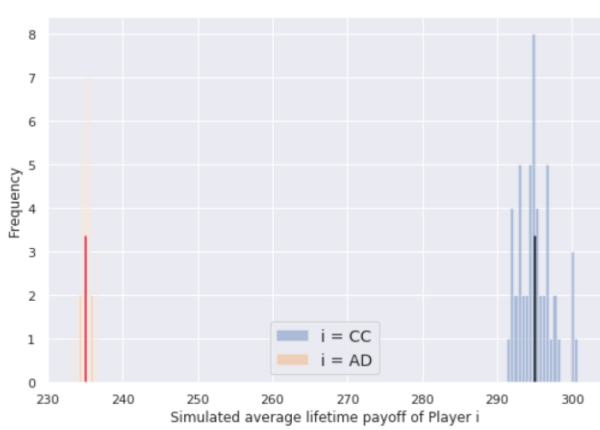
The two distributions in each panel below are significantly different according to a two-sided Mann-Whitney test ($p < .00001$). These test results suggest that *i* has material incentives to act according to the CC strategy, unless the number of AD players is greater than or equal to four. While the symmetric cooperation situation in the C-Min treatment is less stable than in the F-Min treatment (Figure 1.5.2), it is more stable compared with the N treatment.



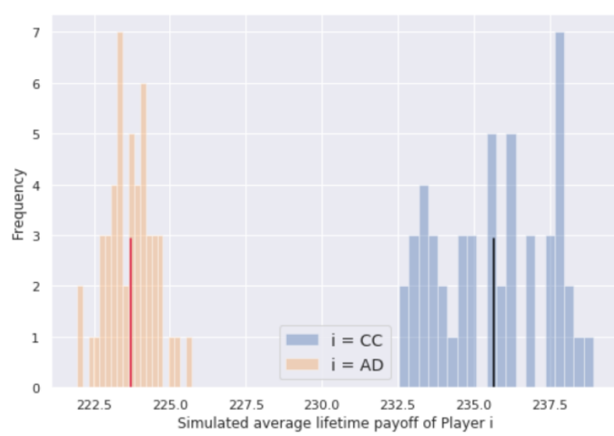
(*a*) When all the seven other members use the CC strategy



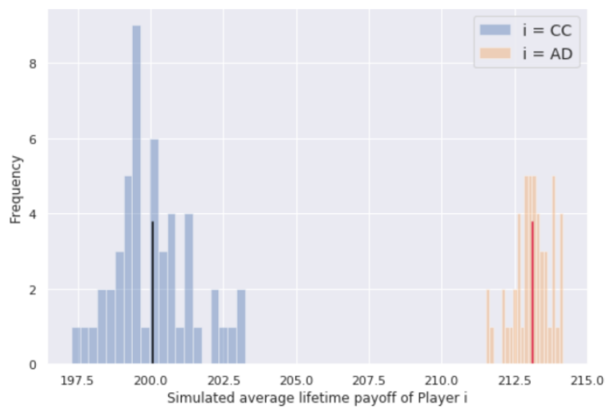
(*b*) When six use the CC strategy and one uses the AD strategy out of the seven other members



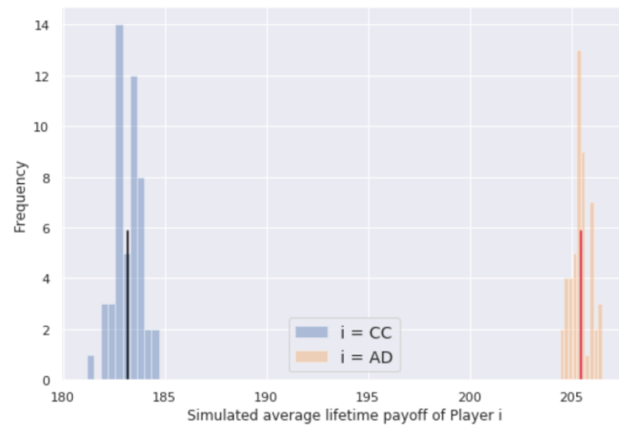
(*c*) When five use the CC strategy and two use the AD strategy out of the seven other members



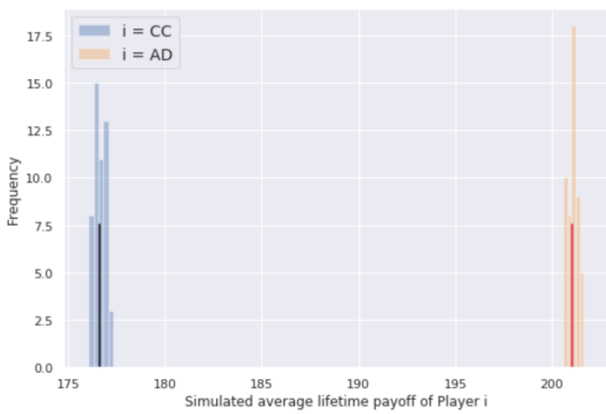
(*d*) When four use the CC strategy and three use the AD strategy out of the seven other members



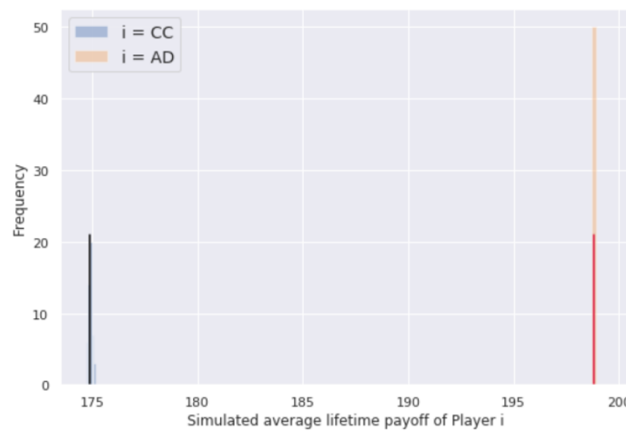
(*e*) When three use the CC strategy and four use the AD strategy out of the seven other members



(*f*) When two use the CC strategy and five use the AD strategy out of the seven other members



(*g*) When one uses the CC strategy and six use the AD strategy out of the seven other members



(*h*) When all the seven other members use the AD strategy

While the simulations in Figures 1.5.2 and 1.5.3 were performed based on the simplest conditional strategy, there are many other conditional cooperative strategies a player can adopt. Additional simulations suggest that the effectiveness of endogenous monitoring is more robust to the types of cooperative strategies that a subject follows when reporting is free rather than costly. For example, one straightforward way to define the CC strategy is that a CC player adjusts action choices over time based on his/her experiences thus far in a given supergame, as follows:

Assumption 3: *When a CC player i is matched with an unmasked person in round t, (s)he conditions (her)his action choice on the partner's action chosen for round t – 1 in the following way:*

- *If the partner has cooperated (defected) in round t – 1 and i has interaction experiences with such an unmasked partner in the past, i will select cooperation in round t with a probability that his/her previously-matched unmasked partners, whose last-round choice was cooperation (defection), selected cooperation.*
- *The CC player i will select cooperation with a probability of 80% in round t when s/he has no relevant experience in a given situation (in round 1 or when i meets for the first time with a person whose last-round action choice was cooperation).*

The CC player's decision toward masked partners is the same as defined in Assumption 1.

For example, suppose that a CC player *i* has interacted five times so far with those whose last-round action choice was cooperation in a given infinitely repeated game and that three out of the five persons selected cooperation with *i*. Suppose that *i* is now (in round *t*) matched with an unmasked member who selected cooperation in round $t - 1$. *i* will then select cooperation with a probability of 60% (= 3/5×100). In summary, under this assumption, CC players consider all their previous relevant experiences when deciding whether to cooperate. Assumption 2(b) is the extreme opposite of Assumption 3 in that CC players *do not consider any experience* and just mimic their unmasked partner's last-round action choice. The subjects' actual conditional behaviors can be considered somewhere between Assumptions 2(b) and 3.

A simulation was conducted by assuming that the AD player's behavior is the same as that in Assumption 2(c). Interestingly, the results revealed that while a cooperative equilibrium exists in both the F-Min and C-Min treatments, the strategy relying on one's own interaction experiences performed worse than the simplified tit-for-tat-like strategy defined in Assumption 2(b). The reason is that with such stochastic action choices, CC players fail to cooperate with other CC players with some probability. Losses from such mistakes gradually accumulate over the course of the play. In addition, CC players mistakenly select cooperation with some probability when matched with AD players (notice that some CC players may select cooperation toward a person with a record of the last-round defection with some probability). This simulation outcome is similar to that of the well-known simulation exercises by Axelrod and Hamilton (1981). Axelrod and Hamilton (1981) internationally solicited strategies that could help sustain cooperation (in an infinitely repeated prisoner's dilemma game with partner matching) from game theorists in economics, sociology, political science, mathematics, evolutionary biology, physics, and computer science, as well as computer hobbyists, and then conducted two computer tournaments in sequence. Among the numerous strategies proposed, "some of the strategies were quite intricate. An example is one which on each move models the behavior of the other player as a Markov process, and then uses Bayesian inference to select what seems the best choice for the long run." (page 1393). However, the two tournaments both found that the simplest tit-for-tat strategy, which was proposed by Professor Anatol Rapoport, performed the best.

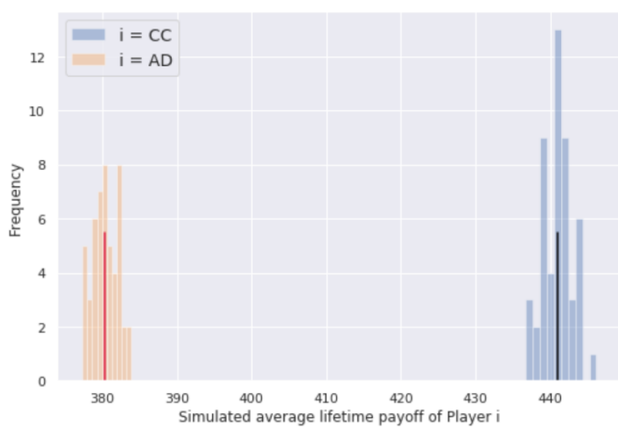
However, the negative effects differ according to the treatment. On the one hand, symmetric cooperation is still quite stable in the F-Min treatment. Figure 1.5.4 indicates that CC players have no material incentive to switch to the AD strategy unless five or more group members deviate from the CC to AD strategy. On the other hand, in the C-Min treatment, the symmetric cooperation situation is as volatile as that in the N treatment. Figure 1.5.5 suggests that when more than one person acts according to the AD strategy, no one has an incentive to behave according to the CC strategy. Thus, these simulations provide the following predictions:

(i) The average cooperation rate is higher in the F-Min than in the N treatment.
(ii) The average cooperation rate is higher in the F-Min than in the C-Min treatment.

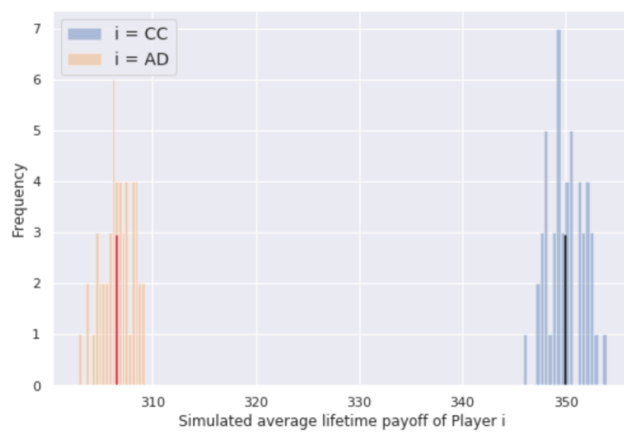
The effectiveness of costly reporting highly depends on the strategy that CC players select. Hence, a clear prediction cannot be made for the comparison between the N and C-Min treatments.

Figure 1.5.4. *Average Lifetime Payoffs Obtained by Player i* <u>*in the F-Min treatment*</u> *when CC players Select Cooperation Stochastically based on their Own Experiences and the Partner's Reputational Information*

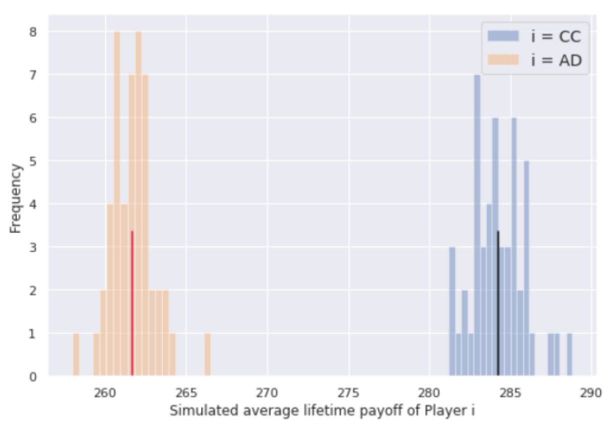
The two distributions in each panel below are significantly different according to a two-sided Mann-Whitney test ($p < .00001$), except for panel *e*. *p* (two-sided) = .2937 for panel *e*. These test results suggest that a conditional cooperator <u>does not have material incentives to switch to the AD strategy unless the number of the AD players is more than or equal to five</u>.



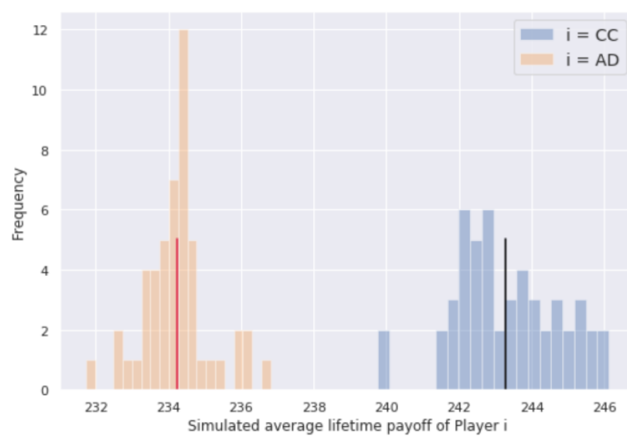
(*a*) When all the seven other members use the CC strategy



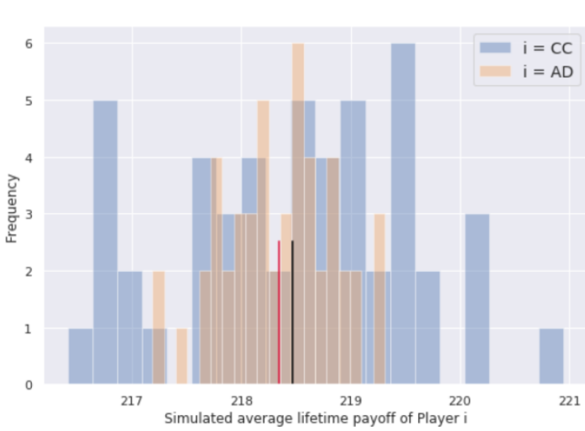
(*b*) When six use the CC strategy and one uses the AD strategy out of the seven other members



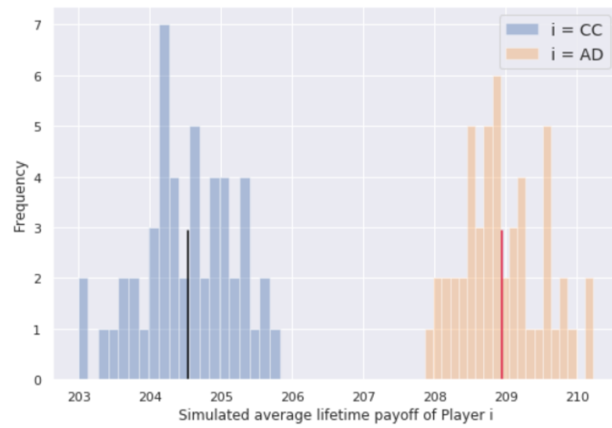
(*c*) When five use the CC strategy and two use the AD strategy out of the seven other members



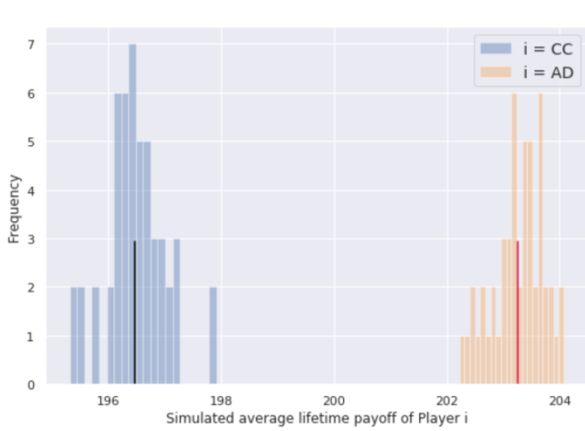
(*d*) When four use the CC strategy and three use the AD strategy out of the seven other members



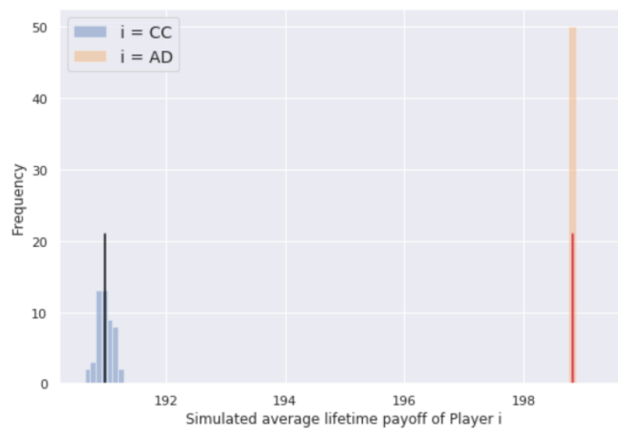
(*e*) When three use the CC strategy and four use the AD strategy out of the seven other members



(*f*) When two use the CC strategy and five use the AD strategy out of the seven other members



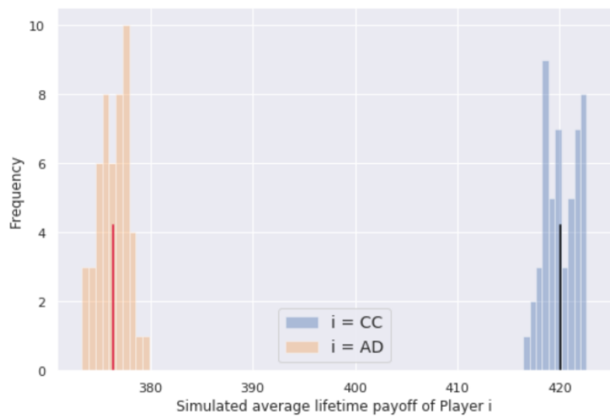
(*g*) When one uses the CC strategy and six use the AD strategy out of the seven other members



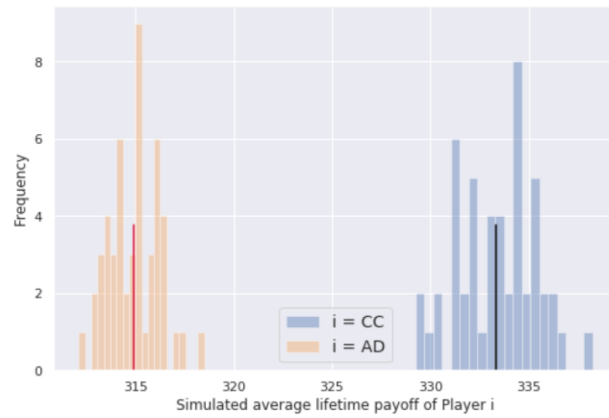
(*h*) When all the seven other members use the AD strategy

Figure 1.5.5. *Average Lifetime Payoffs Obtained by Player i in the C-Min treatment when CC players Select Cooperation Stochastically based on their Own Experiences and the Partner's Reputational Information*

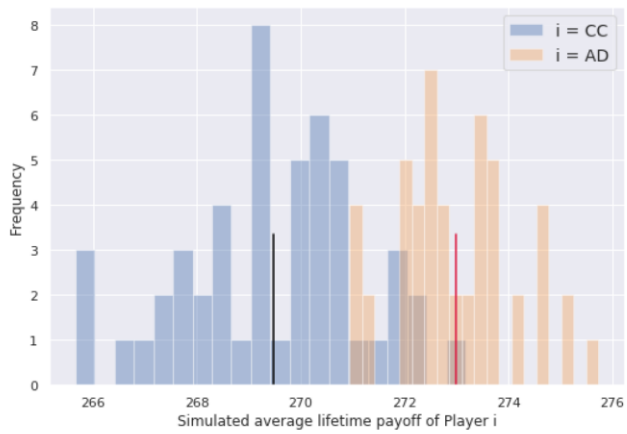
The two distributions in each panel below are significantly different according to a two-sided Mann-Whitney test ($p < .00001$). These test results suggest that *i* does not have material incentives to act according to the CC strategy unless the number of the AD players is less than or equal to one.



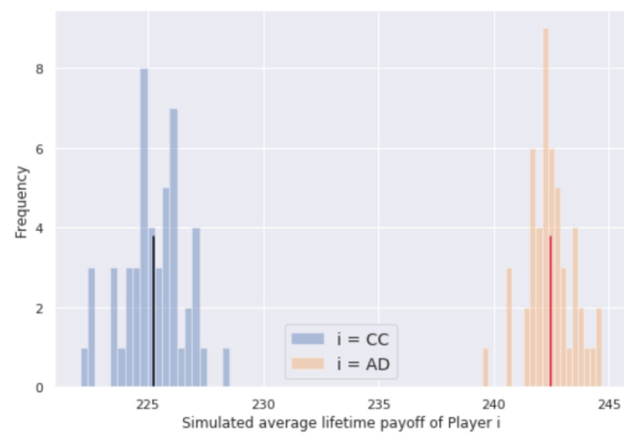
(*a*) When all the seven other members use the CC strategy



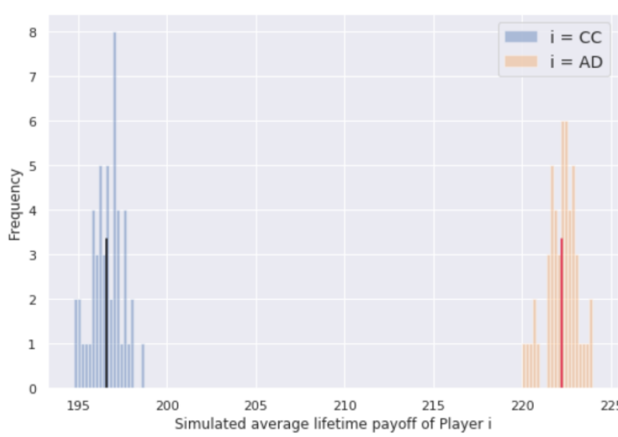
(*b*) When six use the CC strategy and one uses the AD strategy out of the seven other members



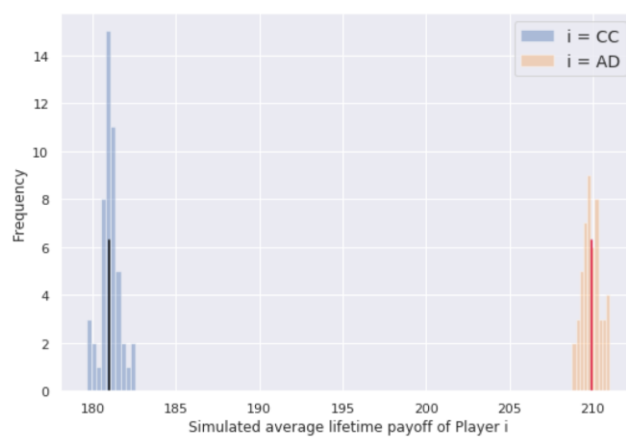
(*c*) When five use the CC strategy and two use the AD strategy out of the seven other members



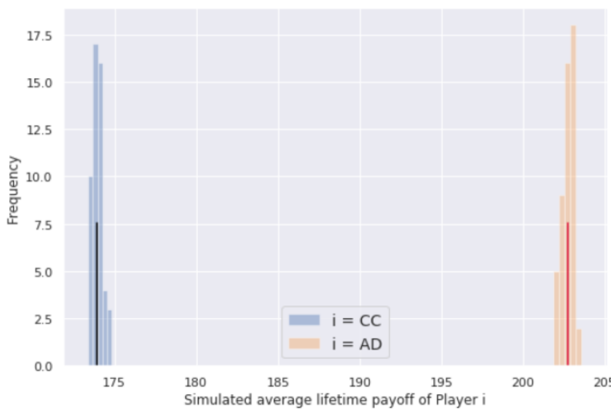
(*d*) When four use the CC strategy and three use the AD strategy out of the seven other members



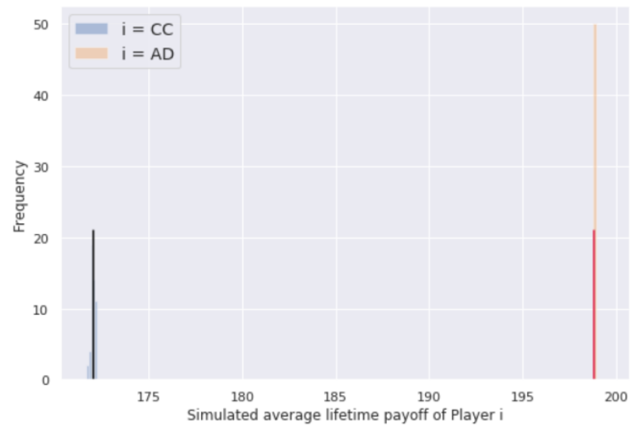
(*e*) When three use the CC strategy and four use the AD strategy out of the seven other members



(*f*) When two use the CC strategy and five use the AD strategy out of the seven other members



(*g*) When one uses the CC strategy and six use the AD strategy out of the seven other members

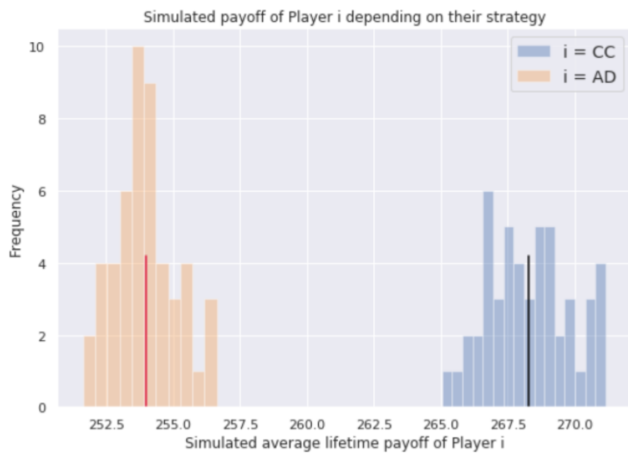


(*h*) When all the seven other members use the AD strategy

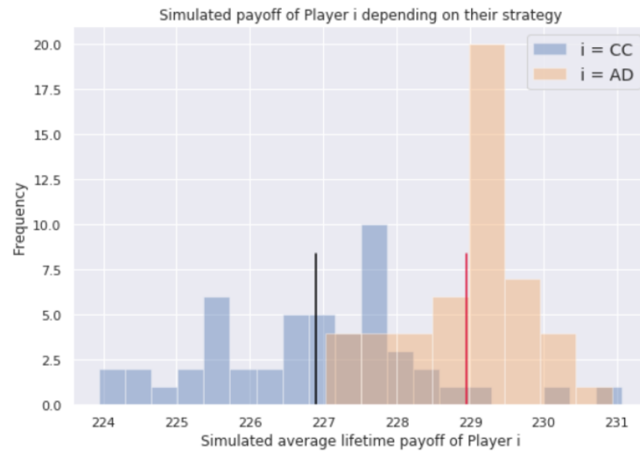
As discussed, it can be assumed that the real subjects' conditional cooperative behaviors lie somewhere between Assumptions 2(b) and 3. It is worth noting that if a strategy adopted by the CC players is defined somewhere between Assumptions 2(b) and 3, the stability of the cooperative equilibrium is also characterized somewhere between the those described in Figures 1.5.3 and 1.5.5 (Figures 1.5.2 and 1.5.4). As an illustration, another simulation was conducted for the C-Min treatment by assuming the following CC strategy:

- A CC player *j* selects cooperation with a probability of 80% in round 1 (when s/he has no experience in a given indefinitely repeated prisoner's dilemma game).
- A CC player *j* selects cooperation with a probability of 100% (0%) when the partner selected cooperation (defection) in the last round, it was reported but *j* does not have any relevant experience in the situation.
- A CC player *j* selects cooperation as defined in Assumption 3 if s/he is matched with an unmasked person who selected cooperation (defection) in the last round and s/he has already interacted with such a person in the past.

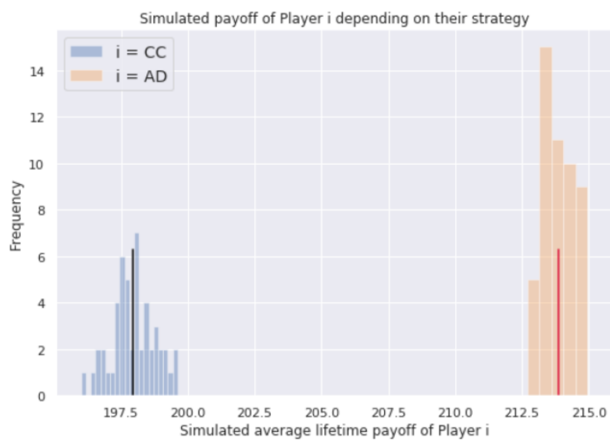
The simulation reveals that under costly reporting, player *i* does not have material incentives to act according to the CC strategy unless the number of AD players is less than or equal to two, whose condition is slightly less strict than the simulation results summarized in Figure 1.5.5. The following three graphs compare the distributions of player *i*'s average lifetime payoffs when s/he acts according to the AD versus the CC strategy, given the seven other members' strategy choices. The two distributions in each of the three panels on the next page are significantly different according to a two-sided Mann-Whitney test ($p < .00001$).



(*a*) When five use the CC strategy and two use the AD strategy out of the seven other members



(*b*) When four use the CC strategy and three use the AD strategy out of the seven other members



(*c*) When three use the CC strategy and four use the AD strategy out of the seven other members

There are eight situations regarding the seven other members' strategy choices. The results for the other five situations are omitted to conserve space.

1.5.3. *The C-Full and F-Full Treatments*

In round *t*, subjects in the C-Full and F-Full treatments are aware of their matched partners' action choices in all the previous rounds in which the partners were reported. While CC players in these treatments can act according to the simple tit-for-tat-like strategy based on the last-round information as described in Assumption 2(b) of Section 1.5.2, they can adopt a more sophisticated discriminatory strategy such that they condition their cooperation decisions *on all the previous rounds in which the partners were reported* (Assumption 4). This strategy strengthens the positive effects of conditionality described in Section 1.5.2.

Assumption 4: *When matched with a person with some history information, a CC player selects cooperation stochastically with a probability that the partner selected cooperation in previous rounds in which the partner was reported. When matched with someone without any history information, the CC player selects cooperation stochastically with a probability that his/her previous masked partners selected cooperation so far in a given supergame (as defined in Assumption 1 in the context of the N treatment).*

For example, suppose that a CC player *i* is matched with someone with history information. Suppose also that the record indicates that the partner selected cooperation in five out of eight reported rounds. Under this circumstance, Assumption 4 indicates that *i* selects cooperation with a probability of $5/8 \times 100 = 62.5\%$. A simulation analysis, summarized in Figures 1.5.6 and 1.5.7, found that this sophisticated conditional strategy magnifies the stability of a cooperative equilibrium, whether reporting is free or costly, compared to those discussed in Section 1.5.2. This effect was driven by an increased quantity of reputational information, which enables CC players to discriminate between group members more accurately. This feature makes the CC strategy more profitable than the AD strategy owing to the improved coordination device. In summary, this simulation exercise suggests that having a public record of reported action choices may help improve cooperation, thus providing the following predictions:

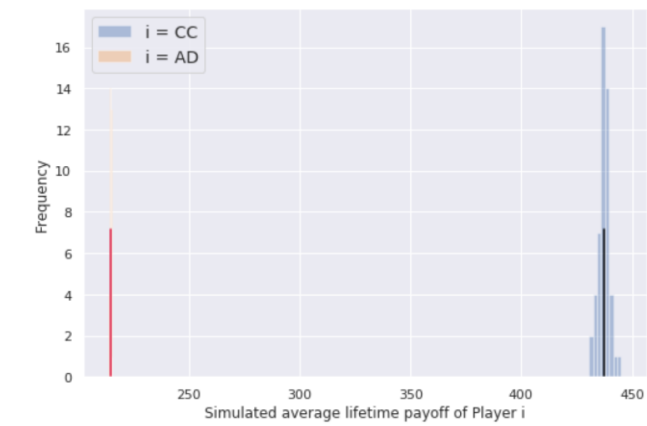
(i) The average cooperation rate is higher in the F-Full than in the F-Min treatment.

(ii) The average cooperation rate is higher in the C-Full than in the C-Min treatment.

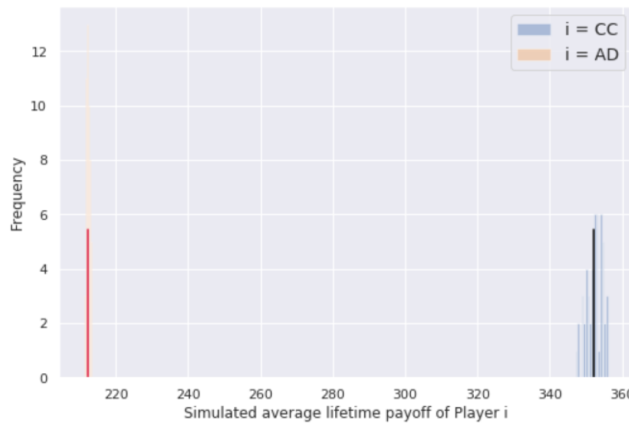
It is worth noting here that despite (i), the impact of having a publicly available record under free reporting (if any) may be small, considering the simulation result that free reporting already has a strong effect, even in the absence of such a record (Section 1.5.2).

Figure 1.5.6. *Average Lifetime Payoffs Obtained by Player i* *in the F-Full treatment*

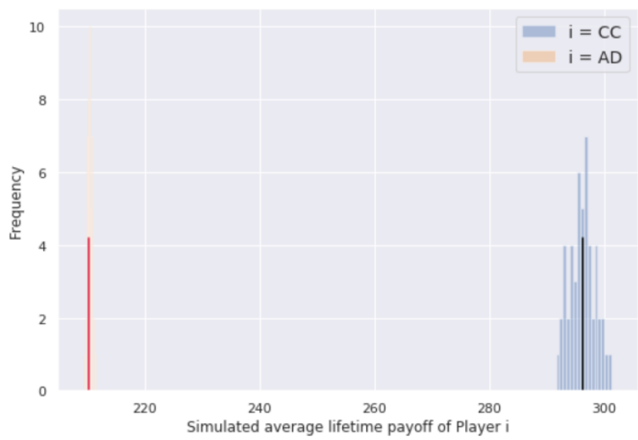
The two distributions in each panel below are significantly different according to a two-sided Mann-Whitney test ($p < .00001$). These test results suggest that *i* has material incentives to act according to the CC strategy unless all the seven other members are the AD players.



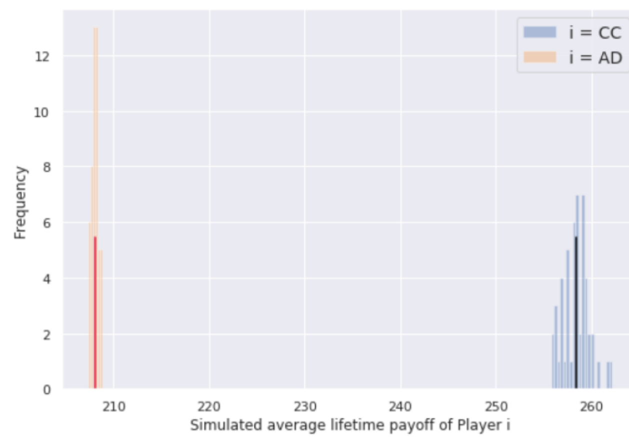
(*a*) When all the seven other members use the CC strategy



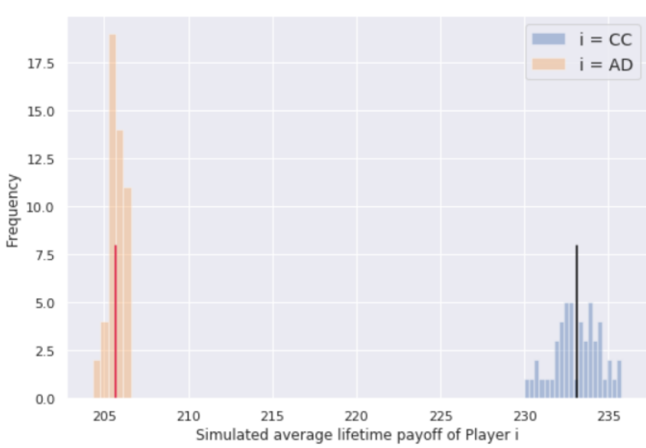
(*b*) When six use the CC strategy and one uses the AD strategy out of the seven other members



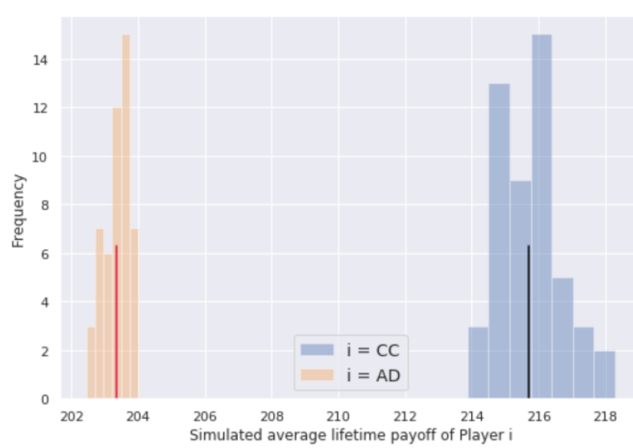
(*c*) When five use the CC strategy and two use the AD strategy out of the seven other members



(*d*) When four use the CC strategy and three use the AD strategy out of the seven other members

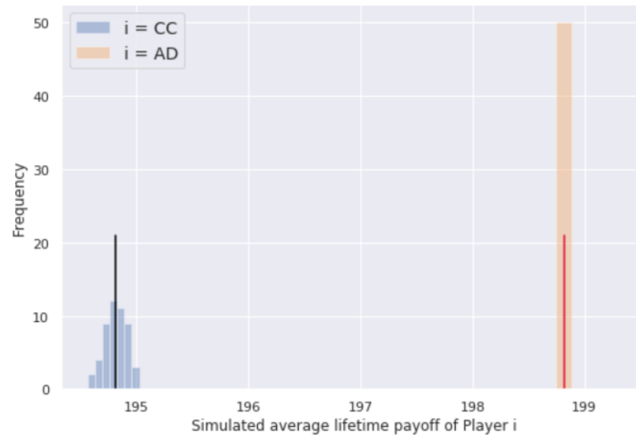


(*e*) When three use the CC strategy and four use the AD strategy out of the seven other members



(*f*) When two use the CC strategy and five use the AD strategy out of the seven other members

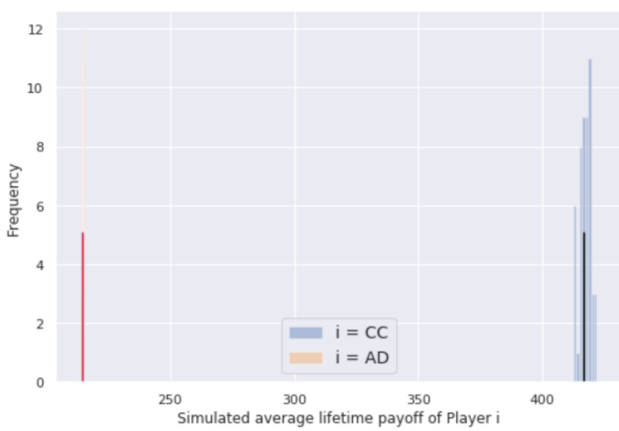
(*g*) When one uses the CC strategy and six use the AD strategy out of the seven other members



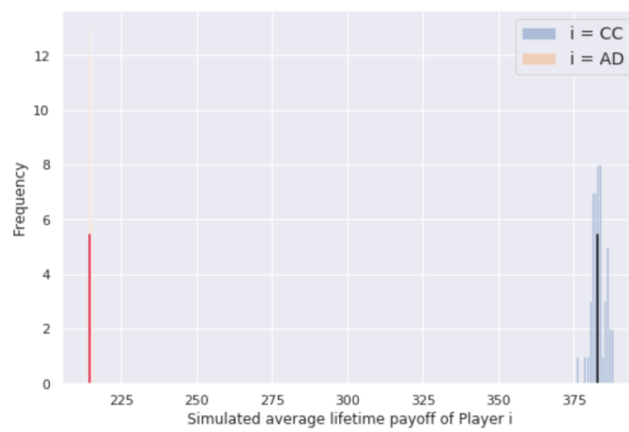
(*h*) When all the seven other members use the AD strategy

Figure 1.5.7. *Average Lifetime Payoffs Obtained by Player i* <u>*in the C-Full treatment*</u>

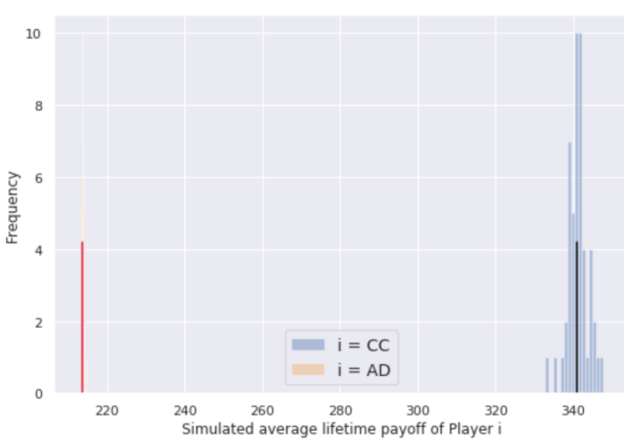
The two distributions in each panel below are significantly different according to a two-sided Mann-Whitney test ($p < .00001$), except for panel *f*. *p* (two-sided) = .8259 for panel *f*. These test results suggest that a conditional cooperator <u>does not have material incentives to switch to the AD strategy unless the number of the AD players is more than five</u>.



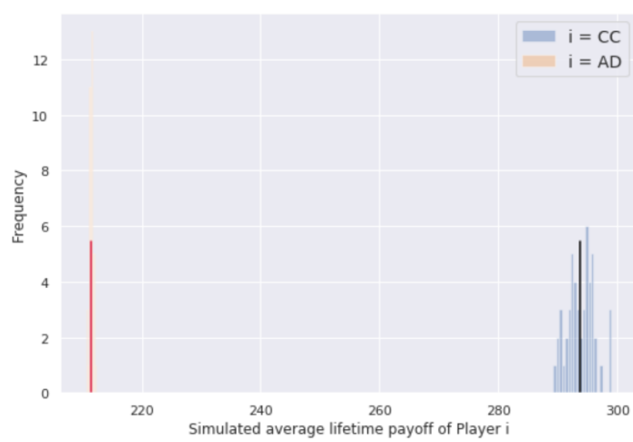
(*a*) When all the seven other members use the CC strategy



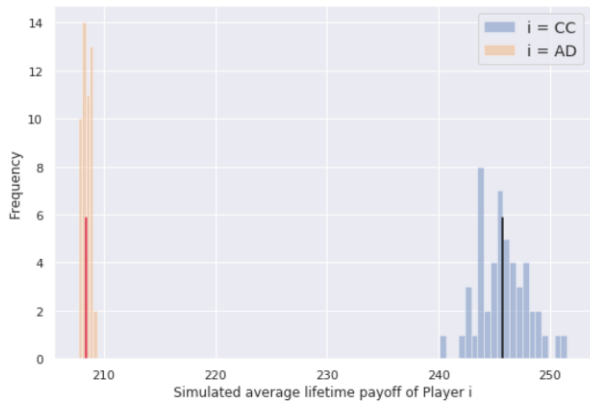
(*b*) When six use the CC strategy and one uses the AD strategy out of the seven other members



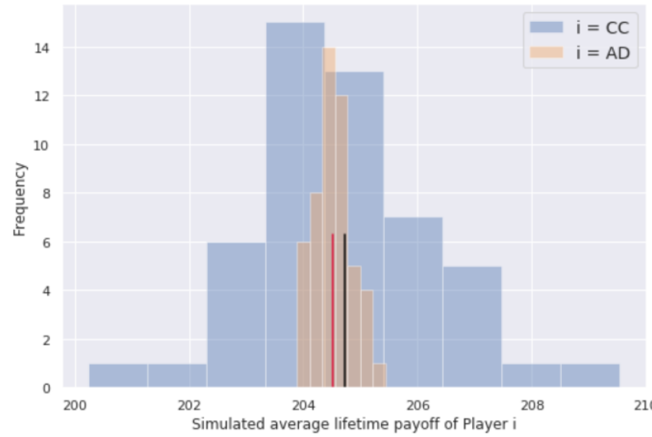
(*c*) When five use the CC strategy and two use the AD strategy out of the seven other members



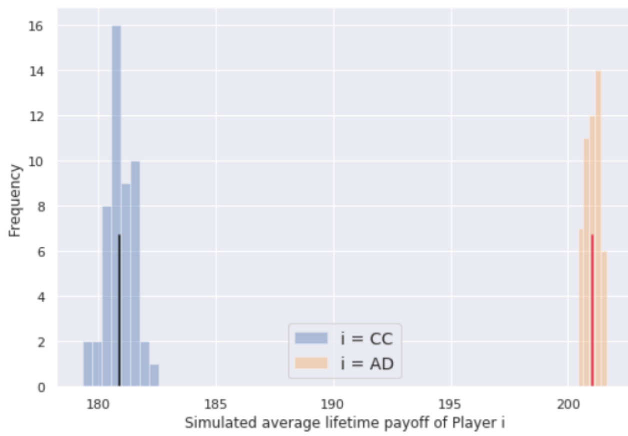
(*d*) When four use the CC strategy and three use the AD strategy out of the seven other members



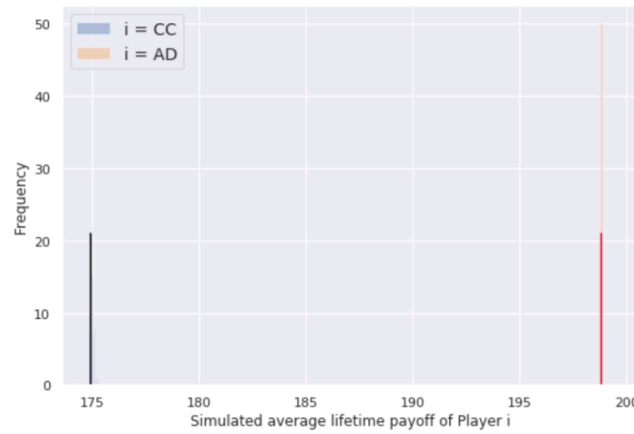
(*e*) When three use the CC strategy and four use the AD strategy out of the seven other members



(*f*) When two use the CC strategy and five use the AD strategy out of the seven other members



(*g*) When one uses the CC strategy and six use the AD strategy out of the seven other members



(*h*) When all the seven other members use the AD strategy

1.5.4. *Additional Simulations for the Four Reporting Treatments – Assuming Three Strategies*

The simulation analyses for the four reporting treatments reported in Sections 1.5.2 and 1.5.3 were conducted by assuming two strategies: (a) the AD strategy and (b) the CC strategy based on their matched partner's reputation (i.e., observable past action choices), to investigate how having reputational information makes coordination easier. However, prior analysis does not answer which conditional cooperative strategy is the winning strategy: conditional cooperation based on *the partner's observable reputation* as in (b), or conditional cooperation based on *their prisoner's dilemma interaction experience in the past*. This subsection re-runs the simulations for the four main treatments by assuming the following three strategies, that is, by additionally considering the CC-E strategy (whose definition is shown below) as a possible strategy in the simulations:

[The Min condition, i.e., the C-Min and F-Min treatments:]

- **AD**: This is described in Section 1.5.2. Specifically, the AD strategy is the strategy where a player reports according to Assumption 2(c) and selects defection unconditionally.
- **CC**: This is defined in Assumptions 2(a) and 2(b) of Section 1.5.2. In other words, this player engages in reporting regardless of whether doing so is free or costly and cooperates conditionally upon the partner's reputation (last-round action choice) if it is observable.
- **CC-E** (Conditional cooperative strategy solely based on one's Own PD Interaction Experience): This strategy is defined in Assumption 1 of Section 1.5.1, while the player always does not report in the C-Min treatment and reports in the F-Min treatment. Under the CC-E strategy, a player decides whether to cooperate based on what has happened thus far in their own PD interactions. This strategy is similar to the TFTs, Grims, and T*K*. The CC-E strategy is the addition of the simulation newly conducted in Section 1.5.4, whereas AD and CC are exactly the same as those used in Section 1.5.2.

[The Full condition, i.e., the C-Full and F-Full treatments:]

- **AD**: This is described in Section 1.5.2. Specifically, the AD strategy is the strategy where a player reports according to Assumption 2(c) and selects defection unconditionally.
- **CC**: This is defined in Assumption 4 of Section 1.5.3. In other words, this player

decides whether to cooperate based on the partner's reputation if it is observable (i.e., how frequently the partner selected cooperation in the previous rounds in which s/he was reported).

- **CC-E**: This strategy is defined above. The CC-E strategy is the addition of the simulation analysis described in Section 1.5.4.

The following table shows the winning strategies of player *i* given the strategy choices of the seven other players in his/her group. If there is no single winning strategy, we use a curly bracket. For example, if the material benefit of acting according to CC is not significantly different from CC-E but the benefits of acting according to CC or CC-E are significantly better than AD at the 5% level, we write {CC-E, CC}**. If the lifetime payoffs of all three strategies are similar in terms of statistical significance, we write them as {AD, CC-E, CC}.

In the table, *, **, and *** indicate that the winning strategies are significantly better than the next best strategy(ies) in terms of lifetime payoffs at the .10 level, at the .05 level, and at the .01 level, respectively.

<u>Under costly reporting</u>: The CC strategy is almost never the winning strategy in the C-Min treatment, regardless of the situation. In this treatment, the CC-E strategy is significantly better than the CC strategy in terms of lifetime payoffs in almost all cases in which cooperation is beneficial. The picture changes in the C-Full treatment; that is, the CC strategy is the clear winner among the three strategies for the 14 situations in the C-Full treatment.

<u>Under free reporting</u>: Cooperative strategies are predominant in the F-Min treatment. The CC-E and CC strategies are equally effective in terms of lifetime payoffs in almost all situations in that treatment. However, the benefit of acting according to the CC strategy is salient in the F-Full treatment.

The analysis results mean that conditional cooperative strategies based on the partner's reported record are more common in the C-Full (F-Full) than in the C-Min (C-Full) treatment.

[Winning strategies by scenario:]

The distribution of strategy choices among 7 other members			Winning strategy (the strategy that leads to the highest lifetime payoff) of player *i* given the 7 other members' strategy choices			
AD	CC-E	CC	C-Min	C-Full	F-Min	F-Full
7	0	0	AD***	AD***	AD***	AD***
6	1	0	AD***	AD***	AD***	AD***
6	0	1	AD***	AD***	AD***	CC***
5	2	0	AD***	AD***	{CC-E, CC}***	AD***
5	1	1	AD***	AD***	{AD, CC-E, CC}	CC***
5	0	2	AD***	CC***	{CC-E, CC}***	{CC-E, CC}***
4	3	0	AD***	AD***	{CC-E, CC}***	AD**
4	2	1	AD***	AD***	{CC-E, CC}***	CC***
4	1	2	{AD, CC-E}***	CC***	CC**	CC***
4	0	3	CC-E***	CC***	{CC-E, CC}***	CC-E***
3	4	0	AD***	AD***	CC**	CC***
3	3	1	{AD, CC-E}***	{AD,CC-E}***	{CC-E, CC}***	CC***
3	2	2	CC-E***	CC***	{CC-E, CC}***	CC***
3	1	3	CC-E***	CC***	{CC-E, CC}***	CC-E*
3	0	4	CC-E***	CC***	{CC-E, CC}***	CC-E***
2	5	0	{AD, CC-E}***	{AD,CC-E}***	{CC-E, CC}***	CC***
2	4	1	CC-E***	CC-E***	{CC-E, CC}***	CC***
2	3	2	CC-E***	CC***	{CC-E, CC}***	CC***
2	2	3	CC-E***	CC***	{CC-E, CC}***	{CC-E, CC}***
2	1	4	CC-E***	CC***	{CC-E, CC}***	CC-E***
2	0	5	CC-E***	CC***	{CC-E, CC}***	CC-E***
1	6	0	CC-E***	CC-E***	{CC-E, CC}***	CC***
1	5	1	CC-E***	CC-E***	{CC-E, CC}***	CC***
1	4	2	CC-E***	CC-E***	{CC-E, CC}***	CC***
1	3	3	CC-E***	CC***	{CC-E, CC}***	CC*
1	2	4	CC-E***	CC***	{CC-E, CC}***	CC-E*
1	1	5	CC-E***	CC***	{CC-E, CC}***	CC-E***
1	0	6	CC-E***	CC***	{CC-E, CC}***	CC-E***
0	7	0	CC-E***	CC-E***	{CC-E, CC}***	{CC-E, CC}***
0	6	1	CC-E***	CC-E***	{CC-E, CC}***	CC-E**
0	5	2	CC-E***	CC-E***	{CC-E, CC}***	{CC-E, CC}***
0	4	3	CC-E***	CC-E***	{CC-E, CC}***	CC-E*
0	3	4	CC-E***	CC-E***	{CC-E, CC}***	{CC-E, CC}***
0	2	5	CC-E***	CC-E***	{CC-E, CC}***	{CC-E, CC}***
0	1	6	CC-E***	CC-E***	{CC-E, CC}***	{CC-E, CC}***
0	0	7	CC-E***	CC-E***	{CC-E, CC}***	{CC-E, CC}***

2. Objective endogenous information transmission

2.1. Introduction

Simultaneous-move interactions in which cooperation is beneficial from a long-term perspective but individuals have strong short-term incentives to defect are ubiquitous in real life, such as in economic transactions in online markets. Public monitoring may play a key role into facilitating cooperation in such interactions, thereby enabling members to implement effective punishment strategies (Mailath and Samuelson 2006). Exogenously given reputational information is known to improve cooperation. Reputational information must be created gradually through motivated actors' voluntary reporting of partners' behaviors for signaling and public monitoring, as many interactions are made privately.

This chapter experimentally studies how people create such information through reporting of partner's action choices, and whether the endogenous monitoring helps sustain cooperation, in an indefinitely repeated prisoner's dilemma game under random matching. The experiment results show that most subjects report their opponents' action choices, thereby successfully cooperating with each other, when reporting does not involve a cost. However, subjects are strongly discouraged from reporting when doing so is costly. As a result, they fail to achieve strong cooperation norms when the reported information is privately conveyed only to their next-round interaction partner. Costly reporting occurs only occasionally even when there is a public record whereby all future partners can check the reported information, but significantly frequently relative to the condition where it is sent to the next partner only. With the public record, groups can foster cooperation norms aided by the relatively frequent reporting and reported information that gets gradually accumulated and becomes more informative over time.

The rest of this chapter proceeds as follows: Section 2.2 discusses related literature, Section 2.3 sets out working hypotheses, Section 2.4 discusses the experimental design, Section 2.5 reports the experiment results. Section 2.6 provides concluding remarks.

2.2. Related literature

The burgeoning experimental literature on cooperation in infinitely repeated dilemma games with random matching has largely confirmed the strong impact of exogenously given reputational information on sustaining cooperation under certain conditions (e.g., Camera and Casari, 2009; Kamei, 2017, Stahl, 2013; Schwartz *et al.*, 2000). Notable theoretical works are

Kandori (1992), Takahashi (2010), and Heller and Mohlin (2018). Public information about every past play of members in groups (Camera and Casari, 2009; Kamei, 2017), all past acts taken by the current partner toward the decision-maker through a unique identification number (Kamei, 2017), or the color-coded reputation mechanism similar to "Standing" (Stahl, 2013) helps improve cooperation. However, aggregated information may not always be enough to improve cooperation. For example, Bigoni *et al.* (2020) found that a numeric balance that summarizes past help given and received does not remove incentives to free ride. But where does reputational information originate from? There have been recent successful attempts by scholars on people's possible *endogenous* formation of reputational information, suggesting that community members can effectively create information and achieve high cooperation norms by voluntarily disclosing their own identifiable information (Kamei, 2017) or by acquiring partners' history information at private costs (Duffy *et al.*, 2013). However, it also suggests that, while information sharing through emotion- or preference-triggered costly reporting of partners' cheating or opportunistic behavior is ubiquitous (Kamei and Putterman, 2017), such reporting alone may not be enough to sustain cooperation (Camera and Casari, 2018). Specifically, in Camera and Casari (2018), allowing "buyer" subjects (which have no action to take) in a helping game to pay a cost to convey the actions of their matched "sellers" (cooperate or defect) to the partners' future counterparts was not enough to improve cooperation, with which the authors conclude that "information about past conduct alone thus appears to be ineffective in overcoming coordination challenges." This result is at odds with real-world observations that users overcome trust problems in online markets (such as eBay, Uber, and Airbnb) by relying on feedback mechanisms (Dellarocas, 2003). However, what makes the voluntary reporting function effective on such online platforms?

In Camera and Casari (2018), their partner's action was privately reported to the partner's future partners, but for *only up to six* rounds, if the buyer *spends a cost* for reporting. Therefore, two important questions remain unanswered. First, how does the presence of a reporting cost influence the effectiveness of endogenous monitoring? Reporting usually involves a cost, because users need to spend time, effort, and mental energy leaving a report. Their negative result may have been driven by the positive reporting cost, considering that players' disclosure decisions have recently been shown to be sensitive to a positive cost in the case of revealing their own information (e.g., Kamei, 2017, 2020b). There was no treatment in which subjects can transmit reputational information for free in Camera and Casari (2018), whose aspect makes answering this question impossible in their study. Second, what happens to people's reporting and cooperation behavior if there is a publicly available platform that stores *all* endogenously reported information? This study proposes and demonstrates that such a publicly available platform may be crucial in overcoming the hurdle of positive reporting costs in online markets to enhance signaling effects, disseminate reputational information effectively, and improve cooperation.

While Camera and Casari (2018) used the setup of a helping game in which only the buyer can report the seller's action, the present study adopts the setup of a prisoner's dilemma game in which both parties can report each other's behavior because economic interactions in some online markets (e.g., eBay, the sharing economy such as Uber and Airbnb) can be better expressed by a prisoner's dilemma game. For example, transactions among Uber users are simultaneous; a passenger decides whether to behave arrogantly toward the driver, while his/her driver decides whether to behave poorly toward the passenger, and a two-way rating system is available. It should be acknowledged that users have different and well-defined roles in real markets (e.g., drivers versus passengers in Uber). While some effects due to the asymmetric roles in a pair may be present, the present study aims to investigate the effects of endogenous monitoring per se without the effects of asymmetric different role assignments. The differences in the design setup make the comparison between Camera and Casari (2018) and the present study less straightforward. However, the attempt here is to re-evaluate the role of endogenous monitoring, focusing on the effects of reporting costs and the reputational platform under (indefinitely repeated) simultaneous-move interactions, such as in online markets.

Gossiping, closer to the topic of voluntary information transmission, has long been actively studied in neighboring fields, such as anthropology, biology, (evolutionary) psychology, and sociology, and has been discussed as helping create a reputation, thereby promoting cooperation in human societies (Dunbar, 2004; Feinberg *et al.*, 2012). For example, as summarized by Kamei and Putterman (2018), the literature suggests that gossiping can be initiated by prosocial individuals when observing others' norm violations or misdeeds and that gossiping activities are linked to reporters' emotional states.

Costly reporting is similar to costly punishment in that other-regarding preferences or emotions cause agents to engage in costly reporting. However, costly reporting differs largely from costly punishment because, in costly reporting, others' misdeeds are judged by those receiving the reports, not by the reporters themselves. While scholars have extensively studied costly punishment over the last few decades (see Gächter and Herrmann [2009] and Chaudhuri [2011] for a survey), surprisingly little attention has been paid to costly reporting until recently in the experimental economics literature. In addition to Camera and Casari (2018), four recent economic experiments explored the functioning of costly reporting and provided useful evidence. However, these studies were all built on finitely repeated games, unlike this study and Camera and Casari (2018); thus, their focus is different from the present study. Because costly reporting is never a materially beneficial act under finite repetition, the prior research has explored non-material reasons for reporting. Prior research has suggested that most costly reporting may take the form of cooperator-defector reporting due to other-regarding preferences in a one-shot prisoner's dilemma where material benefit to the reporter is absent (Kamei and Putterman, 2018); most reporting is truthful even when lying is possible in a trust game (Fonseca and Peters, 2018); having a third party who can engage in reporting boosts trust and trustworthiness in a trust game, driven by the mere fact of being observed by others (Fehr and Sutter, 2019); and information transmission through subjective ratings may not raise transfer and return rates in a trust game (Abrahama *et al.*, 2016). Regarding the finding of Fehr and Sutter (2019), see also Kamei (2018), who shows the impact of high visibility on altruistic acts. This channel is absent in the present study since a third party is not introduced (see the Section 2.4 for experimental design).

By contrast, endogenous monitoring may lead to cooperation as an equilibrium outcome under infinite repetition. Hence, the focus of this Chapter is to study the possible evolution of cooperation and players' strategy choices under endogenous monitoring, with the aim of contributing not only to the experimental literature on cooperation and infinitely repeated dilemma games but also to the literature on reputation, by providing new evidence that reporting may be deterred to a large extent by the presence of a positive reporting cost even in long-term interactions with multiple equilibria and the efficiency of monitoring may depend on the availability of a platform that stores reported information.

In the experiment, recruited participants played an indefinitely repeated prisoner's dilemma game under random matching. In each main treatment, the subjects were given an opportunity to report their matched partners' actions to the partners' future partners. Four main treatments were constructed by varying the two factors (2×2 factorial design). The first treatment factor is the reporting cost; reporting is either free or costly. While reporting usually costs the reporter, the costs (e.g., time and mental energy to write a report) may differ by platform. The second treatment factor is the information structure: either the reported action choice is informed to the partner's next interaction partner only or to all future partners. In addition to the four treatments, a control treatment was conducted in which subjects had no opportunity to engage in reporting.

The experimental results showed that cooperation easily collapses in the control setup where endogenous monitoring is not possible, which is consistent with prior research findings (Camera and Casari, 2009; Kamei, 2017). However, subjects can achieve strong cooperation norms if they can report another's action for free under the weak condition, that is, even when the reported action choice is informed to the partner's next partner only. Nevertheless, the effect of endogenous monitoring is sensitive to reporting costs. Under this condition, endogenous monitoring has almost no effect when reporting is costly as the cost discourages reporting. This implies that a device that mitigates the cost of reporting (whether time or mental energy) may help foster cooperation in a community by encouraging reporting, even without any additional mechanism such as storing reports.

When a community has a publicly available platform that stores all the reported information, monitoring efficiency *does not* depend on reporting costs. Subjects can gradually accumulate information and refer to all previously reported behaviors of their matched partners when deciding on an action, thereby sustaining cooperation. Storing compromises the negative effect of a positive reporting cost in discouraging reporting, underscoring the beneficial effect of storing reputational information.

Further, a structural estimation was conducted to gain insights into the subjects' strategy choices. The results show that subjects' strategy choices are greatly affected by endogenous monitoring institutions. For example, a large fraction of subjects in the experiment is estimated to cooperate conditionally upon their matched partners' reputations when a platform that stores all reports is present.

Note that there are two main discrepancies between real online markets and the present experimental setup. First, while reporting was always truthful in the present experiment, reviews in real online markets are cheap talk based on users' subjective judgments. To the authors' view, the experimental setup with truthful information is an acceptable simplification, because prior experiments on gossiping found that almost all reviews are truthful even when lying is possible (e.g., Fonseca and Peters, 2018). The advantage of using truthful information in the experiment is that it tightens the connection between the experimental design and theory with a simplified setup. As discussed in Section 1.4, Takahashi (2010) provided theory on how the information of a partner's past play affects equilibrium strategies. Second, competition in partner choice was absent in the present experiment, whereas users in most real markets can choose their partners. Competition typically strengthens the value of information because reputational information serves as a basis for users' partner selection (Kamei and Putterman, 2017). Thus, the present experiment can be treated as a conservative test of the role of endogenous monitoring, whose results show that even without partner choice, revealed information boosts cooperation under certain conditions. Matching in transactions in some markets resembles exogenous (random) matching. Examples include Uber, which is characterized by blind passenger acceptance and cancellation penalty. Uber drivers must decide whether to accept a ride request without knowing the passenger's destination or fare; once the ride is accepted, cancellation leads to a penalty (e.g., Rosenblat and Stark, 2016). Uber passengers are exogenously assigned drivers when they request rides; once drivers accept their requests, passengers are penalized if they cancel.

2.3. Hypothesis Development

The three theoretical suggestions discussed in Section 1.4. imply that there would be substantial reporting when reporting does not involve costs, as reputational information helps sustain cooperation, thereby increasing lifetime payoffs. Some subjects may also engage in reporting even if doing so is costly for strategic reasons, for example, because the gain from mutual cooperation is large considering the random continuation probability of 95%. Some subjects' reporting may be driven in part by non-material reasons, as discussed by Kamei and Putterman (2018). Having said that, the presence of reporting costs would discourage reporting, thus making reporting less frequent in the costly-reporting than in the free-reporting treatments, because players have incentives to free ride on others' reporting if it is costly.

Hypothesis 1: *(a) Cooperation can be sustained at a higher level with than without reputational information. (b) Some subjects engage in reporting whether doing so is free or costly, but reporting is on average more frequent when it is free than costly.*

However, as have been discussed in Section 1.5, recent experiments suggest that theoretical analyses based solely on unforgiving strategies, such as the grim trigger, may not be accurate. For example, Dal Bó and Frechétte (2011) estimated the distribution of subjects' strategy choices under partner matching, showing that the tit-for-tat strategy is the most frequently adopted cooperative strategy, whereas the grim trigger strategy is not common. As discussed further in Section 2.5.3, the grim trigger strategy was frequently adopted as the tit-for-tat strategy in the present environment (random matching).

While the simulation in Section 1.5 shows the presence of a symmetric cooperation situation in which every group member selects cooperation in the equilibrium path under all five treatment conditions, clear treatment differences emerge. First, it is difficult to sustain cooperation in the N treatment. As detailed in Section 1.5.1, cooperative equilibrium is volatile because defection spreads quickly to all members as soon as more than one player deviates from the cooperative strategy. The simulated pattern in the N treatment is consistent with prior findings that cooperation tends to remain at low levels without reputational information. The average cooperation rate when the group size was four was 59.5% in Camera and Casari (2009) and 33.4% in Kamei (2017) under the continuation probability of 95%, and 42.2% in Kamei (2020a) under the continuation probability of 90% when no reputational information was available. It is worth noting that sustaining cooperation is theoretically more difficult when the group size is eight than four.

Second, reputational information helps prevent a breakdown of cooperation if CC players choose cooperation conditionally upon their partners' reputations based on reports (Appendices 1.5.2 and 1.5.3).[4] This simulated pattern is consistent with Hypothesis 1.a discussed based on standard theory. Having said this, the effectiveness of endogenous monitoring depends on reporting costs and information structure. On the one hand, symmetric cooperation is very stable when reporting does not involve costs. This holds for both the F-Min and F-Full treatments (regardless of the information structure). For example, the simulation results indicate that a player in the F-Min treatment has material incentives to follow the CC strategy (rather than the AD strategy) under reasonable assumptions, unless more than the majority of group members act according to the AD strategy (Section 1.5.2). Having a public platform that stores previously reported information in the F-Full treatment strengthens the stability of the cooperative equilibrium (Section 1.5.3). These positive effects are driven by a large quantity of reported information, thereby enabling CC players to discriminate accurately between members based on their observable cooperation history. Hence, players are deterred from behaving uncooperatively because of future material concerns.

[4] Simulations were performed based on two simplest assumptions for CC players. The first assumes that CC players select cooperation (defection) in round t if their current-round partners selected cooperation (defection) in round $t - 1$ and the action was observable. According to this assumption, the history information was used as a coordination device, but their past interaction experiences were not considered. The second one assumes that CC players adjust action choices over time such that they would select cooperation in round t stochastically based on all their relevant prior interaction experiences. Specifically, players would mimic how previous partners who had history information selected cooperation toward themselves up to round $t - 1$ (see the Section 1.5 in the detail). CC players' behaviours in a laboratory can be considered somewhere in the middle of these two extreme assumptions.

However, the impact of endogenous monitoring is weaker under costly reporting than free reporting in the simulation. As detailed in Appendices 1.5.2 and 1.5.3, the simulated results show that cooperation can be sustained at a high level in the C-Min treatment if players select actions as their partners' reputational information indicates, like a parrot (e.g., a player selects cooperation if his/her partner selected cooperation in the last round and it is observable). Such information effects as coordination devices are stronger in the C-Full than in the C-Min treatment.[5] However, the positive effects diminish if players consider their own prior interaction experiences and then adjust their cooperation decisions, instead of simply relying on the tit-for-tat-like strategy. This is because the number of reports is not large, and such adjustments create miscoordination among CC players, meaning that the impact of reported information becomes weaker compared with the parrot-like approach. In the context of an infinitely repeated prisoner's dilemma game with partner matching, Axelrod and Hamilton (1981) demonstrated that a simple tit-for-tat strategy works better than any strategy (e.g., sophisticated strategies based on the Markov process and Bayesian inference) in sustaining cooperation in computer simulations. The simulation results are summarized in Hypothesis 2.

Hypothesis 2: *(a) Cooperation cannot be sustained high in the N treatment. (b) The level of cooperation is higher in the F-Min (F-Full) than in the C-Min (C-Full) treatment. (c) The impact of endogenous monitoring is stronger in the C-Full (F-Full) than in the C-Min (F-Min) treatment.*

One unanswered question is which conditional strategy subjects choose in the four reporting treatments: conditional cooperation based on the information of the partner's reported records while they themselves contribute to reporting, or conditional cooperation based on their own interaction experience without spending costs (engaging in costly reporting). To answer this question, an additional simulation was performed by considering three strategies: AD and the two types of CC strategies. The results reveal that players are more likely to obtain higher lifetime payoffs when they cooperate based on the reported records in the C-Full (F-Full) than in the C-Min (C-Full) treatment (see Section 1.5.4). This is because, similar to what has already been discussed, CC players can discriminate between their partners more accurately based on observable cooperation history in the Full than in the Min treatments, thus enabling easier coordination in the former than in the latter. This additional simulation leads to Hypothesis 3:

[5] The positive effects of costly reporting are nevertheless smaller compared with free reporting, since players' ability to discriminate peers is lower under costly than free reporting due to the smaller size of the reported information in the Min condition (Figures 1.5.2, 1.5.3, 1.5.6 and 1.5.7).

Hypothesis 3: *The conditional cooperative strategy based on the information about the partner's reported records is more frequently adopted in the C-Full (F-Full) than in the C-Min (F-Min) treatment.*

These simulations assume that some CC players engage in reporting irrespective of the reporting cost because the reporting cost is just one point. Note, however, that they may be reluctant to report partners' actions in the costly reporting treatments, even though the reporting cost is the lowest positive amount and interactions are infinitely repeated. In the context of voluntary disclosure of own information, Kamei (2017) demonstrated that people may have a discontinuity in disclosure decisions between zero and positive costs (also see Abraham *et al.* [2016], Kamei [2020b], Kamei and Putterman [2018], and Shampanier *et al.* [2007] for evidence under finite repetition). To explore the possible heterogeneity in subjects' reporting, a structural estimation of reporting strategy choices will be performed using the experimental data in Section 2.5.3.

2.4. Experimental Design

This study implements an infinitely repeated game based on a random continuation rule. A multiple supergame design is adopted to allow subjects to learn and update strategy choices from supergame to supergame (Dal Bó and Fréchette, 2018). Specifically, subjects can play an indefinitely repeated prisoner's dilemma game with random matching up to six times. An additional requirement is set such that the duration of interactions is up to two hours in total to avoid having an excessively lengthy experiment session (which could contaminate data due to the subjects' fatigue). However, most sessions (11 out of 16 sessions) went over all the six supergames. An "indefinitely repeated prisoner's dilemma game" is also called a supergame in this Chapter (it was called a "phase" in the instructions distributed to subjects).

Subjects are randomly assigned to a group of eight at the beginning of each supergame, and the group composition does not change throughout the supergame. A larger group size was selected compared with Camera and Casari (2009) and Kamei (2017) where the group size was four, since this study considers large-scale economies (e.g., online platforms) where information does not automatically spread among community members without reporting. In response to this design choice, a Markov transition matrix and equilibrium conditions were derived as summarized in Section 1.4 and Appendix A.1. Each subject is randomly paired with another member within their group in every round and plays a prisoner's dilemma game (four pairs are randomly formed in their group); see Figure 2.1 for the payoff matrix of the stage game. Because the group size is eight, the probability that a subject will interact with a specific group member in a round is one-seventh; they do not interact with those outside their groups within a supergame. The subjects' interactions are anonymous in the sense that they do not know their partners' IDs. However, they learn about their partners' action choices in the prior rounds in which they were reported. Neither decisions nor past interaction outcomes affect the matching process. The duration of each supergame is not pre-determined: subjects' interactions in a given supergame will end with a probability of 5%. An integer between 1 and 100 is randomly drawn at the end of each round. If it is greater than or equal to 96, subjects do not have the next round. The expected length of each supergame is therefore 20 (= 1/(1−.95)).

Figure 2.1.: *Payoff Matrix of the Stage Game*

		Player 2	
		cooperate	defect
Player 1	cooperate	25, 25	5, 30
	defect	30, 5	10,10

Note: This matrix was used in Camera and Casari (2009) and Kamei (2017). Their studies used a group size of four.

As discussed previously, group assignment across supergames follows a random matching protocol. Specifically, once a given supergame is over, all groups are dissolved in the session and subjects are randomly assigned to a group of eight in the following supergame. Information from a given supergame is not transferred to future supergames.

All the experimental design pieces, such as group size, matching conditions within and across the supergames, payoff matrix of the stage game, and continuation probability, are common knowledge for the subjects.

This experiment comprises five treatments. The first treatment, denoted as the "No Reporting" treatment (dubbed "N"), serves as a control condition. Subjects repeat the prisoner's dilemma game under random matching without any information revelation, subject to the random continuation rule. In each round, the subjects learn that they are randomly matched with one of the seven members of their groups, after which they play the prisoner's dilemma game. The other four treatments allow subjects to report their partner's action choice (cooperate or defect) to that person's future partner[s]. For simplicity, it is set that the subjects' reporting is always truthful, and they know that their peers' reports are also always verifiable. This design setup was used also in Camera and Casari (2018) and Kamei and Putterman (2018). Fonseca and Peters (2018) found that even without any material incentive, most trustors reported truthful information about their matched trustees as gossips in a trust game when their messages did not need to be objective.

2.4.1. The Four Reporting Treatments

At the end of every round, each subject can report their partner's action choice to that person's future partner(s) in a given supergame. This "two-way" reporting design is different from Camera and Casari (2018) in which only one party can engage in reporting in a helping game. The treatment conditions are designed using a 2 × 2 factorial design with two dimensions (Table 2.1). The first dimension is the presence of a cost that a subject must pay to report; that is, reporting is either cost-free or costly. Reporting may not be considered free in reality because individuals need to incur time (opportunity cost) or effort to spread information, for example, to warn others. Resnick and Zeckhauser (2002) found that many users on real online platforms do not leave comments when having economic transactions there, consistent with the idea that reporting is costly. For instance, it may take some time and mental energy for users to log into the website and leave a report; however, the cost differs depending on the user-friendliness of the platform. In the costly reporting condition, a subject needs to pay one point to report his/her current-round partner's action choice. The reports must always be truthful. If the subject does not report it, no points will be deducted from his/her payoff. The payoff gain from the total surplus maximization of the stage game is 15 points (= 25 – 10) (see Figure 2.1). Therefore, this reporting cost is sufficiently small, at only one-fifteenth of the gain. Camera and Casari (2018) also used the minimum reporting cost, i.e., one point, in a helping game for the buyer to (truthfully) report his/her matched seller's action. However, the unit cost in their study is considered arguably larger than the present one because the payoff gain of the total surplus maximization in their stage game is six points (page 675 of their paper).

The second dimension of the 2 × 2 design is the consequences of reporting. In the "Min" ("Minimum") condition, if a subject reports his/her partner's action choice in round t, only that partner's round $t + 1$ interaction counterpart will be informed of the choice before deciding how to act. This one-round memory condition was used in Kamei and Putterman (2018). In the "Full" condition, by contrast, if a subject reports his/her partner's action choice in round t, all future counterparts of this partner will learn the choice reported in round t. In other words, it is the perfect-memory condition, and reporting is more cost-effective in the Full condition. As the expected future duration of plays after reporting is 20 (= 1/(1 – 0.95)) rounds, the cost per receiver of the report is 1/20 in the Full condition, while the cost is 0.95 in the Min condition. The signaling value of reporting is therefore stronger in the Full condition than in the Min condition.

Subjects in each treatment are fully informed of the two-way reporting process and their respective information conditions. The information setup of Camera and Casari (2018) falls in the middle between the Min and Full conditions: In an indefinitely repeated helping game, their subjects can observe partners' action choices reported during the six preceding rounds in a given supergame.

The four main treatments are called the "Free Reporting, Minimum" (F-Min), "Costly Reporting, Minimum" (C-Min), "Free Reporting, Full" (F-Full), and "Costly Reporting, Full" (C-Full) treatments.

Table 2.1: *Summary of Treatments*

Treatment	Available history information on round *t* partner before deciding whether to cooperate in round *t*	Cost of reporting	Number of subjects (sessions)	Number of obs.	Avg. SG length [rounds][#2, #3]
N	n.a.	n.a.	72 (3)	9,120	19.41
F-Min	Round *t* partner's action choices made in round $t-1$ if the partner was reported in that round	0 points	88 (4)[#1]	7,336	17.62
C-Min		1 point	64 (3)	10,080	27.33
F-Full	Round *t* partner's action choices made in all past rounds up to round $t-1$ in a given supergame in which the partner was reported by group members	0 points	72 (3)	10,320	25.63
C-Full		1 point	64 (3)	6,480	16.88
Total			360 (16)	43,336	21.37

Notes: [#1] Four sessions were conducted for the F-Min treatment (unlike the other treatments) because one session could not be completed as one subject withdrew from the experiment in the middle of the session. The observations up to the time of the student's withdrawal were used as data along with the three other sessions, because the session proceeded without any issues until then. [#2] As explained earlier, the subjects in the five sessions did not complete all six supergames. The average supergame lengths were calculated using only the supergames completed by subjects. [#3] Appendix Table B.1 reports the average realized supergame lengths in the first, middle, and final thirds of the experiment.

2.4.2. Using a Block Design to Collect a Large Number of Observations

Considering that infinite repetition is designed using a random continuation rule, a block design is employed to collect large observations in each supergame. Fréchette and Yuksel (2017) showed that subjects' behaviors under the block design do not differ from those under the standard random continuation rule, i.e., the method first used by Roth and Murnighan (1978). In each supergame, the subjects play blocks of ten rounds in sequence. That is, they will play ten rounds, assuming a random continuation probability of 95%. In a given round, each subject is randomly paired with a member of their group and interacts with each other in the prisoner's dilemma game (Figure 2.1). However, they are not informed of an integer randomly drawn for each round until the end of the tenth round in a given block. After the tenth round, the subjects are informed of the integers drawn for all ten rounds. Their payoffs are determined based on the rounds before the round in which an integer greater than 95 is first realized. For example, suppose that the ten randomly drawn integers are 4, 34, 98, 56, 32, 93, 2, 45, 14, and 32 in sequence. In this situation, subjects' total payoffs in the supergame will be calculated based on the interaction outcomes until the third round in this block (the interaction outcomes from the fourth round will not be counted in calculating total payoff), and they will move on to the next supergame. If the ten integers are all less than 96, then subjects will move on to the next block in the same supergame.

It should be noted here that with the block design, all subjects have interactions in each supergame for at least ten rounds. Mengel *et al.* (2022) demonstrated that a realized supergame length has an impact on subjects' cooperation rates in the following supergames (also see Dal Bó and Fréchette [2018] and Engle-Warnick and Slonim [2006]). The block design is quite useful for avoiding extremely short supergames, which may discourage subjects from learning to cooperate.

2.4.3. Experimental Procedure

Sixteen sessions were conducted at the EXEC laboratory at the University of York, the United Kingdom from July to November 2018 (Table 2.1). A total of 360 students there participated in the experiment. 58.1% of the subjects (209 students) were female, and 16.9% (61 students) were economics majors. The percentages of female subjects were 52.8%, 59.4%, 61.4%, 67.2%, and 50.0% in the N, C-Min, F-Min, C-Full, and F-Full treatments, respectively. The percentages of economics students were 19.4%, 15.6%, 15.9%, 23.4%, and 11.1% in the N, C-Min, F-Min, C-Full, and F-Full treatments, respectively. All the subjects were recruited through solicitation messages sent through *hroot* (Bock *et al.*, 2014). None of the subjects participated in more than one session. No communication among the subjects was allowed after entering the laboratory and before the experiment ended. Except the instructions, the experiment was programmed using the zTree software (Fischbacher, 2007). Only neutrally framed words were used in the instructions (any loaded words such as cooperate and defect were avoided) – see Appendix C. The instructions were read aloud by the researcher. The subjects were also asked to answer a few control questions at the beginning of each session to check their understanding of the experiment. The conversion rate was 150 points in the experiment to one pound sterling. The average per-subject payment was 16.50 pounds sterling. The average per-subject payments were 14.69, 15.62, 17.24, 16.64, and 18.03 pound sterling in the N, C-Min, F-Min, C-Full, and F-Full treatments, respectively.

2.5. Experiment Results

An overview of the subjects' cooperation rates and the effects of endogenous monitoring is provided in Section 2.5.1. The subjects' reporting behaviors are examined in Section 2.5.2. Finally, as the driving forces behind the observed treatment differences, the structural estimation results of the subjects' strategy choices are discussed in Section 2.5.3.

2.5.1. Cooperation Rates

As shown in Figure 2, the average cooperation rates were calculated using data from round 1 in supergames, the first block (first ten rounds) in supergames, and all rounds, as the random continuation rule was adopted in the experiment (Dal Bó and Fréchette, 2018). Effects of interaction lengths in the current supergame are minimized (except influence from the differences in the realized previous supergame length across the treatments) if observations in the first round or in the first block are used for the analysis, since subjects in all the treatments have gone through the first ten rounds of each supergame thanks to the block design.

It shows first that the subjects' cooperation rates were modest when reporting was not possible (panel *i*), whose result is consistent with Hypothesis 2.a. For example, the average cooperation rate in the N treatment was 46.5% in round 1 and 35.2% across all rounds. A higher cooperation rate in round 1 than in later rounds implies that some subjects turned to punishment mode for some duration after a negative experience. Having said that, the average cooperation rate in the first block was 33.9%, whose level was similar to the cooperation rate across all rounds. This means that cooperation dynamics quickly settled into stable patterns over time.

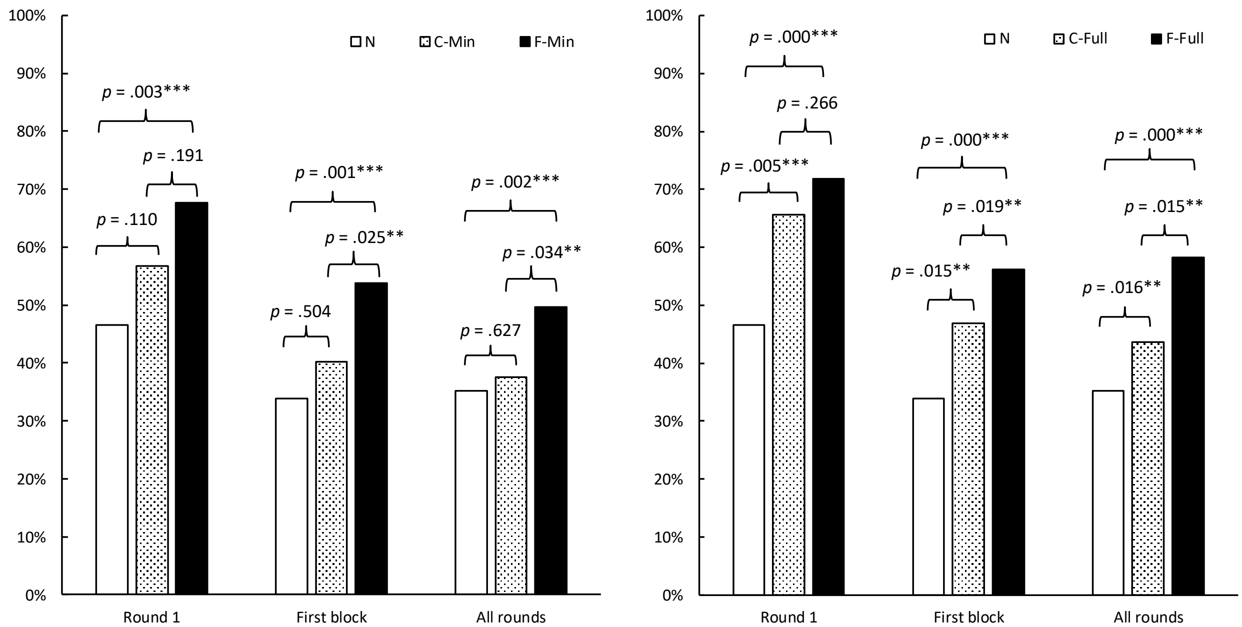
Figure 2.2 also summarizes the average cooperation rates under endogenous monitoring. Appendix Figure B.3 reports the average payoffs by treatment. Since it reveals qualitatively the same implications as seen from Figure 2.2, the discussions in Section 2.5.1 will be made based on the average cooperation rates. A subject random effects probit regression was then used to evaluate each treatment difference, while estimating standard errors bootstrapped and clustered at the subject level to allow for correlation between observations from the same subject. As random matching was used in each session, session effects might have affected subjects' behavior. To supplement the significance tests reported in Figure 2.2, another regression analysis was performed while also adding session random effects. The additional regressions generate qualitatively similar—somewhat stronger for some specifications—results (see Appendix Figure B.1). As realized previous supergame lengths may affect subjects' decision to cooperate in the current supergame (Mengel *et al.*, 2022), the previous supergame length is also added as a control in the regressions (e.g., Dal Bó and Fréchette, 2018, Engle-Warnick and Slonim, 2006). This reveals that the effects of endogenous monitoring depend on both reporting costs and information structure. First, under the Min condition, endogenous monitoring has a strong effect on improving cooperation if reporting does not involve costs (F-Min treatment). The positive effect in the F-Min treatment relative to the N treatment was significant regardless of the data used (Figure 2.2i). By contrast, costly reporting has only mild effects under this information condition. The average cooperation rate was not significantly higher in the C-Min than in the N treatment (again see Figure 2.2i). The discrepancy between C-Min and F-Min is consistent with Hypothesis 2.b. Section 2.5.2 will explain that the weak effect in the C-Min treatment was driven by the presence of a positive reporting cost, which significantly deterred subjects' decisions to report. On average, the larger the quantity of information created through more frequent reporting, the more persistent the cooperation sustained at high levels.

Second, under the Full condition (Figure 2.2.ii), subjects achieved strong cooperation in the first round, and they sustained it relatively well over time in a given supergame, when reporting did not involve costs (F-Full treatment). Similar to the Min condition, and consistent with Hypothesis 2.b, the presence of a positive reporting cost significantly undermined cooperation in the Full condition (panel *ii*) as the positive cost discouraged reporting, as will be explained in Section 4.2. However, costly reporting still improved cooperation significantly in the C-Full treatment relative to the N or C-Min treatment, supporting Hypothesis 2.c. In particular, the average round 1 cooperation rate for the C-Full treatment was very high, 65.6%.

Note a comparison between the F-Min and F-Full treatments shows a positive effect of having larger history information; however, the effect is quite small, which is inconsistent with Hypothesis 2.c. The average cooperation rate in round 1 (over all rounds) was 67.7% (49.7%) in the F-Min treatment versus 71.8% (58.2%) in the F-Full treatment. This suggests that having additional mechanisms in addition to the available reputational platform is desirable to induce subjects to use reputations more effectively for cooperation in the F-Full treatment than in the F-Min treatment.

Result 1: *(a) Cooperation was modest in the N treatment. (b) The level of cooperation was higher in the F-Min (F-Full) than in the C-Min (C-Full) treatment. (b) The impact of endogenous monitoring was stronger in the C-Full than in the C-Min treatment, but the impact was similar for the F-Min and F-Full treatments.*

Figure 2.2: *Average Cooperation Rate by Treatment*



(*i*) C-Min and F-Min treatments

(*ii*) C-Full and F-Full treatments

Notes: p-values (two-sided) were calculated based on subject random effects probit regressions with robust standard errors bootstrapped and clustered at the subject level (300 replications). "First block" refers to the first ten rounds of supergames. In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, while having a dummy equal to 1 for the first supergame (which makes it possible to control for cooperation behaviors without prior experience). *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

The impact of endogenous monitoring is also evident in the across-supergame cooperation dynamics. However, these trends provide new insights (Figure 2.3). First, the supergame-average cooperation rate decreased over time in the N treatment. The rate of decrease was significant (see columns (2) and (3) of Appendix Table B.2). Hence, it can be concluded that in the absence of reputational information, subjects fail to cooperate even after gaining experience, supporting Hypotheses 1.a and 2.a. Second, under the Min condition (panel I), free reporting has a positive effect on cooperation uniformly across the six supergames. The round 1 cooperation rates were consistently around 70% across the experiment in the F-Min treatment, which means that the subjects' high willingness to cooperate persisted over time (panel I.*i*). While there are no clear trends if the data after round 1 are incorporated (panels I.*ii* and I.*iii*), it indicates that the groups achieved significantly stronger cooperation norms with endogenous monitoring compared with the N treatment, whether data from earlier supergames (supergames 1 to 3) or from later supergames (supergames 4 to 6) are used. Treatment differences were calculated as identified in Figure 2.2 when using only the data from supergames 1 to 3, and also when using only the data from supergames 4 to 6. As shown in Appendix Figure B.2, in each data subset, the difference in the average cooperation rate is significant between the N and F-Min treatments, regardless of which rounds of plays are used (the first round only, the first block only, or all rounds). By contrast, Figure 2.3.I suggests that costly reporting has only mild effects across the six supergames in the C-Min treatment. This strengthens Result 1.b. As shown in Appendix Figure B.2, the effect of costly reporting was not significant in the C-Min treatment, regardless of which data were considered (the first or second half of the experiment). Although the subjects in the C-Min treatment cooperated somewhat more frequently than those in the N treatment in the first round (panel I.*i*), the overall average cooperative behavior in the former was almost similar to that in the latter (panels I.*ii* and I.*iii*).

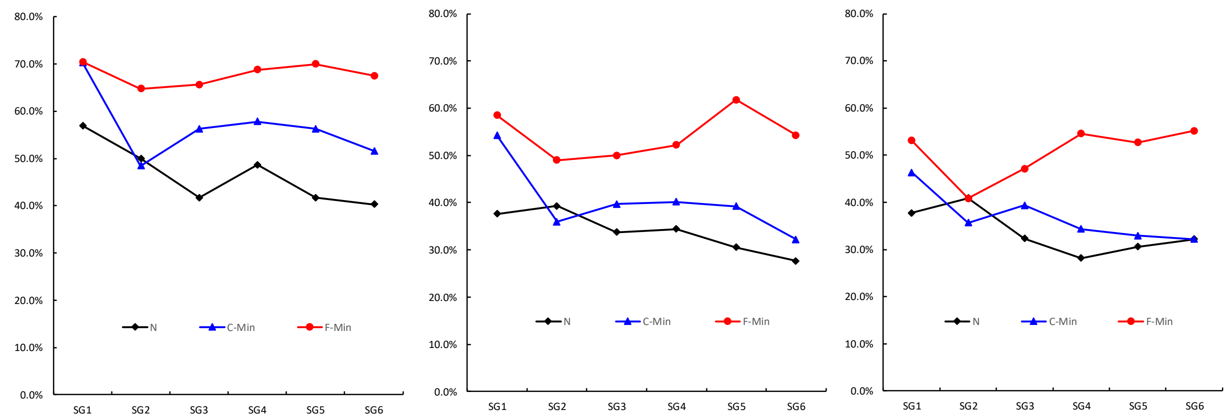
Figure 2.3 also reveals the different dynamics between the two reporting costs under the Full condition (panel II). Similar to the F-Min treatment, the subjects achieved high cooperation norms from the first supergame in the F-Full treatment. However, when reporting was costly (C-Full), the subjects took time to learn cooperation. Nevertheless, the learning was significant and successful.[6] As a result, groups in the C-Full treatment achieved significantly higher cooperation rates than those in the N treatment in the second half of the experiment (fourth to sixth supergames) – see Appendix Figure B.2. This suggests that the subjects gradually learned how to utilize the recorded reported information. Such gradual learning is reasonable considering that only a subset of actions was reported, and the distribution of accumulated information might have been biased. As explained in Section 2.5.2, the subjects' reporting rates were far less than 50% in the C-Full treatment, which was only somewhat higher than in the C-Min treatment.

Result 2: *(a) Under the Min condition, while subjects sustained cooperation at high levels in the F-Min treatment, they failed to do so in the C-Min treatment. (c) Under the Full condition,*

[6] The increasing trend of cooperation in the C-Full treatment was significant. See the coefficient estimates for the supergame number variable in Appendix Table B.2.

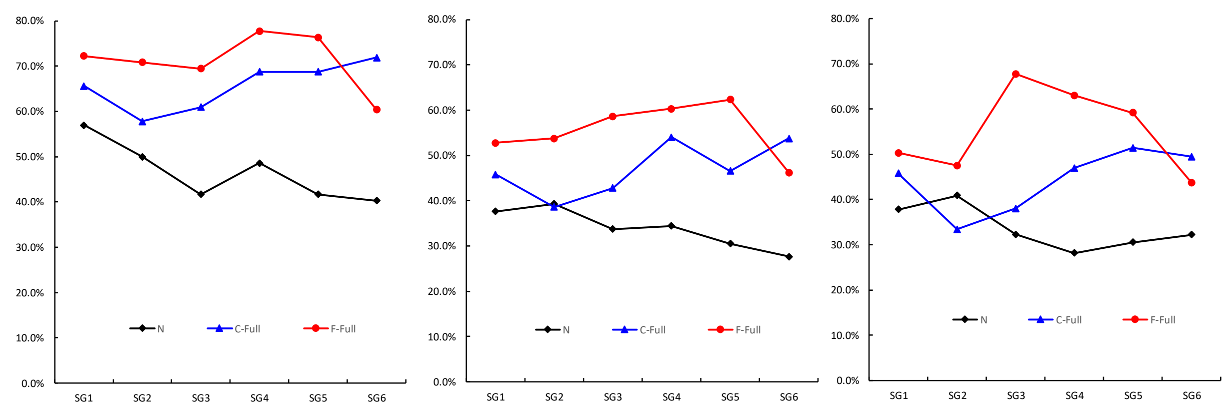
subjects sustained cooperation from the onset in the F-Full treatment, while they gradually learned to cooperate and achieved strong cooperation in later supergames in the C-Full treatment.

Figure 2.3: *Average Cooperation Rate, Supergame by Supergame*



(*i*) Round 1 (*ii*) First block (first ten rounds) (*iii*) All rounds

I. C-Min and F-Min treatments



(*i*) Round 1 (*ii*) First block (first ten rounds) (*iii*) All rounds

II. C-Full and F-Full treatments

As touched upon earlier, the average cooperation rate was higher in round 1 than in later rounds for all the treatments (Figures 2.2 and 2.3). A regression analysis confirms that the subjects' cooperation rates gradually declined over time within supergames in all treatments (Appendix Table B.2). This resonates with the idea that subjects behave conditionally cooperatively or are in punishment mode for some duration after having negative experiences (e.g., Camera and Casari, 2009; Fischbacher and Gächter, 2010). Section 2.5.3 will be devoted to analyzing exactly what strategies the subjects used in the experiment.

2.5.2. Reporting

Subjects' failure to learn cooperation in the C-Min treatment (Results 1.b, 1.c, and 2.a) can be explained by the small amount of reputational information. Table 2.3 summarizes the subjects' reporting rates by treatment (Appendix Figure B.4 summarizes the average reporting rates by supergame). It shows that the subjects were far less likely to engage in reporting in the C-Min than in the F-Min treatment. The strong negative impact of positive reporting costs is remarkable, considering that the cost is only one point (= 0.67 pence). However, this is consistent with the results of recent research that showed players' sensitivity to cost in the context of voluntary disclosure of their own information (Kamei, 2017, 2020b).

Subjects' frequency of reporting did not differ by information condition when reporting did not involve costs (see again Table 2.3). This implies that, perhaps since already more than 70% of the subjects engaged in reporting even in the Min condition, having a publicly available platform in the F-Full treatment did not improve material incentives to report.

Turning to costly reporting, subjects engaged in reporting significantly more frequently in the C-Full than in the C-Min treatment, but reporting in the C-Full treatment was still far weaker than that in the F-Full treatment. Thus, the negative effect of positive reporting costs is robust to the information condition (Min or Full).

The reporting frequencies (Table 2.3) and success/failure of cooperation (Figures 2.2 and 2.3) are roughly consistent with the prediction from Takahashi (2010). As summarized in row b of Table 1.4, cooperation evolves under endogenous monitoring, provided that the memory length is at least one. A report is expected to stay for 0.95 rounds (20 rounds) in the Min (Full) condition, as the continuation probability is 95%. The average quantity of the partner's past play is therefore roughly calculated as 0.197 (= 20.7%×0.95), 0.682 (= 71.7%×0.95), 5.68 (= 28.4%×20), and 15.5 (= 77.5%×20) in the C-Min, F-Min, C-Full, and F-Full treatments, respectively. Here, 20.7%, 71.7%, 28.4% and 77.5% are the average reporting rates of the respective treatments (Table 2.3). Thus, the memory length was much less than 1 in the C-Min treatment only. The memory length was much larger than 1 in the two Full treatments. The analysis in Section 2.5.3 reveals that a large memory length in the Full condition induced subjects to cooperate based on their partner's reputation.

Result 3: *(a) Subjects were significantly more likely to report partners when reporting was free than costly. (b) While the reporting rates were at high levels similarly for the F-Min and F-Full treatments, the rates were significantly higher in the C-Full than in the C-Min treatment.*

Table 2.4 summarizes the average reporting rates by stage game outcome. Appendix Table B.4 reports the treatment differences in the average reporting rates by stage game outcome (e.g., cooperator-cooperator reporting). Three further interesting patterns emerge. First, cooperators were more likely than defectors to engage in reporting under each treatment condition, regardless of whether they were matched with

Table 2.3: *Average Reporting Rates by Treatment*

	Data used for calculations								
	Round 1			First block			All rounds		
	Costly		Free	Costly		Free	Costly		Free
reporting:									
information:									
Min	28.1%	<***	76.0%	23.5%	<***	72.6%	20.7%	<***	71.7%
	∧**		=	∧*		=	∧**		=
Full	41.9%	<***	74.0%	30.8%	<***	74.2%	28.4%	<***	77.5%

Notes: "First block" refers to the first ten rounds of supergames. Each treatment comparison was based on a subject random effects probit regression with robust standard errors bootstrapped and clustered at the subject level (300 replications), with a treatment dummy as an independent variable. In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, while also having a dummy that equals 1 for the first supergame. *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

cooperators or defectors. This suggests that some defectors may not have appreciated the benefits of creating reputational information and/or may have free ridden on cooperators' reporting. Second, cooperators were more likely to engage in costly reporting when matched with defectors rather than when matched with cooperators (panels *i* and *iii*). These differences were significant in the C-Full treatment. This pattern resonates with the idea that cooperators' reporting is partly driven by other-regarding motives or emotional responses (Kamei and Putterman, 2018). On the other hand, cooperators reported both cooperators and defectors quite frequently when reporting was free. Third, both the cooperators and defectors frequently engaged in reporting when reporting did not involve costs. However, not everyone has done so. This is not surprising considering that some people are known to behave uncooperatively, even though a Pareto-dominant cooperative equilibrium exists in an infinitely repeated dilemma game.[7]

[7] Some subjects' decision not to report their partners' actions in the F-Min and F-Full treatments may have been caused by their limited cognitive ability, as discussed in Arruñada and Casari (2016) and Kamei (2020b).

Table 2.4: *Average Reporting Rates by Stage Game Outcome*

(*i*) C-Min treatment

	Data used for calculations								
	Round 1			First block			All rounds		
Decision-maker: Partner:	Cooperator		Defector	Cooperator		Defector	Cooperator		Defector
Cooperator	31.5%	=	19.1%	36.6%	>***	19.1%	35.5%	>***	17.7%
	=		=	=		∨***	=		∨***
Defector	47.9%	>**	8.3%	42.4%	>***	9.4%	38.6%	>***	7.6%

(*ii*) F-Min treatment

	Data used for calculations								
	Round 1			First block			All rounds		
Decision-maker: Partner:	Cooperator		Defector	Cooperator		Defector	Cooperator		Defector
Cooperator	86.3%	>**	59.0%	86.5%	>***	67.3%	87.2%	>***	66.0%
	=		=	∨**		∨*	∨***		=
Defector	82.1%	=	54.3%	77.6%	>***	55.3%	75.6%	>***	57.5%

(*iii*) C-Full treatment

	Data used for calculations								
	Round 1			First block			All rounds		
Decision-maker: Partner:	Cooperator		Defector	Cooperator		Defector	Cooperator		Defector
Cooperator	48.9%	>***	13.9%	38.6%	>***	17.8%	39.2%	>**	18.0%
	∧***		=	∧***		=	∧***		∨*
Defector	77.8%	>*	11.7%	59.8%	>***	17.0%	56.2%	>***	14.4%

(*iv*) F-Full treatment

	Data used for calculations								
	Round 1			First block			All rounds		
Decision-maker: Partner:	Cooperator		Defector	Cooperator		Defector	Cooperator		Defector
Cooperator	82.0%	>***	44.8%	84.8%	>***	52.9%	86.3%	>***	57.9%
	=		=	=		∧***	=		∧***
Defector	85.1%	=	9.7%	79.7%	>**	69.2%	79.3%	=	73.6%

Notes: "First block" refers to the first ten rounds of supergames. Each treatment comparison was based on a subject random effects probit regression with robust standard errors bootstrapped and clustered at the subject level (300 replications), with a treatment dummy as the independent variable. In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, while also having a dummy that equals 1 for the first supergame. Appendix Table B.3 reports the average reporting rates by supergame.

*, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

One may wonder how subjects' reporting was affected by *others'* previous reporting. It is possible that their reporting activities were partly characterized by *conditional* behaviors. For example, a reciprocal subject may be more likely to engage in reporting to help community members if s/he enjoys the benefits of receiving larger information about the current-round partner than otherwise. People's conditional behaviors were widely documented, for example in cooperation decisions (Fischbacher, Gächter and Fehr, 2010), direct punishment (Kamei, 2014), and third-party punishment (Kamei, 2018). To explore possible conditional reporting behaviors, partial correlations between subjects' reporting decisions and the quantity of information they received were calculated, confirming significantly positive relationships (Appendix Table B.5). The subjects in the C-Min and F-Min treatments were likely to report by approximately 17.4 and 10.7 percentage points more, respectively, when they received a report than otherwise. In the C-Full and F-Full treatments, a 10% increase in subject *i*'s quantity of reported information raises the likelihood that his/her current-round partner reports *i* by around 1.3 and 1.4 percentage points, respectively.

Result 4: *(a) Cooperators were more likely than defectors to engage in reporting under each treatment condition. (b) Cooperator-defector reporting was more common than in any other stage game situation when reporting was costly. (c) Both cooperators and defectors frequently engaged in reporting when reporting did not involve a cost. (d) Subjects' reporting was positively correlated with their partners' frequencies of being reported in the past.*

2.5.3. Structural Estimation of Subjects' Strategy Choices

In Section 2.5.1, it was found that endogenous monitoring greatly affected subjects' decisions to cooperate. However, it is still unclear how subjects' strategy choices changed by endogenous monitoring. To answer this question, the subjects' strategy choices regarding cooperation were estimated, supergame by supergame, by applying the maximum likelihood method developed by Dal Bó and Frechétte (2011).[8] This method assumes a fixed number of strategies that subjects can adopt and then estimates a probability distribution over the strategies in the dataset to maximize the likelihood. While the theoretical analysis in Section 3 assumes a few specific strategies such as AD, GT, and what we call the conditional cooperative (CC) strategies, a larger number of specific strategies were considered in the structural estimation to

[8] As explained in Dal Bó and Frechétte (2011), the gamma value in the structural estimation (SFEM) captures the size of noise (page 423). The gamma values estimated for all models shown in the present paper are strongly significant (Appendix Tables B.7, B.8, B.9, and B.10). This means that the models predict our subjects' strategy choices significantly better than random choices in the dataset of the present experiment.

avoid missing important strategies and to obtain detailed insights. Dal Bó and Frechétte (2011) assumed six strategies, AD, AC, GT, TFT, WSLS, and T2 in their estimation. Subjects' strategy choices were estimated assuming the same set of strategies used in the Dal Bó and Frechétte (2011) for each of our five treatments as a preliminary analysis (see Appendix Figure B.5 for the result. As summarized in Table 2.5, the two types of CC strategies were considered, so that the structural estimation is parallel to the argument in Section 3.[9] The first type is the CC strategy in which players' decisions are conditional upon their interaction experience; and it includes variants of grim trigger, tit for tat, and trigger strategies, namely GT, GT2, GT3, SGT, TFT, TF2T, TF3T, 2TFT, T2, T3, T4, and T5, in all five treatments. The second type is the CC strategy based on their partners' reputations rather than their interaction experience; and it was considered for the four reporting treatments (further details below).[10] As a preliminary analysis, a regression was conducted to investigate the relationship between subjects' decision to cooperate and their partner's reputational information (Appendix Table B.6). The result finds that subjects on average selected cooperation conditionally upon their matched partners' reputations. In addition to these two types of strategies, AD, AC, and WSLS were also added to the structural estimation following prior research (Dal Bó and Frechétte, 2011).

[9] A subject is assumed to cooperate in the first round of a given supergame unless s/he acts on the AD strategy.

Table 2.5: *The List of Strategies Assumed in the Estimation*

Strategy		Definition
AD	Always Defect	A subject who defects always
AC	Always Cooperate	A subject who cooperates always
Grims		A subject who acts according to GT, GT2, GT3 or SGT
GT	Grim Trigger	A subject who cooperates if s/he has not yet experienced any defection
GT*K*	Grim Trigger *K* {*K* = 2, 3}	A subject who cooperates until *K* consecutive rounds occur in which either player's action was defection; otherwise, s/he defects forever
SGT	Strong Grim Trigger	A subject who selects cooperation if s/he did not experience defection in his/her stage game interactions so far and also did not see any instance of defection in his/her partners' observable reputation records
TFTs		A subject who acts according to TFT, TF2T, TF3T or 2TFT
TFT	Tit for Tat	A subject who cooperates (defects) if the last partner cooperated (defected).
TF*K*T	Tit for *K* Tats {*K* = 2, 3}	A subject who cooperates unless partner's action was defection in either of the last *K* rounds
2TFT	2 Tits for 1 Tat	A subject who defects two rounds (cooperates) if the last partner defected (if his/her two recent partners both cooperated)
WSLS	Win Stay, Lose Shift	A subject who cooperates if either mutual cooperation or mutual defection was realized in his/her last round
TKs		A subject who acts according to T2, T3, T4 or T5
T*K*	Trigger strategy with *K* rounds of punishment	A subject who defects *K* rounds after experiencing defection, after which s/he returns to cooperation
Reps		A subject who acts according to a reputation strategy listed below
RepL	Reputation Last Round	A subject who cooperates in round *t* if his/her matched partner selected cooperation in round *t*–1 and it is observable (s/he defects otherwise)
Rep*K*	Reputation *K*% {*K* = 25, 50, 75 or 100}	A subject who cooperates (defects) if his/her partner cooperated at least *K*% (< *K*%) of the time in the partner's observable reputation record
6Rep*K*	6-Round Reputation *K*% {*K* = 50, 100}	A subject who cooperates (defects) if his/her partner cooperated at least *K*% (< *K*%) of the time in the partner's observable reputation record up to round *t*-6.

Notes: The definitions of AD, AC, GT, TFT, T2, and WSLS are the same as those in Dal Bó and Frechétte (2011). The definitions of GTK, TF*K*T, and 2TFT are the same as those used by Rand *et al.* (2015).

Panel *i* of Figure 2.4 summarizes the estimated distribution of the subjects' strategy choices in the N treatment. The results show that the highest fraction (45.9%) of subjects' strategy choices is explained by the AD strategy. It also showed that the popularity of the AD strategy increased from supergame to supergame after gaining experience. The high prevalence and increasing popularity of the AD strategy can be thought of as causing cooperation breakdown in the N treatment (Figures 2 and 3) and underlines the difficulty of sustaining cooperation under random matching in an anonymous community, even with infinite repetition. However, it resonates with the so-called "Anti-Folk Theorem" idea, which proposes negative consequences of strong commitment types in communities (Sugaya and Wolitzky, 2020).

Other than the AD strategy, Grims and TFTs accounted for a relatively large fraction of strategy choices in the N treatment, i.e., 20.1% and 20.8% of the subjects' strategies, respectively. As discussed in Section 3, Dal Bó and Frechétte (2011) found that, in their partner-matching design, almost all subjects' decisions were explained by the AD or TFT strategy. The equal prevalence of the Grims and TFTs in the present study implies that the matching protocol (partner or random matching) affects subjects' strategy choices.

Subjects had reputational information in the four reporting treatments. As such, the distributions of subjects' strategy choices were estimated by including additional strategies that assumes that a subject's action choice is affected by their partner's reputational information (Table 2.5). First, the "RepL" strategy was considered in all the four treatments. A RepL subject is assumed to choose an action solely based on their partner's previous round's reputation; that is, the subject cooperates in round t if his/her round t partner cooperated in round t–1 and it is observable; otherwise, s/he defects in round t. Second, Rep*K* and 6Rep*K* was also considered in the C-Full and F-Full treatments, as all previously reported information was available, and memory length may have affected choices. K reflects the threshold of the partner's reputational quality that induces a subject to cooperate. A Rep*K* subject is assumed to cooperate in round t if his/her partner cooperated at least K% of the time thus far in the observable reputation record. Four threshold strategies, Rep25, Rep50, Rep75, and Rep100, were considered by varying the value K, as the threshold for cooperation may differ by subject. The 6Rep*K* strategy is a threshold strategy based on the partner's choices in the last six rounds. This strategy was considered in addition to Rep*K*, as reports were observable to subjects for only six rounds in Camera and Casari (2018), and one may wonder whether memory length matters.

Third, as subjects can learn their partners' past action choices through reporting (Camera and Casari, 2009; Kamei, 2017), the SGT strategy was also considered in all four reporting treatments, in addition to the GT and GT*K* strategies. An SGT subject i is assumed to select cooperation only when i did not experience defection in his/her stage game interactions thus far and i also did not see any instance of defection in the partners' observable reputation records.

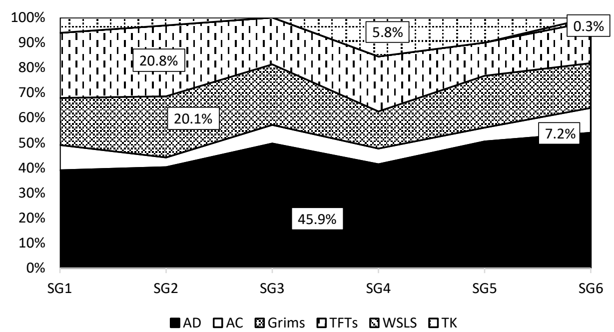
Panels *ii* to *v* of Figure 2.4 show the estimation results. Two interesting patterns are observed. First, the percentages of subjects who acted according to the AD strategy was substantially smaller under endogenous monitoring than in the N treatment. The percentages were especially small when reporting does not involve a cost: they were 40.0% and 63.0% smaller in the F-Min and F-Full treatments, respectively, than in the N treatment (the differences are each significant – see Part II of Appendix Table B.8). The percentages of choosing the AD strategy under costly reporting were 36.1% and 27.9% in the C-Min and C-Full treatments, respectively. The percentages were not significantly different between the N and C-Min treatments (Part II of Appendix Table B.8). The high percentage of the AD type in the C-Min treatment resonates with the idea that subjects' decisions may be discontinuous between zero and positive costs (e.g., Kamei, 2017, 2020b). On the other hand, the relatively low percentage of the AD type in the C-Full treatment, which was significantly smaller than that in the N treatment, means that the availability of a reputational platform altered subjects' strategy choices, whose interpretation turned out to be correct judging from the estimated strategy distribution, as discussed below.

Second, there is a clear contrast in the impact of endogenous monitoring on subjects' strategy choices between the Min and Full conditions. On the one hand, under the Min condition, endogenous monitoring encouraged subjects to act on the AC strategy, relative to the N treatment. This most generous strategy was quite popular especially in the F-Min treatment: A little over 20% of subjects under the F-Min treatment acted according to the AC strategy. Endogenous monitoring also encouraged some subjects–around 7.3% (C-Min) and 8.2% (F-Min) of subjects– to choose an action based on their partner's reputation (last-round action choice). However, under the Full condition, remarkably, 29.5% and 46.4% of the subjects were estimated to have acted based on the Reps strategy in the C-Full and F-Full treatments, respectively. The difference in the percentage of the Reps strategy between the C-Min (F-Min) and C-Full (F-Full) treatments is significant at the 1% level (Part II of Appendix Table B.8). Instead, both the TFTs and Grims were estimated to be much smaller in the two Full treatments than in the N treatment. It follows that the availability of a publicly available reputational platform drastically altered subjects' strategy choices in the Full condition relative to the Min condition, whose result is consistent with Hypothesis 3. This strategy distribution is reasonable because all reported action choices are stored on the platform (Result 3), and subjects in the C-Full and F-Full treatments can rely on reputational information in choosing an action, instead of relying on their own experiences and using the tit for tat.

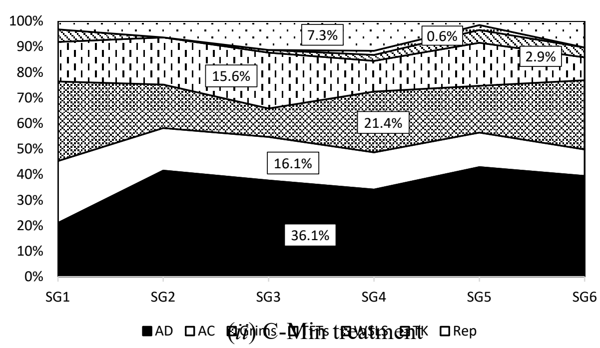
Result 5: *(a) The most frequently used strategy in the N treatment was the AD strategy. (b) The popularity of the AD strategy was significantly lower when endogenous monitoring was made for free (F-Min, F-Full) or when a reputational platform that stores all reported records was available (C-Full, F-Full). (c) In the C-Full and F-Full treatments, a large percentage of subjects* *chose actions conditionally upon their partner's reputation. The percentages of the Reps subjects were significantly larger compared with the corresponding Min treatments.*

Which reputation strategy has gained popularity in the Full conditions? As already discussed, the structural estimation includes seven specific reputation strategies–RepL, 6Rep100, 6Rep50, Rep100, Rep75, Rep50, and Rep25–to accommodate possible heterogeneity in the subjects' strategy choices. A detailed look at the estimation result reveals that, on average, 0.83% (2.83%), 1.26% (1.43%), 0.00% (6.78%), 5.55% (3.45%), 2.63% (4.01%), 12.85% (19.46%), and 6.36% (8.39%) of subjects' choices are explained by RepL, 6Rep100, 6Rep50, Rep100, Rep 75, Rep 50, and Rep25, respectively, in the C-Full (F-Full) treatment.[11] This

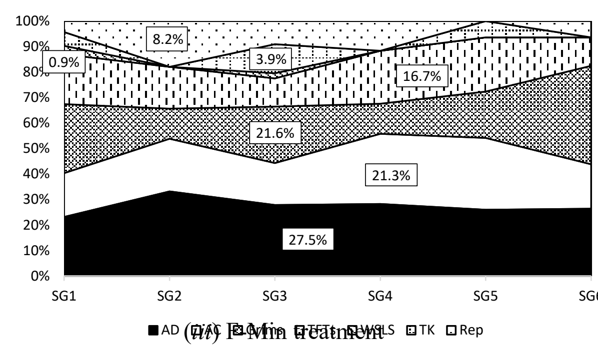
Figure 2.4: *Strategy Choices Regarding Cooperation, Supergame by Supergame*



(*i*) N treatment

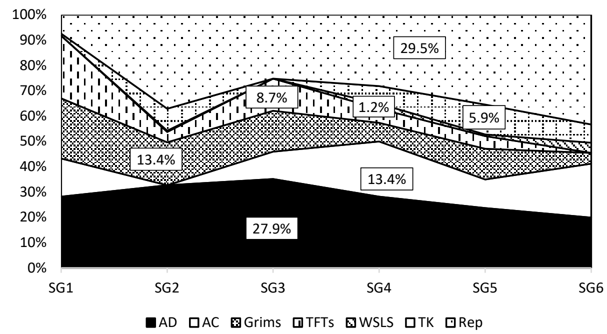


(*ii*) C-Min treatment

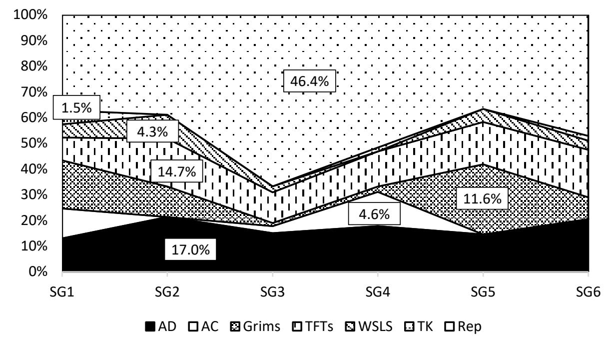


(*iii*) F-Min treatment

[11] These percentages were calculated by averaging the percentages of the strategies across the six supergames based on the estimation results summarized in Figure 2.4 and Appendix Table B.8.



(*iv*) C-Full treatment



(*v*) F-Full treatment

Notes: Grims includes GT, GT2, GT3, and SGT. TFTs includes TFT, TF2T, TF3T, and 2TFT. TK includes T2, T3, T4, and T5. Rep includes RepL in the C-Min and F-Min treatments (RepL, 6Rep100, 6Rep50, Rep100, Rep75, Rep50, and Rep25 in the C-Full and F-Full treatments). The detail of the estimation result can be found in Appendix Table B.8. The percentage written in each region indicates the average percentage in which a given strategy was used by the subjects across the six supergames.

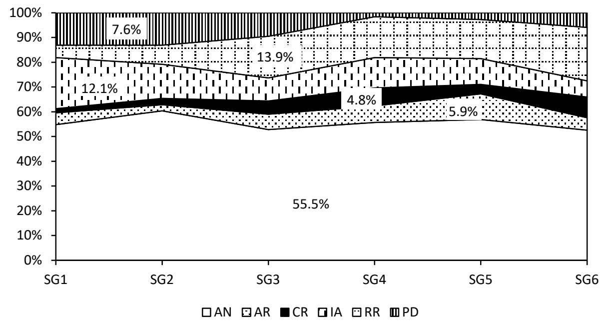
implies that in choosing an action, most of the Reps subjects took reports from all the previous rounds into account rather than focusing on the reports on the partner's decisions in the last round or in the last six rounds. It also indicates that the most frequently used threshold in the Full treatments is 50% (Rep50, i.e., the strategy in which subject cooperates if his/her partner cooperated at least 50% thus far according to the partner's reputation record). While Figure 2.4 and Appendix Table B.8 usefully uncovered the trends of and the across-treatment differences in subjects' strategy choices, some readers may be concerned that the number of observations is smaller if estimations are performed supergame by supergame than otherwise. To supplement these results, additional structural estimations were performed using observations from (a) all the six phases and (b) the second half of the experiments (phases 4 to 6), although a disadvantage here may be that subjects' strategy choices may be noisier considering some subjects changed strategies across the supergames. Appendix Table B.9 summarizes the additional results, showing qualitatively similar patterns to those in Figure 2.4.

The final question that remains unanswered is exactly what motivates subjects to engage in reporting. While we uncovered not only differences in the reporting rate by stage game outcome but also evidence of conditional reporting (Results 3 and 4), the subjects' reporting may be motivated by heterogeneous reasons. As a final analysis, a structural estimation of the subjects' reporting strategy choices was performed using the maximum likelihood method.

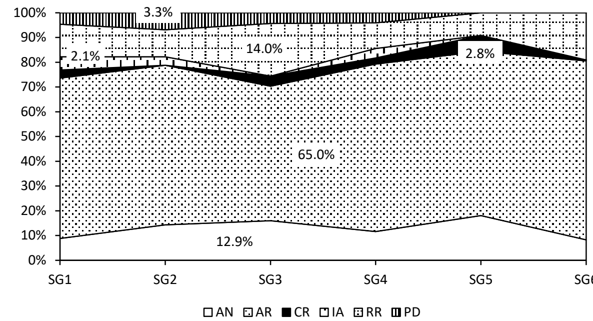
Six reporting strategies were assumed for this estimation. The first strategy is called the "Always Not Report" strategy, shortened as AN. A subject in this category never engages in reporting. The second strategy, called "Always Report" (shortened as AR), is defined literally as the one in which a subject always engages in reporting. These two strategies are similar to the AD and AC strategies in the context of prisoner's dilemma interactions. Considering that subjects' reporting was on average conditional upon others' reporting (Table B.5), the "Conditional Reporting" strategy (shortened as CR) was included as the third strategy. The CR subjects reciprocate others' previous reporting. The specific definition is as follows: a CR subject *i* reports his/her partner in round *t* if *i* received a report in that round in the Min condition; and the subject reports his/her partner if the matched partner was reported at least 50% thus far in the Full condition. A threshold of 50% was set here, as Rep50 was found to be by far the most popular reputation strategy for deciding whether to cooperate (see the discussion above). The CR subject is assumed to engage in reporting in the first round of each supergame.

Three more strategies were further included to capture the possibility that their reporting is driven by other-regarding preferences or emotions. First, the IA (shortened from "Inequity Aversion") strategy is defined as one where subject *i* reports his/her partner only when *i* cooperated but the partner defected in the current interaction (*i* does not report the partner for the other three prisoner's dilemma outcomes). Notice that an inequity-averse cooperator incurs a utility loss when exploited by a defector because of a feeling of disadvantage (Fehr and Schmidt, 1999). Second, a RR (shortened from "Reciprocal Reporting") type *i* reports his/her partner when *i* cooperated, but not when *i* defected. This reporting is driven by reciprocity in the prisoner's dilemma interaction (Rabin, 1993; Dufwenberg and Kirchsteiger, 2004). It is assumed that a reciprocal cooperator engages in reporting when matched with a cooperator (defector) through positive (negative) reciprocity. Third, the PD (shortened from "Punishing Defecting Partner") strategy is defined as one where *i* always reports when matched with a defector due to negative emotions.

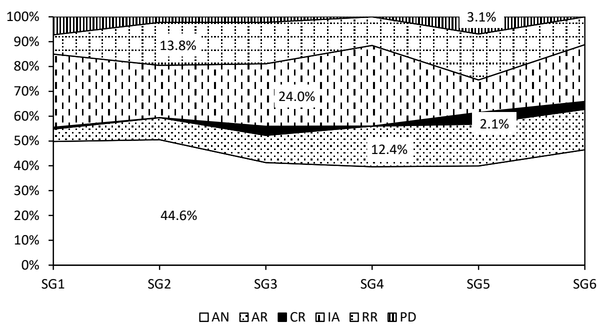
Figure 2.5: *Reporting Strategy Choices, Supergame by Supergame*



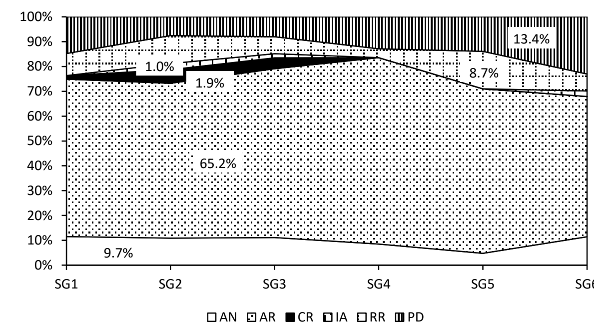
(*i*) C-Min treatment



(*ii*) F-Min treatment



(*iii*) C-Full treatment



(*iv*) F-Full treatment

Notes: The percentage written in each region indicates the average percentage in which a given strategy was used by subjects across the six supergames. The detail of the estimation result can be found in Appendix Table B.10.

Figure 2.5 reports the estimation results. It shows first that the AN strategy was by far the most popular strategy when reporting was costly. The percentages of the AN subjects were huge – 55.5% and 44.6% in the C-Min and C-Full treatments, respectively. By sharp contrast, almost all subjects were estimated to have engaged in (some) reporting when reporting did not involve a cost. The percentage of the AN subjects was estimated only at 12.9% (9.7%) in the F-Min (F-Full) treatment, which is significantly smaller than that in the C-Min (C-Full) treatment (Appendix Table B.10). The difference in the reporting strategy choices between free versus costly reporting suggests a strong discontinuity in people's reporting between zero and positive costs.

Second, more than the majority of subjects acted according to the AR strategy when reporting did not involve costs. This means that most subjects appreciated the beneficial effects of reputational information on cooperation. Interestingly, however, this result is in clear contrast to the costly reporting settings: Unconditional reporting accounted for only 5.9% and 12.4% of the subjects' reporting strategies in the C-Min and C-Full treatments, respectively. It follows that some non-material motives and/or emotions are required to overcome the hurdle of positive reporting costs. Third, consistent with this conjecture, a significantly larger proportion of subjects acted according to the IA strategy under costly reporting than under free reporting (Figure 2.5, Appendix Table B.10). This can be interpreted to mean that cooperators who were averse to disadvantageous inequality were motivated to warn others, to prevent the defecting partners from earning high by exploiting their peers.

Result 6: *(a) The AN strategy was by far the most prevalent strategy when reporting was costly. By contrast, (b) this strategy was rarely selected when reporting did not involve a cost. Instead, around 65% of subjects acted according to the AR strategy in the F-Min and F-Full treatments. (c) Costly reporting was partly driven by cooperators' behindness aversion.*

2.6. Conclusion

This study experimentally investigated how endogenous monitoring through voluntary reporting can improve cooperation among strangers in an indefinitely repeated prisoner's dilemma game. The results first indicated that its effectiveness is affected to a large extent by reporting costs. On the one hand, when reporting did not involve a cost, subjects reported their partners' action choices more than 70% of the time on average, and then achieved strong cooperation norms under random matching. Remarkably, the strong impact of endogenous monitoring did not depend on the availability of a platform whereby all future partners could check the previously reported information.

On the other hand, subjects only occasionally engaged in reporting when it was costly. As a result, costly reporting had almost no effects on boosting cooperation when the reported information was transmitted only to the next-round partners. This result, along with the strong positive effect detected in the F-Min treatment, suggests that a policy that reduces reporting costs (e.g., time and mental energy) may help foster cooperation norms in a community without any mechanism, such as a data-storing platform. In clear contrast, costly reporting had a positive effect when a publicly available platform that stores reputational information was present. The strong interaction effect between costly reporting and the reputational platform can explain why reputation mechanisms in real online markets, such as eBay and Uber, function effectively, despite the possible selection bias of reported information and unwanted side effects embedded in the mechanism (Dellarocas, 2003).

The percentage of the subjects who acted according to their partners' reputations differed according to the information structure. The results of a structural estimation of subjects' strategy choices found that only around 7% to 8% of the subjects acted according to the Reps strategy when the reported information was not stored. In sharp contrast, with the reputational platform [under the Full condition], 29.5% (46.4%) of the subjects were estimated to have acted based on the Reps strategy when reporting was costly (cost-free). Hence, a publicly available reputation platform plays a vital role in encouraging players to use reputational information. Nevertheless, the analysis revealed strong heterogeneity in the subjects' strategy choices, suggesting that care should be exercised when analyzing subjects' cooperation behaviors under endogenous monitoring using theoretical models and simulations.

Although the experimental findings were clear, there are many exciting directions for future research. For instance, it would be meaningful to explore how the results obtained in the experiment are robust to the parameters of the experiment, such as the payoff matrix, continuation probability, group size, size of the reporting cost, and contents/formats of reporting. For example, the continuation probability was set to 95% in this study. The impact of endogenous monitoring may depend on the probability, considering the prior research finding that subjects' decisions to cooperate may be strongly affected by the degree of people's patience (Dal Bó and Fréchette, 2018). Likewise, the functioning of endogenous monitoring may depend on group size because the theoretical literature on repeated games discusses the effects of group size under random matching (Kandori, 1992). Alternatively, both the way players engage in reporting and how they respond to reputational information may differ according to the flexibility of pairing, the content of information (e.g., action choices, feedback comments), and/or the verifiability of the information (trustful or cheap talk). A standard random matching protocol was used for this experiment. Additionally, the subjects could only truthfully report their opponents' action choices. These are good simplifications because the theoretical frameworks are well developed for the setup with the standard random matching protocol and truthful history information (e.g., Kandori, 1992; Ellison, 1994; Camera and Casari, 2009; Takahashi, 2010). Nevertheless, users on real online platforms can choose with whom they deal based on rating scores and (subjective) feedback comments. Such partner choices and detailed communication content may further boost the effectiveness of endogenous monitoring, as shown in the context of auctions (Brosig-Koch and Heinrich, 2018). It is undoubtedly worthwhile exploring the role of endogenous monitoring in depth.

3. Subjective ratings and word-of-mouth feedback: Evidence from experiment and field

3.1. Introduction

Building on the insights from Chapter 2, where we explored the dynamics of cooperation under conditions of cost-free and costly reporting, we now turn our attention to a more nuanced aspect of repeated interactions: the role of subjective reputation systems and word-of-mouth communication. Chapter 2 revealed that the quality of platforms storing reported information influences the efficacy of endogenous monitoring in fostering cooperation norms. With this background, the central focus of Chapter 3 is to delve deeper into the mechanics and implications of reputation systems, particularly those based on subjective ratings and feedback.

Our research interest stems from a noticeable trend across various industries that employ reputation mechanisms to facilitate beneficial interactions. Companies like Boeing, Walmart, and P&G use 'score cards' to assess their suppliers, while online platforms like Amazon, Airbnb, and TripAdvisor feature distinct subjective and objective rating systems. The evolution of such mechanisms, like eBay's transition from subjective to objective ratings, beckons a more thorough investigation into their impact on cooperative behaviour.

Methodologically, we employ experimental setups that extend the repeated Prisoner's Dilemma framework, incorporating both subjective ratings and word-of-mouth communication. The contributions of this chapter are manifold. First, we elucidate how subjective reputation systems may facilitate higher levels of cooperation compared to objective ones, thereby offering a different angle to the findings of Chapter 2. Second, we explore the incremental effect of adding written feedback to ratings, assessing its capability to further elevate cooperation levels.

The rest of this chapter proceeds as follows: Section 3.2 discusses related literature, Section 3.3 discusses a piece of field data and sets out a hypothesis, Section 3.4 discusses the experimental design, Section 3.5 reports the experiment results. Section 2.6 provides concluding remarks.

3.2. Related literature

Many business and private transactions nowadays involve repeated interactions with the same or varying similar agents. Therefore, there is certainly merit in tailoring the reputation system to an underlying platform: reporting that works well for one-time purchases might not work for repeated service. For example, in one-time transactions, such as an Airbnb apartment rental, the buyer may be more interested in knowing if the property's features matched the advert. In contrast, for recurring services such as subscription food delivery, subjective metrics such as trustworthiness may be more important. There have been successful attempts to study how the reputation mechanism works for a particular trading platform. For example, see Bolton and Ben Greiner (2013) and Nosko and Tadelis (2015) for eBay, and Fradkin et al. (2018) for Airbnb.

This chapter contributes to the literature on reputation in repeated games. Camera and Casari (2009), Duffy and Ochs (2009), and Kamei (2017) vary the availability of information about their counterpart's past play in the repeated Prisoner's dilemma setup. Stahl (2013) explores reputation in a repeated prisoner's dilemma using colour-coded labels. The label alternates between green and purple as a function of past behaviour, signalling one's reputation. As a result, cooperators had the incentive to maintain their good reputations by continuing to cooperate, while defectors had the incentive to improve their bad reputations by cooperating as well. This finding is consistent with other work on reputation formation in social networks (e.g., Bala and Goyal, 2000; Kranton and Minehart, 2001; Jackson and Watts, 2002). One potential limitation of Stahl's study is that it only considers one particular type of repeated prisoners' dilemma game: one-shot games with random matching and no information about opponents except for their past behaviour (as reflected in subjective ratings). It is possible that different types of games would yield different results. For example, Sanfey et al. (2003) found that people are more likely to use indirect reciprocity (i.e., punish uncooperative behaviour even when they are not personally harmed by it) when playing against known opponents than when playing against strangers. It remains an open question whether similar results would be obtained in a game like the one studied by Stahl (2013).

Reputation was also studied in other types of games, such as Trust game (Duffy et al., 2013), Online Trading Markets (Bolton et al. (2004, 2005); Bolton and Ben Greiner, 2013), and Public Goods games (Kamei and Putterman, 2017). However, most of the abovementioned studies, except Bolton and Ben Greiner (2013), used reputation mechanisms based on objective information about the past actions of one's counterpart. This study, in contrast, considers a subjective reputation system.

Another interesting avenue in the literature focuses on the interpretation of subjective ratings. One drawback of subjective ratings is that they can be interpreted differently by different people. Greiff and Paetzel (2016) had players evaluate their partners subjectively using ratings of 0 to 10 stars. The game was a two-player public goods game, with four outcomes of possible contributions {0,1,2,3}, leaving few possibilities to link rating to a contribution rate. They find that information about partners alone is insufficient to raise contributions. Instead, contribution rises only when participants observe their own evaluations. They also find that when participants have to form first- and second-order beliefs about others in a reputation system, they are more likely to use heuristic cues (e.g., the number of previous evaluations) rather than thoughtful deliberation. This finding has implications for the design of reputation systems, as it suggests that heuristic cues may play a more prominent role in these systems than previously thought.

Finally, the complexity of written reviews in reputation systems should not be overlooked. Written review (i.e. word-of-mouth communication) may limit the impact of this problem. The issue arises, however, that textual information is generally more complex to process than numerical information. This is because our brains are wired to more quickly process numbers and patterns. As a result, customers can simply give a product or service a quick rating without having to write out a lengthy review. This makes it much more convenient for customers, who are often busy and do not have time to write a detailed review.

Another seminal paper that deals with both objective to subjective information is the one by Honhon and Hyndman (2020). That paper examines how three different matching institutions (random, fixed, and flexible) affect cooperation in a repeated prisoner’s dilemma. As intuitively expected, cooperation rates were lowest under random matching, highest under fixed matching, and intermediate in the flexible matching institution. Additionally, the presence of a reputation mechanism had an impact on cooperation. Authors utilised subjective (based on subjects’ ratings) and objective (based on subjects’ actions) reputation mechanisms, finding both led to increases in cooperative behaviour. However, only the subjective reputation mechanism notably led to higher cooperation rates when using fixed matching. The authors suggest this is due to certain reputation mechanisms being more forgiving of early deviations from cooperation depending on which type of matching institution is used - allowing participants to learn the value of cooperating rather than getting stuck with a bad reputation and uncooperative relationships.

3.3. Subjective ratings on Amazon

Amazon is an e-commerce platform where people can buy products online. It provides convenient access to large amounts of information and allows customers to interact by leaving reviews, making it an ideal choice for studying user behaviour in relation to reputation systems. We leveraged Amazon's dataset of customer reviews to derive meaningful insights into how interactions are subjectively rated. This provided a valuable foundation for the subsequent lab experiment.

3.3.1. Pokémon collectible cards

Pokémon collectible cards are trading cards featuring characters from the popular Pokémon video game and television series. The first set of these cards was released in 1996 and since then, many more have been produced. Collectors enjoy buying, selling, and trading them with other collectors to build their own collections. Booster packs are special packages that contain additional randomised Pokémon cards for people to add to their collections. These usually come in sets of 10 or 11 cards which often include rarer or harder-to-find types of Pokémon creatures (e.g. see Adinolf and Turkay (2011) for more context).

One issue in the trading card industry is "pack searching" - when individuals open packs to look for valuable cards, reseal them, and then offer them to unsuspecting buyers who believe they have a chance of getting a rare item. Another issue is card counterfeiting. Two similar phenomena are also observed in collectible sportscard market (O'Brien, Gramling, and Rodriguez, 1995). To protect themselves from a dishonest seller, buyers could research subjective feedback, stars and reviews, left for the seller in question. Consequently, Amazon feedback system plays an integral role in providing such information. Analysis of customer reviews left following purchases can help us draw parallels to the laboratory results. Furthermore, comparison between results obtained through examining user behaviour on Amazon and our laboratory experiment enable us increase external validity by demonstrating that similar patterns exist across different contexts.

Webscraping technology has become increasingly popular over recent years due its ability to provide rapid access to vast amounts data from various sources. For this project we utilized Python programming language[12] along with 'BeautifulSoup'[13] and 'Scrapy'[14] packages as our

[12] Documentation available at: https://www.python.org/
[13] Documentation available at: https://beautiful-soup-4.readthedocs.io/en/latest/
[14] Documentation available at: https://docs.scrapy.org/en/latest/

main scraping tool. The algorithm searches through HTML documents located at specific URLs provided by Amazon website and extracts relevant data regarding customer feedback left after purchasing Pokémon cards and booster packs. Once all required information is gathered into single file, it undergoes further cleaning process aimed at removing irrelevant entries associated with non-related items or duplicate values if any occurred during extraction process. After completing these steps detailed dataset consisting only of relevant records is ready for subsequent analysis. Book by Mitchell (2018) goes over the technicalities of the process in detail.

We have collected 14,649 ratings and feedbacks from 520 items on the market in the United Kingdom, being Pokémon collectible cards or booster packs. We note three interesting patterns. Firstly, there is a moderate positive relationship between price and number of reviews, with a Pearson correlation coefficient of 0.2686 (significant at 1%). This suggests that higher priced items tend to have more reviews, although the effect is relatively small. It is possible that this could be due to buyers being willing to spend more money on an item when they are more confident in its quality based on other reviews, or because sellers set higher prices for items which already have many reviews.

Secondly, which rating scores are associated with higher price? Most booster packs offer similar chances to get a rare item, and face value of a standalone collectible card is open information. Genuineness and trustworthiness of the buyer is usually the main concern. One would naturally expect items with high fraction of 5-star ratings to be pricier. We regress item price on variables corresponding to percentage fractions of 5 respective ratings.

Table 3.1: *Price and rating association (field data)*

Dependent variable: Item price, pound sterling

Fraction of 5-star ratings, %	0.439*** (.050)
Fraction of 4-star ratings, %	-0.145 (.264)
Fraction of 3-star ratings, %	0.419* (.216)
Fraction of 2-star ratings, %	0.237 (.218)
Fraction of 1-star ratings, %	0.433** (.244)

# of Observations	470
F-statistic	58.27
Prob > F-statistic	.0000

Notes: Some observations were dropped from initial 520 due to having zero rating scores. We additionally control for number of rating scores. Standard errors in parentheses. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

The results in Table 3.1 indicate that the price of an item is significantly associated with the percentage of 5-star reviews it receives. Specifically, for every 1% increase in five-star reviews, we see a 44-pence increase in price. Surprisingly, there was no significant association between either 4-star, 3-star or 2-star reviews and item prices. Additionally, there appears to be a weak positive 1-star review percentages and prices. Overall, these findings suggest that buyers may be willing to pay more for items that have higher ratings from other customers.

Does existing information help create new information? We note negative relationship between the number of existing reviews and a pace at which new reviews are added. For instance, items with greater than 50 ratings receive, on average, 0.142 new rating scores per day whereas items with less than 50 ratings receive, on average, 0.441 new rating scores per day. This suggests that people may be less likely to leave a review when they observe that many other people have already reviewed the item in question.

In line with the discussed in Section 1.4 and Appendix A.2, supplemented by the Amazon data discussed here, we formulate Hypothesis 4:

Hypothesis 4: *Cooperation can be sustained at a higher level with than without subjective reputational information.*

3.4. Experimental design

This study builds upon the design of Chapter 2, adding using an infinitely repeated prisoner's dilemma game with a random termination rule. A multiple-stage design was adopted (e.g., Dal Bó and Fréchette, 2018; Gill and Rosokha 2020, Cooper and Kagel, 2022) to allow subjects to learn and adopt strategies, with subjects playing up to 6 supergames. A 'supergame' constitutes one game of indefinitely repeated prisoner's dilemma with random matching, where the next period has a 90% probability of happening. 'Supergame' was called 'phase' in the instructions for participants; further in this text 'phase' and 'supergame' are interchangeable. In this experiment, eight out of nine sessions went through all of six phases, with one session terminating prematurely due to a computer error. Subjects were randomly assigned to the groups of 6 at the beginning of each supergame, and groups retained their composition for the duration of the supergame. The group size of six is larger than that of Camera and Casari (2009) and Kamei (2017), but smaller than that used in Chapter 2, and it merely has to do with funding limitations. The transition matrix and equilibrium conditions are discussed briefly in Section 1.4 and then in more detail in Appendix A2.

During every period of play, each subject is randomly paired with another member of their group and interacts. Then move on to the next period, where they are again randomly paired with another group member. Since the group size is six, the probability that a subject will interact with a specific group member in a period is one-fifth. Subjects do not interact with those outside their group in a given phase. At the beginning of the new phase, groups get reshuffled. Subjects' interactions are anonymous in the sense that they do not know their partners' IDs. Neither their decisions nor their interaction outcomes in the past affect the matching process. The duration of each phase is not pre-determined: subjects' interactions in a given phase will continue with a probability of 90%. Namely, an integer between 1 and 100 is randomly drawn at the end of each period. If it is less than (greater than or equal to) 91, subjects will play (will not play) the next round. Therefore, the expected length of each phase is ten (= 1/(1−.90)) periods. The payoff matrix of the stage game is shown in Figure 3.1. The same matrix was used in studies featuring groups of four (Camera and Casari, 2009; Kamei, 2017) and was used in groups of eight in the previous chapter.

Figure 3.1: *Payoff Matrix of the Stage Game*

		Player 2	
		cooperate (Y)	defect (Z)
Player 1	cooperate (Y)	25, 25	5, 30
	defect (Z)	30, 5	10,10

Once the phase is over, groups are reassigned. Group assignment adheres to the conventional random matching protocol for the new phase. Subjects are randomly assigned to a new group of six in the following phase. Additionally, subjects are assigned new IDs. No information from a given phase is carried over to a future phase. Please refer to the screenshots in Appendix C for reference.

3.4.1. The Treatments

This experiment consists of three treatments. The treatment with no information is a 'Control' treatment, subjects play the aforementioned interactions without any information revelation, subject to the random termination rule. In each round, subjects only know that they are randomly matched with one of the five members in their groups. The other two treatments, dubbed '*Rating'* and '*Rating + Feedback*' (dubbed 'Feedback' treatment for short henceforth) allow subjects to express their attitude towards the action choice of their partner (cooperation or defection).

Control Treatment: Subjects play the game without any information revelation. They only know they are randomly matched with one of the five members in their groups. There is no way for subjects to express their attitudes towards their partners' actions (cooperation or defection).

Rating Treatment: In this treatment, subjects can express their attitude towards their partner's action (cooperation or defection) through ratings (on a scale of 1 to 5 stars). However, the specific action choice (cooperation or defection) is not explicitly revealed. There is no option to leave a textual review.

Rating + Feedback Treatment (Feedback for short): Similar to the Rating Treatment, subjects can express their attitude through ratings. In addition, they can also provide written feedback. The action choice is not automatically revealed but can be included in the text body of the review.

Further, that information is available to that person's future partner(s). In the aftermath of the experiment, we discovered that only 71,2% of reviews (948 out of 1,322) did mention the action choice (Y or Z). Unlike the study in Chapter 2, the design here leaves room for untruthful reports. Some studies, however, for example, Fonseca and Peters (2018), examining the Trust game, found that even without any material incentives, most trustors reported truthful information about their matched trustees as gossip in a trust game when their messages did not need to be objective. We further saw that in 100% of cases where the review explicitly stated a player chose Z, the action for that player in that period was indeed a defection.

3.4.2. Experimental Procedure

The experiment was conducted with students who were recruited by solicitation messages sent through *hroot* (Bock et al., 2014). No communication was allowed among the subjects after they entered the laboratory and before the experiment ended. A total of 150 students across nine sessions took part, and the experiment took place in a computer laboratory at the University of Durham in the United Kingdom from December 2020 through November 2021 (Table 3.2). The experiment was programmed using the *zTree-software* (Fischbacher, 2007). Only neutrally framed words were used in the instructions, any behaviour-implying words, such as cooperate and defect, were avoided. A similar block design feature as in Chapter 2 was utilized in this experiment.

Table 3.2: *Summary of Treatments*

Treatment	Available information on round *t* partner before choosing an action in round *t*	# of subjects (sessions)	# of obs.	Avg. SG length [rounds]
Control	n.a.	54 (3)	4,374	13.50
Rating	Subjective rating scores	48 (3)	3,900	13.33
Feedback	Subjective rating scores and written feedback	48 (3)	4,140	14.44
Total		150 (9)	12,414	13.76

Notes: Detailed information on round realisations is presented in the Appendix Table B.11

The instructions were read aloud by the researcher. Subjects were also asked to answer a few control questions to check their understanding of the experiment at the start of each session. No subjects participated in more than one session. Subjects additionally received £3 as a show-up fee. To verify that subjects are familiar with 5-star rating systems, questions were asked on whether participants have used such systems on popular online platforms, with 100% indicating using it at least once.

3.5. Results from the Laboratory Experiment

This part is organized as follows. Section 3.5.1. provides an overview of subjects' cooperation rates and the effects of group monitoring. Section 3.5.2 examines subjects' reporting behaviours, while Section 3.5.3 discusses the similarity of rating tendencies between the lab and the field. Finally, Section 3.5.4 concludes with a strategy estimation.

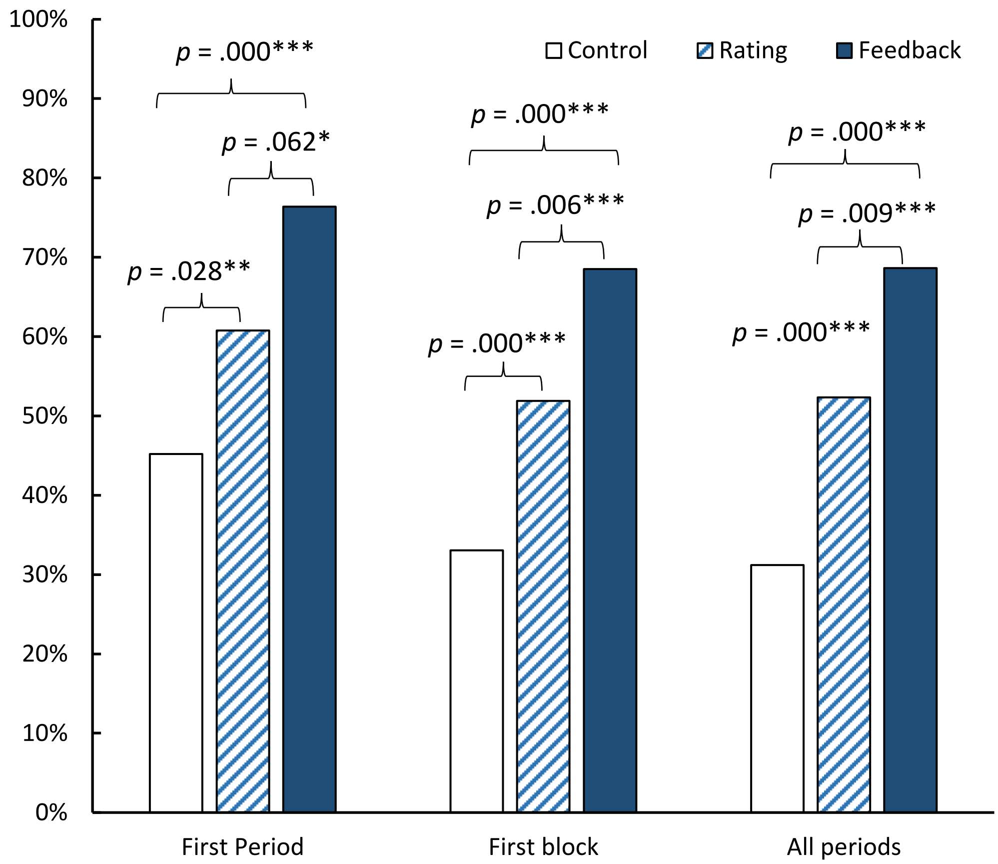
3.5.1. Cooperation insights

Figure 3.2 below provides a first insight into reviews' effects on cooperation. Average cooperation rates were calculated based on data from the first period, the first block in the phase, and all phases. The random termination rule was adopted in this study as explained in Section 2.2.3 (e.g. Dal Bó and Fréchette, 2018), which is similar to the one used in the experiment of Chapter 2. Data is balanced across the treatments if observations in the first round or from the first block are used since subjects in all the treatments went through the first ten rounds of each supergame thanks to the block design.

We observe several tendencies. First, when leaving any kind of feedback was impossible, cooperation rates were relatively low (Figure 3.2). Considering data from all periods, the first block and first period, the average cooperation rates in the Control treatment were, respectively, 31.2%, 33.1%, and 45.2%. Subjects appear to be strategically navigating their first moves in the supergame, possibly to cultivate a positive reputation. Greater cooperation rates in the first period are in line with findings of previous studies (e.g. Dal Bó and Fréchette, 2018; Honhon and Hyndman, 2020) and with the result discussed in Chapter 2, suggesting subjects employ strategies starting with cooperation or opt for cooperation when no previous period information is present. Despite the continuation probability of 90%, 15 out of 53 (28%) phases lasted more than one block; hence it is viable to present 'all data' and 'first block only' separately. We do note, however, that 'all data' and 'first block only' do have relatively similar levels for Control, Rating and feedback (31.2%/33.1%; 51.9%/52.4%; 68.5%/68.6%). This suggests that the dynamics of community cooperation swiftly settled into some predictable patterns throughout a phase. Second, it is essential to consider the substance of the reported information: whether it was only a star rating (Rating treatment) or both a star rating and verbal feedback (Feedback treatment). There is a significantly positive impact of the rating information. Consider Control vs Rating treatments. Period 1 cooperation rates are 45.2% vs 60.8%, showing that at the very onset of the supergame, larger portion of subjects chooses to start with cooperation without having observed the behaviour of those others in the group. We observe that the average cooperation rate is significantly higher in Rating or Feedback treatments than in the Control treatment (60.8% vs 45.2% and 68.6% vs 33.1%, respectively). This finding is expected, since previous studies have shown that providing feedback to players can foster cooperation (e.g Dal Bó and Fréchette, 2018; Honhon and Hyndman, 2020). Furthermore, we also see a significant difference between the Rating and Feedback treatments; with an average cooperation rate of 68.5% when both star rating and verbal feedback was provided compared to 51.9% when only a star rating was present. This suggests that subjects were more likely to cooperate when their behaviour received a verbose judgement rather than just an abstract score on an unspecified scale which may be due to aversion against getting negative comments from peers about one's own actions.

Result 3.1: *(a) Providing feedback to players fosters cooperation, with significantly higher cooperation rates in Rating or Feedback treatments than the Control treatment. (b) Additionally, a significant difference between the Rating and Feedback treatments implies that subjects are more likely to cooperate when their behaviour receives verbose judgement rather than just an abstract score.*

Figure 3.2: *Average Cooperation Rate by Treatment*

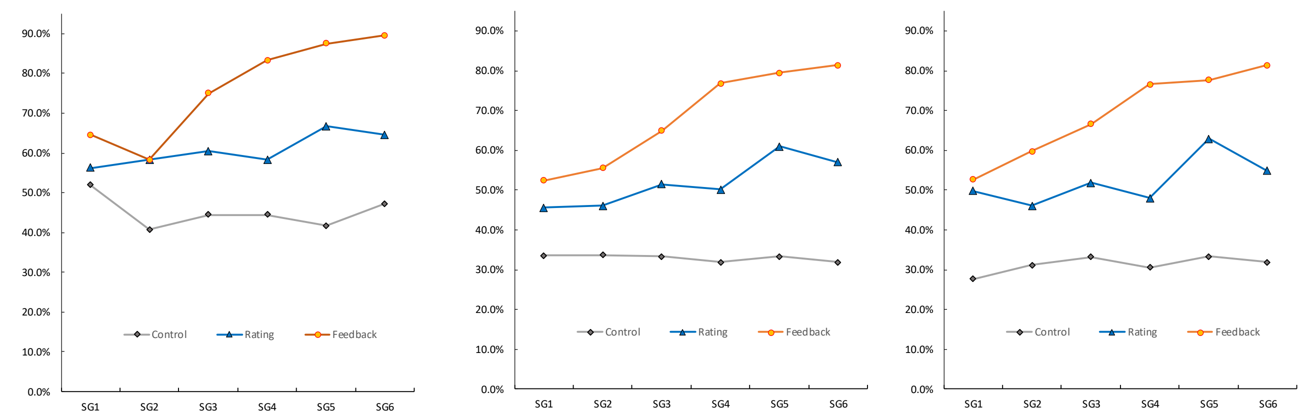


Notes: p-values (two-sided) were calculated based on subject random effects probit regressions with robust standard errors bootstrapped and clustered at the subject level (300 replications). "First block" refers to the first ten rounds of supergames. In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, while having a dummy equal to 1 for the first supergame (which makes it possible to control for cooperation behaviours without prior experience). *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

The supergame dynamics across the session provide further insights into the effects of feedback on cooperation. For example, in the Control treatment, we observe that the average cooperation rate remains relatively flat at around 30% for all periods and first block data (Figure 3.3). This suggests that once players are familiar with their environment and others' behaviour, they adjust their strategies and maintain a similar level of cooperation throughout the supergames played within a phase. In contrast, when rating information is present, we see a slight upward trend over time in both 'all periods' and 'first period only' data from the Rating treatment. However, this upward trend stops in the 6th supergame as subjects realize the game will not continue beyond this point, resulting in a drop in overall cooperation levels during the last supergame (58.6%). Finally, Feedback treatment shows an even more pronounced upwards trend; both 'all periods' and 'first period only' show high levels of consistent increase in Cooperation rates over time, indicating that subjects had learned to cooperate based on verbal feedback provided by peers between rounds leading up to a high level of cooperation by the end of the session. The lack of drop in the last supergame may indicate that aversion to verbose judgement is still strong.

Result 3.2: *Unlike Control, both Rating and Feedback treatments showed an upwards trend in cooperation rates over time, with Feedback resulting in the highest levels of cooperation by the end of the session.*

Figure 3.3: *Average Cooperation Rate, Supergame by Supergame*



(*i*) Round 1 (*ii*) First block (*iii*) All rounds

It is interesting to explore if group compositions matter, e.g. if certain 'groups' cooperate more than others. We employed a Mixed-Effects Linear Model to investigate the role of group dynamics in cooperative behaviour. This approach allows us to account for both individual and session-level variability. The results are presented in Table 3.3.

Table 3.3: *Mixed-Effects Model Coefficients for Group-Level Cooperation*

Dependent variable: a dummy that equals 1 (0) if subject *i* chose to cooperate (defect) in round *t*. Reported values are β values from the Group variable in the model equation

	Group 1	Group 2	Group 3
Control	0.235***	0.031	0.058***
Rating	0.472 ***	0.021	-0.013
Feedback	0.794 ***	-0.067***	-0.087***
Number of Observations:	4140		

Notes: Mixed-Effects Linear Models with both subject and session random effects were employed. The models were estimated using REML and converged, although Treatment 3 triggered a convergence warning. The analysis includes all observations except those with missing values in specific variables. The reference group for all treatments is Group 1. The Phase variable was included to account for within-session temporal effects on cooperation.

*, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

- Control: A statistically significant difference in cooperative behaviour is observed between Group 3 and Group 1. Specifically, Group 3 exhibits higher cooperation (coef. β = 0.058, $p < 0.01$).
- Rating: No significant difference in cooperation across groups.
- Feedback: Both Group 2 and Group 3 tend to be less cooperative than Group 1 (coef. β = -0.067 and β = -0.087 respectively, $p < 0.01$)

The most clustered cooperative behaviour is noted in Treatment 3, where verbal feedback was allowed. This could indicate that the potential for nuanced communication and reputational concerns may foster cooperation, although this remains speculative.

3.5.2. Rating insights

Table 3.4 breaks down reporting rates by treatment condition. Across the length of the six supergames, subjects had similar patterns regarding engaging in reporting. It suggests that the option to leave word-of-mouth feedback in addition to the rating did not impact their decision to pay for reporting. Such a finding may cast doubt on the necessity of maintaining and storing word-of-mouth information on online platforms, however, recall that cooperation was sustained at a significantly higher level. It is notable, however, that Round 1 results do show subjects are more engaged with writing feedbacks a bit more than merely leaving ratings. Since Round 1 analysis includes the opening round of every supergame, that cannot be explained by only the subjects' initial curiosity. That brings up the question of the evolution of reporting rates. It appears subjects' engagement with reporting dropped rapidly within a single supergame but was reignited at the start of a new supergame. One possibility could be that subjects were unsatisfied with the quality or quantity of accumulated information in the group and had hoped for a different picture in the new group. Notably, such enthusiasm did not decrease across supergames. We also note such behaviour starts from supergame two onwards. Effects of supergame commencement were not observed in Chapter 2, neither in Free nor Costly treatments.

Result 3.3: *The option to leave word-of-mouth feedback in addition to rating did not significantly impact subjects' decision to pay for reporting, but engagement with reporting was reignited at the start of new supergames.*

Table 3.4: *Average Rating Rates by Treatment*

	Data used for calculations								
	Round 1			First block			All rounds		
Reporting type:	Rating		Feedback	Rating		Feedback	Rating		Feedback
All Supergames	**53.5%**	**<****	**64.6%**	**33.7%**	**=**	**35.3%**	**33.3%**	**=**	**33.2%**
Supergame 1	33.3%		35.4%	34.4%		38.5%	37.5%		39.5%
Supergame 2	54.2%		68.8%	35.4%		40.6%	35.4%		37.6%
Supergame 3	56.3%		75.0%	34.2%		43.5%	32.6%		37.2%
Supergame 4	58.3%		66.7%	36.7%		36.3%	33.3%		32.6%
Supergame 5	60.4%		77.1%	32.9%		27.9%	33.3%		25.3%
Supergame 6	58.3%		64.6%	28.8%		24.8%	26.2%		24.8%

Notes: Each treatment comparison was made based on a subject random effects probit regression with robust bootstrapped standard errors (300 replications), while having a treatment dummy as an independent variable. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

Now let us discuss the influence of reputational information on action choices in the rating and feedback treatments. Results from a subject-level random effects probit regression show (Table 3.5) that partners' average ratings have a significant impact on cooperation choices for both treatments. This suggests that subjects take into account their partner's reputational information before deciding whether to cooperate or defect, more so when they can access additional word-of-mouth feedback compared to just ratings.

Table 3.5: *Reputational Information and Action Choices*

Dependent variable: a dummy that equals 1 (0) if subject *i* chose to cooperate (defect) in round *t*.

	Treatment	
	Rating	Feedback
Partners average rating [0;5]	.102*** (.013)	.092*** (.015)
First supergame dummy {= 0 for the first supergame; 1 otherwise}	.005 (.029)	.174*** (.030)
Perceived supergame length	.005*** (.001)	-.000 (.001)
Constant	-1.212*** (.157)	-1.09*** (.220)
# of Observations	3,257	3,562
Wald chi-squared	87.30	82.00
Prob > Wald chi-squared	.0000	.0000

Notes: Subject random effects probit regressions with robust bootstrapped standard errors (300 replications). Marginal effects are reported on coefficients, aside from the constant. All observations except the ones in round 1 (no reputation) were used. 'Perceived supergame length' is 10 in the first supergame, otherwise – previous supergame length. The first supergame dummy was included to control for cooperation behaviors without any experience.

*, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

The analysis reveals that average rating is a strong predictor of cooperation: each unit of average rating on i raises the probability that i's partner will cooperate in round t by 10.2% for Rating treatment and 9.2% for Feedback treatment. The results also suggest that participants were more likely to cooperate at the beginning of each supergame as indicated by a positive coefficient associated with first supergame dummy in the feedback treatment (0.174). This may be due to subjects' initial curiosity which led them to be more cooperative in order to build trust among themselves quickly before engaging in further rounds of interaction within those groups. Additionally, perceived supergame length was found to positively correlate with cooperation decisions in both treatments suggesting that longer perceived game lengths slightly increased cooperation rates overall (.005).

Result 3.4: *Average rating is a strong predictor of cooperation and both ratings and word-of-mouth feedback increase the likelihood of cooperative behaviour within our experimental setup.*

Let us look more into subjects' reporting by stage game outcome. The results (Table 3.6) suggest that cooperators were more likely to report in general compared to defectors regardless of treatment condition (Rating or Feedback). Cooperator-defector reporting was the most common type, similar to our findings in 2.4.2. This was especially evident in the Feedback treatment, where participants had to provide additional comments about another subject. Here we also have to consider that, despite the same reporting cost, reporting in Feedback treatment required more typing effort from subjects compared to Rating. The vast majority of subjects left non-empty reports, despite it being an option. On the other hand, defectors maintained low rates of overall reporting behaviour, both at the beginning and the end of the game.

Table 3.6: *Average Reporting Rates by Stage Game Outcome*

(*i*) Rating treatment

	Data used for calculations								
	Round 1			First block			All rounds		
decision-maker: / partner:	cooperator		defector	cooperator		defector	cooperator		defector
cooperator	76.7%	>***	27.1%	42.9%	>***	28.6%	42.1%	>***	26.7%
	=		∨**	∧**		∨***	=		∨***
defector	69.5%	>**	14.8%	52.6%	>***	16.1%	54.0%	>***	15.4%

(*ii*) Feedback treatment

	Data used for calculations								
	Round 1			First block			All rounds		
decision-maker: / partner:	cooperator		defector	cooperator		defector	cooperator		defector
cooperator	70.3%	>**	39.6%	32.2%	>***	36.4%	29.9%	>***	36.5%
	=		=	∨**		∨*	∨***		=
defector	83.3%	=	30.0%	63.9%	>***	25.5%	62.3%	>***	23.4%

Notes: Each treatment comparison was made based on a subject random effects probit regression with robust bootstrapped standard errors (300 replications), while having a treatment dummy as the independent variable. In the regressions, the length of previous supergame was controlled as an independent variable for observations after the first supergame while having a dummy which equals 1 for the first supergame.
*, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

It revealed an interesting finding when it came to cooperator-cooperator interactions: these resulted in higher reporting rates during earlier rounds of play. This may be due to the fact that participants repeated interactions with high probability (90%), thereby making reports about Cooperative behaviour potentially helpful for maintaining cooperation norms among members within communities over time.

One may wonder how subjects' decision to report was affected by existing level of information. In this study subjects' rating decisions are significantly positively correlated with the quantity of their observed information (Table 3.7), even more so in Feedback treatment. In the Feedback treatment, a 10% increase in a subject i's quantity of reported information raises the likelihood that her current-round partner reports i by around 1.4 percentage points, while in the Rating treatment the raise was 0.2 percentage points.

Result 3.5: *(a) Cooperators were more likely than defectors to engage in reporting under both treatment conditions. (b) Cooperator-defector reporting was more common than in any other pair. (c) Cooperator-cooperator reporting was more frequently observed compared with both findings of Chapter 2 and the literature (e.g. Kamei and Putterman (2018)).*

Table 3.7: *Partial Correlations between Observed number of Ratings and Decision to Rate*

	Rating	Feedback
Pairwise correlation between *i*'s decision to report in round *t* {=1 if they rated their partner, 0 otherwise} and the quantity of *i*'s round *t* partner *j*'s reputation {the % of rounds in a given supergame where *j* was rated so far}	.0260	.1368
Two-sided *p*-value	.075*	<.001***

Notes: The two-sided *p*-value in each column was calculated based on a subject random effects probit regression with robust bootstrapped standard errors (300 replications) in which the dependent variable is *i*'s decision to rate in round *t*. A dummy that indicates whether *i* received a report for her round *t* partner's last-round action was included as an independent variable. Further, the cooperator-cooperator reporting dummy, the cooperator-defector reporting dummy and the defector-cooperator reporting dummy (the reference group was the defector-defector outcome) were included as controls. These three dummies indicate subjects' stage game outcomes in the current round. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

3.5.2. Insights on the star choices: Lab and field

We compared the frequency of star ratings in a laboratory experiment, where subjects rated their partners after playing the stage game, to the frequency of star ratings on Amazon for a particular item – Pokemon Cards (see Section 3.3). The distribution of ratings across all interactions in both the laboratory and field settings shows a striking similarity, with mean 3.468 (3.401), and standard deviation of 1.807 (1.801) for lab (field) data (Table 3.8). In line with previously discussed result, we observe 91% of cooperator-cooperator interactions receiving 5 stars and 84.1% of cooperator-defector interactions receiving 1 star.

Table 3.8: *Distribution of star ratings*

	Laboratory n = 2671					**Field** n = 14615
Stars	Cooperator-Cooperator	Cooperator-Defector	Defector-Cooperator	Defector-Defector	**All data**	
1	7 (0.54%)	550 (84.1%)	43 (12.22%)	235 (62.5%)	835 (31.26%)	4572 (31.28%)
2	2 (0.16%)	31 (4.74%)	20 (5.68%)	46 (12.23%)	99 (3.71%)	717 (4.91%)
3	16 (1.24%)	29 (4.43%)	34 (9.66%)	65 (17.29%)	144 (5.39%)	885 (6.06%)
4	91 (7.06%)	11 (1.68%)	48 (13.64%)	17 (4.52%)	167 (6.25%)	1180 (8.07%)
5	1173 (91%)	33 (5.05%)	207 (58.81%)	13 (3.46%)	1426(53.39%)	7261 (49.68%)
Non-focal choices	109 (8.46%)	71 (10.85%)	102 (28.98%)	128 (34.4%)		
Mean (all ratings)					**3.468**	**3.401**
St. dev (all ratings)					**1.807**	**1.801**

Additionally, defector-defector interaction ratings were found to be more noisy than the other three cases, which could suggest that participants had a tendency to avoid using extreme values when rating their partner's performance. This indicates that participants may have been trying to use the rating system as an indicator of quality or satisfaction with their partner's behavior rather than simply labeling it as either “positive” or “negative.” Furthermore, cooperators tended to adhere more strictly to the focal ratings, while defectors had higher variability in their rating choices including selecting 3 stars for 17.29% of defector-defector interactions despite only two outcomes being available for them in the stage game. This suggests that participants may have interpreted success differently depending on whether they interacted

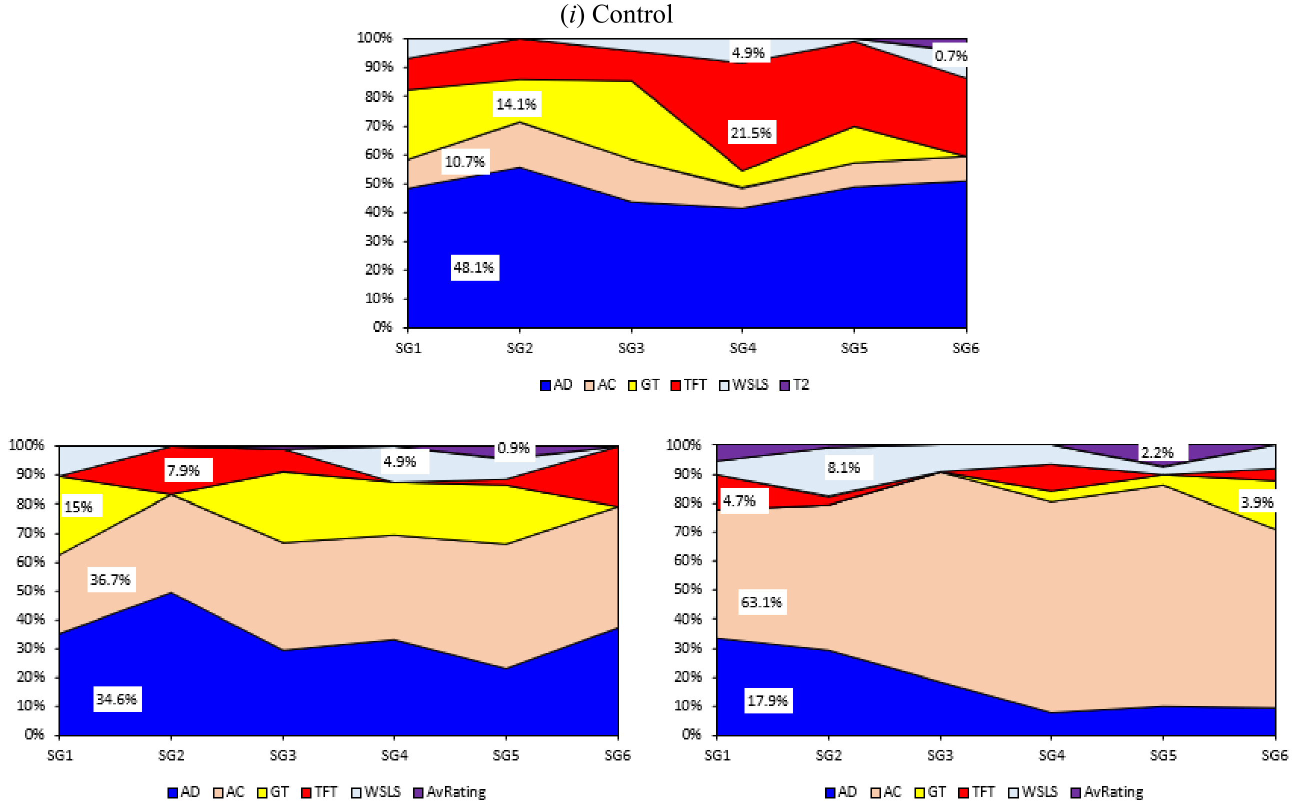
with another cooperator or defector during each round and highlights potential biases when it comes to interpreting one's own behavior and experience within such contexts. This result is however consistent with some research suggesting people tend to avoid extreme values when rating. For instance, psychology literature finds reviews closer to the average may be considered more helpful by than those exhibiting extremes of opinion pole (Jiang, Gretzel and Law, 2010).
Result 3.6: *The rating distribution is consistent across the lab and the field, both with respect to central tendencies and the U-shaped distribution, where the extremes are anchored to either one-star or five-star ratings.*

3.5.4. Structural Estimation of Subjects' Strategy Choices

We approach a similar structural estimation in the spirit of Section 2.5.3. The similar set of strategies assumed in Dal Bó and Frechétte (2011) was used for the Control treatment (see panel *i* of Figure 3.4): AD ("Always Defect"), AC ("Always Cooperate"), GT ("Grim Trigger"), TFT ("Tit For Tat"), WSLS ("Win Stay Loose Shift"), and T2 ("Trigger Strategy with 2 Periods of Punishment").[15,16] The result, in line with findings in 2.4.4 shows that 69.6% of the subjects' strategy choices were explained by the same two strategies – the AD and TFT strategies.

Figure 3.4: *Strategy Choices Regarding Cooperation by Supergame*

(*i*) Control



(*ii*) Rating (*iii*) Feedback

Note: The percentage written in each region indicates the average percentage in which a given strategy was used by subjects across the six supergames.

Considering the treatments with reputational information, a new strategy was added based on Average Rating (labelled the "AvRating" strategy). It can be defined as follows: the subject is assumed to select cooperation (defection) in round t if her matched partner j has an average rating

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[15] A GT subject selects defection in all future rounds as soon as she experiences defection.

[16] The GT, TFT, WSLS, and T2 subjects are assumed to select cooperation in the first round of a given supergame.

of at least 3.0 (less than 50%) in his observable reputational record. Counterintuitively we find the newly added strategy to account for far too little of the subjects' choices. At the same time, we see a substantial increase in an unconditional cooperative AC strategy. This likely is linked to the overall high cooperation rate in reputational treatments. Addtitonally, this tiny fraction of the AvRating strategy may be due to subjects' aversion to the possibility of getting a bad reputation and, as such, the urge to cooperate often. This could be explained by the fact that cooperation with low-rated partners carries reputational risks for the subject regarding future interactions. Therefore, even if other strategies might appear more beneficial at first glance, subjects tend to opt for cooperation when facing low-rated partners to avoid potential reputational damage.

Result 3.7: *(a) 69.6% of subjects' strategy choices were explained by the AD and TFT strategies in the N treatment. (b) The percentages of the AD subjects were much lower with reputational information, especially in the Feedback treatment, where conditionally and unconditionally cooperative strategies explained 74% on average.*

3.6. Conclusion

Our primary goal in this chapter was to explore the role of reputation mechanisms on cooperative behaviour in a repeated Prisoner's Dilemma game. We hypothesised that both ratings and word-of-mouth feedback would promote higher levels of cooperation than without these reputational elements. To test this hypothesis, we conducted a laboratory experiment with human subjects as well as analysed field data and found consistent evidence for our hypothesis.

In particular, we found that providing either ratings or word-of-mouth feedback significantly increased cooperation compared to the control group without such reputational information. This finding is consistent with Stahl's (2013) research which showed that colour-coded labels signalling one's reputation could incentivise cooperators to maintain their good reputations by continuing to cooperate and defectors to improve their bad reputations by cooperating as well. Furthermore, when rating and feedback were combined in the Feedback treatment, even higher levels of cooperation were observed compared to just ratings alone. This suggests that providing detailed verbal judgement through reviews is more effective at promoting cooperative behaviour than simply abstract scores or labels associated with one's reputation. Moreover, we also found that the average rating was strongly correlated with the recipient's behaviour (cooperation, defection), and cooperators were more likely to engage in reporting under both treatments than defectors. Finally, our results showed similar rating habits across lab and field experiments which indicate consistency between experimental conditions within an artificial environment as well as real-world settings.

Our findings are also consistent with the literature on networks (e.g., Bala and Goyal, 2000; Kranton and Minehart, 2001; Jackson and Watts, 2002), which suggests that reputation formation plays a vital role in sustaining a cooperative equilibrium.

Overall, our findings support the notion that reputation mechanisms can play an essential role in sustaining cooperative equilibria by encouraging individuals to act cooperatively due to incentives derived from social evaluation by peers. Thus reputation mechanisms have potential applications beyond game theory contexts: they may be helpful tools for designing online marketplaces or peer-to-peer networks where it is crucial for participants to cooperate rather than cheat against each other for mutual benefits.

Finally, the development of a reputation in the scope of business-to-business interactions has yet to be extensively studied by scholars. Further research into how reputation forms in social systems could improve our understanding and help to manage organisational performance.

Appendix

Appendix A: Theoretical Analysis

A.1. Transition Matrix and Standard Equilibrium Analysis

This section discusses threshold δ above which selecting the grim trigger strategy (cooperative strategy) is a Nash equilibrium (δ^*, hereafter), assuming that the strategy space is restricted to only the grim trigger strategy and the always defect strategy. Note that it is also a NE for all players to act according to the always defect strategy for any δ.

The first step to find δ^* is to construct a Markov transition matrix that describes how defection spreads across a group, assuming that all members (other than a specific member *i* who deviates from the grim trigger strategy in a given round) act in accordance with the grim trigger strategy. The value function of player *i* can next be defined depending on the transition matrix and the number of defectors in that round. Denote the value function when the number of defectors is d as V_d. δ^* can be derived by using the condition that the expected lifetime payoff of *i* is lower when deviating from than following the grim trigger strategy even when s/he is the first player to deviate from the trigger strategy in his/her group. The details of this case (equilibrium path) are summarized in Section A.1.1.

Nevertheless, once players are allowed to select any strategy, acting according to the grim trigger strategy is no longer an equilibrium, because players have certain incentives to refrain from punishing defectors to prevent defection from spreading in the group. This can be demonstrated using an off-equilibrium case in which there is a material incentive for a member to choose cooperation once, after which the member turns to the punishment mode, when observing a defection (Section A.1.2).

A.1.1. *Threshold δ above which everyone acts according to the grim trigger strategy*

Assume that everyone acts according to the grim trigger strategy, but one player decides to defect without observing defection. Consider this player, i.e., the player who selects defection (player *i*, hereafter). p_d is used to express the probability of *i* interacting with a cooperator when the number of defectors is d. As a random matching protocol is used, the probability vector for *i* interacting with a cooperator can be found as follows:

$$p = (p_1, p_2, p_3, p_4, p_5, p_6, p_7, p_8) = (1, 6/7, 5/7, 4/7, 3/7, 2/7, 1/7, 0).$$

The Markov transition matrix (denoted as M) can be derived as follows:

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	0	1	0	0	0	0	0	0
2	0	1/7	0	6/7	0	0	0	0
3	0	0	0	3/7	0	4/7	0	0
4	0	0	0	3/35	0	24/35	0	8/35
5	0	0	0	0	0	3/7	0	4/7
6	0	0	0	0	0	1/7	0	6/7
7	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	1

Following the notation used in Camera and Casari (2009), the bold numbers in the rows and columns indicate the numbers of defectors in round t (current round) and round t + 1 (next round), respectively. The followings summarize derivations of some entries in M:

Pr[4|3] = 3/7. Consider any defector in round t (denoted as defector 1). The number of defectors will be four in round t + 1 if defector 1 is matched with another defector in round t, because the remaining defector should then be matched with a cooperator. This occurs with a probability of 2/7. The number of defectors will also be four in round t + 1 if defector 1 is paired with a cooperator and the remaining two defectors are paired with each other. This occurs with a probability of 1/7 (= 5/7×1/5). In other words, Pr[4|3] **=** 2/7+1/7 = 3/7.

Pr[6|3] = 4/7. The number of defectors will be six in round t + 1 when all three defectors are paired with cooperators in round t. The probability is 5/7×4/5 = 4/7.

Pr[4|4] = 3/35. The number of defectors will remain unchanged if each defector matches another defector. This occurs with a probability of 3/7×1/5 = 3/35.

Pr[6|4] = 24/35. Consider any defector (defector 1) in round t as in the previous explanation. The number of defectors in round t + 1 will be six for the following two cases:

- Defector 1 is matched with another defector, whereas the two remaining defectors are matched with cooperators. This occurs with a probability of 3/7×4/5 = 12/35.
- Defector 1 matches with a cooperator, another defector matches with a cooperator, and the remaining two defectors are paired. This occurs with a probability of 4/7×(2/5+3/5×1/3) = 12/35.

Pr[8|4] = 8/35. This transition occurs when all defectors are matched with cooperators. This situation occurs with a probability of 4/7×3/5×2/3 = 8/35.

Pr[6|5] = 3/7. The number of defectors will increase by one from round t to t+1 if one cooperator is paired with another cooperator in round t. This occurs with a probability of 2/7+5/7×1/5 = 3/7.

Pr[8|5] = 4/7. Each cooperator must match with a defector. This occurs with a probability of 5/7×4/5 = 4/7.

We not aware of a direct formula that captures the computation of the probabilities in the Markov transition matrix. Notably, the works of Camera and Casari, both in their 2007 and 2009 papers, similarly resort to a case-by-case narrative to explain the transition probabilities. This approach has the benefit of providing a rigorous explanation for each transition, taking into account each situation. Possibly, to facilitate understanding for the reader, a broad template to generalise the calculations can be presented as:

$$Pr[d\_new \mid d] = \frac{Number\ of\ ways\ to\ get\ d\_new\ defectors\ in\ the\ next\ round,\ \ given\ d\ in\ the\ current\ round}{Total\ number\ of\ ways\ to\ pair\ players\ in\ the\ current\ round}$$

The value function for player *i* can be expressed using the Markov transition matrix:

$$V_d = z + p_d(h - z) + \delta M_d V,$$

where M_d is the d^{th} row of *M*, *h* = 30 (the payoff of a defector when interacting with a cooperator), and *z* = 10 (the sucker payoff; that is, the stage game payoff from mutual defection).

Using transition matrix *M*, V_d for each *d* can be expressed as follows:

- $V_1 = h + \delta V_2$.
- $V_2 = z + \frac{6}{7}(h - z) + \delta\left(\frac{1}{7}V_2 + \frac{6}{7}V_4\right)$.
- $V_3 = z + \frac{5}{7}(h - z) + \delta\left(\frac{3}{7}V_4 + \frac{4}{7}V_6\right)$.
- $V_4 = z + \frac{4}{7}(h - z) + \delta\left(\frac{3}{35}V_4 + \frac{24}{35}V_6 + \frac{8}{35}V_8\right)$.
- $V_5 = z + \frac{3}{7}(h - z) + \delta\left(\frac{3}{7}V_6 + \frac{4}{7}V_8\right)$.
- $V_6 = z + \frac{2}{7}(h - z) + \delta\left(\frac{1}{7}V_6 + \frac{6}{7}V_8\right)$.
- $V_7 = z + \frac{1}{7}(h - z) + \delta V_8$.
- $V_8 = \frac{z}{1-\delta}$.

The expected lifetime payoff of player *i* can be expressed in terms of *h*, *z* and δ using the above value functions recursively:

$$V_7 = z + \frac{1}{7}(h - z) + \frac{\delta z}{1-\delta}.$$

$$V_6 = \frac{z(5+\delta) + 2h(1-\delta)}{(\delta-1)(\delta-7)}.$$

$$V_5 = \frac{z(3\delta^2+11\delta+28)+3h(1-\delta)(7+\delta)}{7(\delta-1)(\delta-7)}.$$

$$V_4 = \frac{z(-31\delta^2-56\delta-105)-28h(1-\delta)(5+\delta)}{(3\delta-35)(\delta-1)(\delta-7)}.$$

$$V_3 = \frac{z(-75\delta^3-366\delta^2-413\delta-490)+h(75\delta^3+345\delta^2+805\delta-1{,}225)}{(3\delta-35)(7\delta-7)(\delta-7)}.$$

$$V_2 = \frac{z(183\delta^3+395\delta^2+329\delta+245)+h(-186\delta^3-318\delta^2-966\delta+1{,}470)}{(3\delta-35)(\delta-1)(\delta-7)^2}.$$

$$V_1 = h + \frac{z\delta(183\delta^3+395\delta^2+329\delta+245)+h\delta(-186\delta^3-318\delta^2-966\delta+1{,}470)}{(3\delta-35)(\delta-1)(\delta-7)^2}.$$

Deviating from the grim trigger strategy is not optimal if $\frac{y}{1-\delta} > V_1$. Here, $y = 25$ (stage game payoff from mutual cooperation). Condition $\frac{y}{1-\delta} > V_1$ reduces to: $\delta > \bar{\delta} \approx .574$.

A.1.2. *Incentives to not exercise punishment even if a player observed defection*

Assume that everyone acts according to the grim trigger strategy, but one betrayed player chooses cooperation in the next round (s/he reverts to the sanctioning strategy after the next round). This is Case 2 of the theoretical analysis included in the appendix of Camera and Casari (2009). Assume that only one player deviates from the grim trigger strategy to check its viability. The motive behind this player's deviation can be interpreted as his/her attempt to prevent defection from spreading quickly to other members. The following shows that players have incentives to deviate from punishment under certain conditions, meaning that acting according to the grim trigger strategy does not constitute an equilibrium.

The term "player 1" refers to the player who decided to deviate from the sanctioning rule by choosing cooperation once more before reverting to defection in the next round. The following considers player 1 and re-performs the analysis, as in Case 1.

In this case, the Markov transition matrix, denoted as $\widetilde{M}$, is different from M because of the presence of player 1. When the number of defectors (d) exceeds one, d–1 defectors sanction according to the grim trigger strategy in this round. $\widetilde{M}$ can be thus derived as follows:

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	0	1	0	0	0	0	0	0
2	0	1/7	6/7	0	0	0	0	0
3	0	0	1/7	2/7	4/7	0	0	0
4	0	0	0	3/35	12/35	12/35	8/35	0
5	0	0	0	0	3/35	12/35	12/35	8/35
6	0	0	0	0	0	1/7	2/7	4/7
7	0	0	0	0	0	0	1/7	6/7
8	0	0	0	0	0	0	0	1

The bold numbers in the rows (columns) indicate the numbers of players who are currently choosing to defect, or choosing to deviate from the trigger strategy despite his/her latest interaction with a defector, in round t (in round $t + 1$).

Rows 1 and 8:

Pr[2|1] = 1 and **Pr[8|8] = 1** by applying the same logic used by Camera and Casari (2009) to the setup with group size of eight.

Row 7 (player 1, one cooperator and six defectors in round t):

The number of defectors will remain seven in round $t + 1$ if player 1 is paired with a cooperator in round t. Thus, **Pr[7|7] = 1/7**.

Row 6 (player 1, two cooperators and five defectors in round t):

There are three cases as summarized below:

(A) The number of defectors will remain six in round $t + 1$, if cooperator i is matched with another cooperator in round t. Hence, **Pr[6|6] = 1/7**.

(B) The number of defectors will be seven in round $t + 1$ if player 1 is paired with one of the two cooperators in round t (the remaining cooperator must then interact with a defector in that round). Hence, **Pr[7|6] = 2/7.**

(C) Finally, the number of defectors in round $t + 1$ will be eight if each cooperator interacts with a defector in round t. Thus, **Pr[8|6] = 5/7×4/5 = 4/7.**

Row 5 (player 1, three cooperators and four defectors in round t):

There are four cases as summarized below:

(A) The number of defectors will be five in round $t + 1$ if player 1 interacts with a cooperator and two cooperators are paired together in round t. In other words, **Pr[5|5] = 3/7×1/5 = 3/35.**

(B) There will be six defectors in round $t + 1$ in the following two situations:

(a) A cooperator is paired with another cooperator in round t, and the remaining cooperator is paired with a defector in that round. This occurs with a probability of 2/7×4/5 = 8/35.

(b) A cooperator is paired with a defector in round t. The remaining two cooperators are paired together. This occurs with a probability of 4/7×1/5 = 4/35.

In short, **Pr[6|5] = 8/35 + 4/35 = 12/35.**

(C) The number of defectors will be seven in round $t + 1$ if player 1 is paired with a cooperator while the remaining two cooperators are each paired with a defector in round t. In other words, **Pr[7|5] = 3/7×4/5 = 12/35.**

(D) The number of defectors will be eight in round $t + 1$ if all three cooperators are paired with defectors in round t. In other words, **Pr[8|5] = 4/7×3/5×2/3 = 8/35.**

Row 4 (player 1, four cooperators and three defectors in round t):

There are four cases as follows:

(A) The number of defectors will remain four in round $t + 1$ if player 1 is paired with a defector, whereas each cooperator is paired with a cooperator in round t. In other words, **Pr[4|4] = 3/7×3/5×1/3 = 3/35.**

(B) The number of defectors will be five in round $t + 1$ in the following two situations:

(a) Player 1 is paired with a cooperator in round t. Another cooperator i is paired with a cooperator, and the remaining cooperator is paired with a defector in that round. This occurs with a probability of 4/7×2/5 = 8/35.

(b) Player 1 is paired with a cooperator in round t. The cooperator i is paired with a defector whereas the remaining cooperator is paired with a cooperator in that round. This occurs with a probability of 4/7×3/5×1/3 = 4/35.

In short, **Pr[5|4] = 8/35 + 4/35 = 12/35.**

(C) The number of defectors will be six in round $t + 1$ if player 1 is paired with a defector and the remaining two defectors are each paired with a cooperator in round t. In other words, **Pr[6|4] = 3/7×4/5 = 12/35.**

(D) The number of defectors will be seven in round $t + 1$ if player 1 is matched with a cooperator, whereas the remaining cooperators are all paired with defectors in round t. Thus, **Pr[7|4] = 4/7×3/5×2/3 = 8/35.**

<u>Row 3</u> (player 1, five cooperators and two defectors in round t):

Logic similar to those already discussed applies to **Pr[3|3] = 1/7** (the number of defectors will be three in round t +1 if the two defectors are paired together in round t)**, Pr[4|3] = 2/7** (the number of defectors will be four in round $t + 1$ if player 1 is paired with a defector in round t) and **Pr[5|3] = 5/7×4/5 = 4/7** (the number of defectors will be five in round $t + 1$ if the two defectors are each paired with a cooperator in round t).

<u>Row 2</u> (player 1, six cooperators and one defector in round t):

Similarly, **Pr[2|2] = 1/7** (the number of defectors will be two in round $t + 1$ if player 1 is paired with a defector in round t); otherwise, **P[3|2] = 6/7**.

The value function for player 1, denoted as $\tilde{V}_d$ in this appendix, depends on d (the number of deviators). The expected lifetime payoff of player 1 can be expressed as follows:

$$\tilde{V}_d = \begin{cases} V_1 & if\ d = 1. \\ l + p_d(y - l) + \delta\widetilde{M}V & if\ d \geq 2. \end{cases}$$

Here, $l = 5$ (the sucker payoff) and $y = 25$ (the mutual cooperation payoff). When $d \geq 2$, $d - 1$ players follow the grim trigger strategy, whereas the remaining one player who has observed defection chooses cooperation, in this round. Here, the third term is $\delta\widetilde{M}V$, not $\delta\widetilde{M}\tilde{V}$, because player 1 reverts to the sanctioning strategy (defection) in the next round.

Using $\widetilde{M}$, the value function $\tilde{V}_d$ can be expressed as follows:

- $\tilde{V}_8 = l + \delta V_8$.
- $\tilde{V}_7 = l + \frac{1}{7}(y - l) + \delta\left(\frac{1}{7}V_7 + \frac{6}{7}V_8\right)$.
- $\tilde{V}_6 = l + \frac{2}{7}(y - l) + \delta\left(\frac{1}{7}V_6 + \frac{2}{7}V_7 + \frac{4}{7}V_8\right)$.
- $\tilde{V}_5 = l + \frac{15}{35}(y - l) + \delta\left(\frac{3}{35}V_5 + \frac{12}{35}V_6 + \frac{12}{35}V_7 + \frac{8}{35}V_8\right)$.
- $\tilde{V}_4 = l + \frac{20}{35}(y - l) + \delta\left(\frac{3}{35}V_4 + \frac{12}{35}V_5 + \frac{12}{35}V_6 + \frac{8}{35}V_7\right)$.
- $\tilde{V}_3 = l + \frac{5}{7}(y - l) + \delta\left(\frac{1}{7}V_3 + \frac{2}{7}V_4 + \frac{4}{7}V_5\right)$.
- $\tilde{V}_2 = l + \frac{6}{7}(y - l) + \delta\left(\frac{1}{7}V_2 + \frac{6}{7}V_3\right)$.

The remaining task is to check whether selecting cooperation after observing a defection is optimal.

(i) $\tilde{V}_8 \leq V_8$:

This is straightforward as $l < z$. Thus, selecting cooperation after observing a defection is not optimal when $d = 8$.

(ii) $\tilde{V}_7 \leq V_7$:

The condition $\tilde{V}_7 \leq V_7$ reduces to the following condition:

$$\delta \leq \frac{-49y + 294z + 49h - 294l}{h - z} = \frac{343}{4},$$

which always holds since δ used in the experiment is less than 1. This suggests that selecting cooperation after observing a defection is not optimal when $d = 7$.

(iii) $\tilde{V}_6 \leq V_6$:

The condition $\tilde{V}_6 \leq V_6$ reduces to the following condition:

$$\delta \leq \frac{14h - 35l - 14y + 35z}{2(h - z)} = \frac{49}{8},$$

which always holds since δ used in the experiment is less than 1. This suggests that selecting cooperation after observing a defection is not optimal when $d = 6$.

(iv) $\tilde{V}_5 \leq V_5$:

The condition $\tilde{V}_5 \leq V_5$ reduces to the following condition:

$$\delta \leq \frac{665}{24} - \frac{7\sqrt{7{,}345}}{24} \approx 2.712,$$

which always holds since δ used in the experiment is less than 1. This suggests that selecting cooperation after observing a defection is not optimal when $d = 5$.

(v) $\tilde{V}_4 \leq V_4$:

The condition $\tilde{V}_4 \leq V_4$ reduces to the following condition:

$$\delta \leq -\frac{115}{32} + \frac{\sqrt{28{,}905}}{32} \approx 1.719,$$

which always holds since δ used in the experiment is less than 1. Thus, selecting cooperation after observing a defection is not optimal when $d = 4$.

(vi) $\tilde{V}_3 \leq V_3$:

The condition $\tilde{V}_3 \leq V_3$ reduces to the following condition:

$$\delta \leq \frac{7(17{,}511{,}949+6{,}084\sqrt{8{,}165{,}949})^{\frac{1}{3}}}{468} + \frac{8{,}827}{36(17{,}511{,}949+6{,}084\sqrt{8{,}165{,}949})^{\frac{1}{3}}} - \frac{161}{36} \approx 1.166,$$

which always holds since δ used in the experiment is less than 1. Thus, selecting cooperation after observing a defection is not optimal when $d = 3$.

(vii) $\tilde{V}_2 \leq V_2$:

The condition $\tilde{V}_2 \leq V_2$ reduces to the following condition:

$$\delta \leq \frac{7(80{,}703{,}351+600\sqrt{18{,}321{,}963{,}933})^{\frac{1}{3}}}{1800} - \frac{101{,}731}{600(80{,}703{,}351+600\sqrt{18{,}321{,}963{,}933})^{\frac{1}{3}}} - \frac{581}{600} \approx 0.840.$$

This suggests that selecting cooperation after observing a defection *is* optimal, provided that the following two conditions are satisfied: (1) the partner is the only defector in the group, and (2) the game will continue with a probability of 84% or higher. These conditions hold since $\delta = 0.95$ in the experiment. As discussed above, the player's decision to deviate from punishment delays the breakdown of cooperation in the group.

A note should be made that in our theoretical analysis based on Kandori's contagious strategy, an upper threshold is commonly present. Such an upper threshold is absent in the paper by Camera and Casari, owing to their focus on a group size of four. However, a broader range of possibilities emerges when considering larger group sizes. We opt for a larger group size of eight, as opposed to four, to align with our research topic of costly reporting in large-scale communities. In such an environment, information does not spread without the reporter incurring a costly effort, contrasting with smaller, closely-knit communities where information can spread without costly reporting.

A.2. Theoretical considerations for 6-player setup

We now discuss 6-player setup which is relevant to chapter 3. We additionally address contagious spread for a different combination of strategies.

A.2.1. Threshold δ above which everyone acts according to the grim trigger strategy

We follow a similar logic to the one in Chapter 2, as well as Camera Casari (2009). Let us assume everyone in the group acts according to the grim trigger strategy, but one player decides to defect without observing defection. Consider this player who selects defection (player *i*, hereafter). p_d is used to express the probability for i to interact with a cooperator when the number of defectors is d. As the random matching protocol is used, the probability vector for i's interacting with a cooperator can be found as follows

$$p = (p_1, p_2, p_3, p_4, p_5, p_6) = (1, 4/5, 3/5, 2/5, 1/5, 0).$$

The Markov transition matrix (denoted as M) can be derived as follows:

	1	**2**	**3**	**4**	**5**	**6**
1	0	1	0	0	0	0
2	0	1/5	0	4/5	0	0
3	0	0	0	9/15	0	6/15
4	0	0	0	1/5	0	4/5
5	0	0	0	0	0	1
6	0	0	0	0	0	1

Following the notations used in Section 2.3.1, the bold numbers in rows and in columns indicate the numbers of defectors in round t (current round) and in round $t + 1$ (next round), respectively. Derivations of two rows in M merit explaining:

Row 3:

Pr[4|3] = 9/15. Consider any defector in round t (denoted as defector 1). The number of defectors will be four in round $t + 1$ if defector 1 is matched with another defector in round t, as the remaining defector should then be matched with a cooperator. This happens with a probability of 2/5 (or 6/15). The number of defectors will also be four in round $t + 1$ if defector 1 is paired with a cooperator and the remaining two defectors are paired with each other. This happens with a probability of 3/15 (= 3/5×1/3). In other words, Pr[4|3] = 6/15+3/15 = 9/15.

Pr[6|3] = 6/15. The number of defectors will be six in round $t + 1$ when all three defectors are paired with cooperators in round t. The probability is: 3/5×2/3 = 6/15.

Row 4:

Pr[4|4] = 1/5. The number of defectors will remain unchanged if the two remaining cooperators are matched. This happens with a probability of 1/5. Should any cooperator be matched with a defector, the remaining cooperator is also bound to be matched with a defector, thus **Pr[6|4] = 4/5.**

The value function for player i can be expressed using the Markov transition matrix:

$$V_d = z + p_d(h - z) + \delta M_d V,$$

where M_d is the d^{th} row of M, $h = 30$ (defector's payoff when interacting with a cooperator), and $z = 10$ (mutual defection payoff).

Using the transition matrix M, V_d for each d can be expressed as follows:

- $V_1 = h + \delta V_2$.
- $V_2 = z + \frac{4}{5}(h - z) + \delta\left(\frac{1}{5}V_2 + \frac{4}{5}V_4\right)$.
- $V_3 = z + \frac{3}{5}(h - z) + \delta\left(\frac{9}{15}V_4 + \frac{6}{15}V_6\right)$.
- $V_4 = z + \frac{2}{5}(h - z) + \delta\left(\frac{1}{5}V_4 + \frac{4}{5}V_6\right)$.
- $V_5 = z + \frac{1}{5}(h - z) + \delta V_6$.
- $V_6 = \frac{z}{1-\delta}$.

The expected lifetime payoff of player i can be expressed in terms of h, z and δ using the above value functions recursively. Calculations have been performed in Maple software, here and henceforth:

$$V_5 = z + \frac{1}{5}(h - z) + \frac{\delta z}{1-\delta}.$$

$$V_4 = \frac{z\delta - 2h\delta + 2h + 3z}{(\delta-1)(\delta-5)}.$$

$$V_3 = \frac{3\delta^2 z - 3\delta^2 h - 12h\delta + 7z\delta + 15h + 10z}{5(\delta-1)(\delta-5)}.$$

$$V_2 = \frac{4\delta^2 h - 5\delta^2 z + 16h\delta - 6z\delta - 20h - 5z}{(\delta-1)(\delta-5)^2}.$$

$$V_1 = h + \frac{(4\delta^2 h - 5\delta^2 z + 16h\delta - 6z\delta - 20h - 5z)\delta}{(\delta-1)(\delta-5)^2}.$$

Deviating from the grim trigger strategy is not optimal if $\frac{y}{1-\delta} > V_1$. In our setup the respective values are:

$y = 25$ (stage game payoff from mutual cooperation);

h = 30 (defector's payoff when interacting with a cooperator);

z = 10 (mutual defection payoff).

The condition $\frac{y}{1-\delta} > V_1$ reduces to: $\delta > \bar{\delta} \approx .525$. Since the continuation probability used in the experiment is 0.90, this suggests that under the assumption of grim trigger strategy set mutual cooperation also holds as an equilibrium, in addition to mutual defection.

Let us give a quick look to the incentives to not exercise punishment even if a player observed defection. Following logic similar to the Section 2.3.1.b., let us consider a case with only 1 defector ($\tilde{V}_2 > V_2$):

$$V_3 = \frac{3\delta^2 z - 3\delta^2 h - 12h\delta + 7z\delta + 15h + 10z}{5(\delta-1)(\delta-5)}.$$

$$V_2 = \frac{4\delta^2 h - 5\delta^2 z + 16h\delta - 6z\delta - 20h - 5z}{(\delta-1)(\delta-5)^2}.$$

$$\tilde{V}_2 = l + \frac{4}{5}(y - l) + \delta\left(\frac{1}{5}V_2 + \frac{4}{5}V_3\right).$$

As in A.1.2, we find that $\tilde{V}_2 > V_2$ holds with $\delta > \bar{\delta} \approx .8557$. This suggests that selecting cooperation after observing a defection is optimal, provided that the following two conditions are satisfied: (1) her partner is the only defector in the group; and (2) the game will continue with a probability of 85% or higher. These conditions hold since δ = 0.90 in the experiment. As discussed, the player's decision to deviate from the punishment mode delays the breakdown of cooperation in the group. We additionally verify that $\tilde{V}_3 > V_3$ doesn't hold $\tilde{V}_3 = l + \frac{3}{5}(y - l) + \delta\left(\frac{1}{5}V_3 + \frac{3}{5}\frac{1}{3}V_2 + \frac{3}{5}\frac{2}{3}V_4\right)$

A.2.2. *Contagious spread in Tit-for-Tat case*

One may wonder what changes if subjects employ different strategies. Another widely studied strategy is Tit-for-tat. In fact, Dal Bó and Frechétte (2011) found that the TFT strategy is the most frequently adopted cooperative strategy while the Grim Trigger strategy is less common. However, it is important to note that this was estimated under partner matching. It is then worthwhile to explore a TFT case as well. Let us assume that everyone in the group acts according to the TFT strategy, but Player 1 decides to unconditionally defect forever. In the same spirit we identify V_d for each number of defectors d:

- $V_1 = h + \delta V_2$.
- $V_2 = z + \frac{4}{5}(h - z) + \delta\left(\frac{1}{5}V_2 + \frac{4}{5}V_3\right)$.
- $V_3 = z + \frac{3}{5}(h - z) + \delta\left(\frac{2}{5}V_3 + \frac{3}{5}V_4\right)$.
- $V_4 = z + \frac{2}{5}(h - z) + \delta\left(\frac{3}{5}V_4 + \frac{2}{5}V_5\right)$.
- $V_5 = z + \frac{1}{5}(h - z) + \delta\left(\frac{4}{5}V_5 + \frac{1}{5}V_6\right)$.
- $V_6 = \frac{z}{1-\delta}$.

Where $\frac{y}{1-\delta} > V_1$ eventually works out as $\frac{y}{1-\delta} > h - \frac{(4h\delta - 4h - z)\delta}{(\delta-1)(4\delta-5)}$, which holds with $\delta > \bar{\delta} \approx .625$, satisfying out threshold.

Is it however feasible for Player 1 to defect just once and revert to cooperating? Unlike in GT case, one instance of defection will not spread like a contagious wildfire, it will rather remain a "hot potato", passed from one TFT player to another every round. Since we analyse the case of a one-time deviation, we assume that Player 1 reverts to playing TFT (that is, cooperating after observing cooperation), so there will always be only one defector in the group till the end of the supergame. In that case, we only need to consider two utility functions, $V_0$and V_1, cases where there are 0 and 1 defector in the group, respectively. After bringing the case of defection into the group, Player 1 begins to cooperate until eventually they are matched with the defector, the current "hot potato" holder, in round t. This would result in that defector observing cooperation from Player 1, returning to cooperation the next round, while Player 1 will find themselves back in the environment as the only defector in period t-1.

- $V_0 = h + \delta V_1$.
- $V_1 = l + \frac{4}{5}(y - l) + \delta\left(\frac{1}{5}V_0 + \frac{4}{5}V_1\right)$.

Solving recursively,

$$V_1 = -\frac{\delta h + l + 4y}{\delta^2 + 4\delta - 5}$$
$$V_0 = h - \frac{\delta(\delta h + l + 4y)}{\delta^2 + 4\delta - 5}$$

The condition $\frac{y}{1-\delta} > V_0$ simplifies to: $\delta > \bar{\delta} \approx .625$, which again satisfies the threshold of our experiment.

A.2.3. *Contagious spread in a mix of GT and TFT*

There has been a long-standing argument about whether subjects employ mixed strategies in an indefinitely repeated prisoner's dilemma (Axelrod and Hamilton, 1981). One could argue by referencing Dal Bó and Frechétte's (2011) evidence that TFT and AD strategies can account for as much as 80% of the data. Additionally, Romero and Rosokha (2018) have studied the mixed strategy choices and found that while most subjects do use mixed strategies, the strategies tend to become less mixed over time and move toward three focal pure strategies: Tit-For-Tat, Grim-Trigger, and Always Defect. With that in mind, we could consider another case where we allow a mix of players in the group who follow the two most common pure cooperative strategies: GT and TFT. Let us consider a group with 1 Grim Trigger player, 4 TFT players, and a player in question (Player 1) who intends to deviate once and play TFT thereafter. That is, players are playing pure strategies, as suggested by convergence in Romero and Rosokha 2018. The notation for utility functions (corresponding to the different states of the environment) may appear complicated, but it is purely a first impression. Let us break down an example of $V_{2\,1\,Y}$: the first subscript '2' is the total number of people who will defect in this period of play, which includes the GT player if they've been 'triggered' in any previous period. It also includes our spotlighted Player 1, who plays TFT and may perform Z action due to facing Z partner in the previous period. The second subscript '1' can only take the values {0;1} and indicates whether the GT player has been 'triggered', that is, whether they are defecting now and forever. A '0' in the second subscript shows the GT player is still cooperating this round. The third subscript, 'Y', indicates which action Player 1 intends to take in the current period. We assume Player 1 defected once, then reverted to pure TFT, where their action choice in period t can subsequently vary based on experience in period t-1. To summarise the current example $V_{2\,1\,Y}$, is an environment where the GT player will defect this period and forever, and one of the TFT players, who are not Player 1, intends to choose Z this round, while the Player 1 intends to play Y. Note that due to the nature of the contagious spread (where the GT player becomes the main transmitter), some environments have no chance of occurring (e.g. $V_{6\,1\,Y}$, $V_{4\,0\,Z}$, etc.).

- $V_{1\,0\,Z} = h + \delta\left(\frac{1}{5}V_{1\,1\,Y} + \frac{4}{5}V_{1\,0\,Y}\right)$
- $V_{1\,0\,Y} = l + \frac{4}{5}(y-l) + \delta\left(\frac{1}{5}V_{1\,0\,Z} + \frac{4}{5}V_{1\,0\,Y}\right)$.
- $V_{1\,1\,Y} = l + \frac{4}{5}(y-l) + \delta\left(\frac{1}{5}V_{2\,1\,Z} + \frac{4}{5}V_{2\,1\,Y}\right)$
- $V_{2\,1\,Z} = z + \frac{3}{5}(h-z) + \delta\left(\frac{1}{5}V_{2\,1\,Z} + \frac{1}{5}V_{3\,1\,Z} + \frac{3}{5}\frac{1}{3}V_{3\,1\,Y} + \frac{3}{5}\frac{2}{3}V_{4\,1\,Y}\right)$
- $V_{2\,1\,Y} = l + \frac{3}{5}(y-l) + \delta\left(\frac{2}{5}V_{3\,1\,Z} + \frac{3}{5}\frac{1}{3}V_{2\,1\,Y} + \frac{3}{5}\frac{2}{3}V_{3\,1\,Y}\right)$
- $V_{3\,1\,Z} = z + \frac{3}{5}(h-z) + \delta\left(\frac{1}{5}V_{3\,1\,Z} + \frac{1}{5}V_{4\,1\,Z} + \frac{3}{5}\frac{1}{3}V_{3\,1\,Y} + \frac{3}{5}\frac{2}{3}V_{4\,1\,Y}\right)$
- $V_{3\,1\,Y} = l + \frac{2}{5}(y-l) + \delta\left(\frac{1}{5}V_{4\,1\,Z} + \frac{2}{5}\frac{1}{3}V_{3\,1\,Z} + \frac{2}{5}\frac{2}{3}V_{4\,1\,Z} + \frac{2}{5}\frac{1}{3}V_{4\,1\,Y} + \frac{2}{5}\frac{2}{3}V_{3\,1\,Y}\right)$
- $V_{4\,1\,Y} = l + \frac{1}{5}(y-l) + \delta\left(\frac{1}{5}V_{4\,1\,Y} + \frac{3}{5}\frac{1}{3}V_{5\,1\,Z} + \frac{3}{5}\frac{2}{3}V_{4\,1\,Z} + \frac{1}{5}V_{5\,1\,Z}\right)$
- $V_{4\,1\,Z} = z + \frac{2}{5}(h-z) + \delta\left(\frac{1}{5}V_{4\,1\,Z} + \frac{2}{5}\frac{2}{3}V_{5\,1\,Z} + \frac{2}{5}\frac{1}{3}V_{4\,1\,Z} + \frac{2}{5}\frac{1}{3}V_{5\,1\,Y} + \frac{2}{5}\frac{2}{3}V_{4\,1\,Y}\right)$
- $V_{5\,1\,Z} = z + \frac{1}{5}(h-z) + \delta\left(\frac{1}{5}V_{5\,1\,Z} + \frac{3}{5}\frac{1}{3}V_{6\,1\,Z} + \frac{3}{5}\frac{2}{3}V_{5\,1\,Z} + \frac{1}{5}V_{5\,1\,Y}\right)$
- $V_{5\,1\,Y} = l + \delta\left(\frac{1}{5}V_{6\,1\,Z} + \frac{4}{5}V_{5\,1\,Y}\right)$
- $V_{6\,1\,Z} = \frac{z}{1-\delta}$

Solving for $\frac{y}{1-\delta} > V_{1\,0\,Z}$ can get quite messy. Eventually, $V_{1\,0\,Z}$ simplifies to:

$$V_{1\,0\,Z} =$$

$$\frac{\delta^7(-16h-10l+16y+10z)+\delta^6(74h+52l-68y-70z)+\delta^5(1072h-252l-1088y+48z)+\delta^4(-5880h+935l+4540y+280z)}{12\delta^7 + 208\delta^6 - 95\delta^5 - 8125\delta^4 - 750\delta^3 +}$$

$$\frac{\delta^3(-12625h+2775l+18100y-250z)+\delta^2(79875h-12875l-59000y+750z)+\delta(-109375h+9375*l+37500*y)+46875h}{+71250*\delta^2 - 109375\delta + 46875}$$

The condition $\frac{y}{1-\delta} > V_{1\,0\,Z}$ simplifies to: $\delta > \bar{\delta} \approx .565$, which again satisfies the threshold of our experiment, as the continuation probability is 0.9. It is intuitive that increasing the number of GT players in the pool would lead to even worse outcomes for the one-time deviator, as the punishment would spread even faster. As for one-time deviations from punishments, we will not demonstrate them for this case, as calculations become increasingly complicated.

A.2.4. A note on Signalling and Probabilistic Reporting.

One may argue that a player that does not receive the information can update his beliefs on the number of AD players are in the group (assuming there is a different incline to send messages between co-operators and defectors). In a setup with no information transmission, like the one considered in A.1.1 that wouldn't be a consideration. Should the setup with reports be considered, under a simplistic assumption that AD players never report, and GT always do, situation remains straightforward. We recall that report information becomes available to subjects prior to making a decision in the dilemma itself. That said, that if Player 1 gets matched with a counterpart who doesn't have a report attached to them, Player 1 can deduce that current state is at the very least is V_2 (applicable to both 8- or 6-player setup). In such case the very same round Player 1 should switch to defection since $z + \frac{6}{7}(h - z) + \delta\left(\frac{1}{7}V_2 + \frac{6}{7}V_4\right)$ is strictly higher than $l + \frac{6}{7}(y - l) + \delta\left(\frac{1}{7}V_2 + \frac{6}{7}V_4\right)$ and contagious spread is inevitable.

We may additionally acknowledge that, should reporting patterns become probabilistic, contagious spread (see A.1.1.) will move by a different trajectory. The game proceeds in rounds where players first observe if their current partner was reported, then make their game choice, and finally decide whether or not to leave a report. Let us look at a particular case of probabilistic reporting.

Let us also introduce assumptions:

(1) Players initially expect all interactions to be reported. This belief changes if they interact with a partner who has not been reported, triggering them to defect and cease reporting.

(2) α and β determine the probability that a cooperator or defector will be reported by their last partner. Specifically, α=0.9 denotes a 90% chance that a cooperator will report, while β=0.1 represents a 10% chance that a defector will report.

(3) Players update their beliefs B_d in two scenarios: if a report confirms that the current partner's last action was cooperation, the belief remains B_d=d; if a report confirms defection or if there is no report, the belief is updated to B_d=d+1. Given these new dynamics, the value functions V_d are recalibrated as follows:

Player 1 defects and has a 10% chance of being reported in the future: $V_1 = h + \frac{5}{7}(h - z) + \delta(0.1 * V_2 + 0.9 * V_3)$

- $V_2 = z + \frac{4}{5}(h - z) + \delta\left(0.9 * \frac{1}{5}V_2 + 0.1 * \frac{1}{5}V_3 + 0.9 * \frac{4}{5}V_4 + 0.1 * \frac{4}{5}V_5\right).$
- $V_3 = z + \frac{3}{5}(h - z) + \delta\left(0.9 * \frac{9}{15}V_4 + 0.1 * \frac{9}{15}V_5 + 0.9 * \frac{6}{15}V_6 + 0.1 * \frac{6}{15}V_6\right)$
- $V_4 = z + \frac{2}{5}(h - z) + \delta\left(0.9 * \frac{1}{5}V_4 + 0.1 * \frac{1}{5}V_5 + 0.9 * \frac{4}{5}V_6 + 0.1 * \frac{4}{5}V_6\right)$
- $V_5 = z + \frac{1}{5}(h - z) + \delta(0.9 * V_6 + 0.1 * V_6)$
- $V_6 = \frac{z}{1-\delta}$

Which simplifies to:

- $V_1 = \frac{-48\delta^4 h + 48\delta^4 z + 199\delta^3 h - 199\delta^3 z + 499\delta^2 h - 580\delta^2 z + 1850\delta h \quad -950\delta z \quad -2500h}{81\delta^3 + 981\delta^2 - 3400\delta + 2500}.$
- $V_2 = \frac{6\delta^3 h - 6\delta^3 z + 424\delta^2 h - 505\delta^2 z + 1570\delta h \quad -670\delta z \quad -2500h - 500z}{81\delta^3 + 981\delta^2 - 3400\delta + 2500}$
- $V_3 = \frac{-6\delta^2 h + 6\delta^2 z + 24\delta h \quad -15\delta z \quad +30h + 20z}{9\delta^2 - 59\delta + 50}$
- $V_4 = \frac{-\delta^2 h + \delta^2 z + 99\delta h \quad +54\delta z \quad +100h + 150z}{45\delta^2 - 295\delta + 250}$
- $V_5 = \frac{\delta h \quad -\delta z \quad -h - 4z}{5\delta + 5}$
- $V_6 = \frac{z}{1-\delta}$

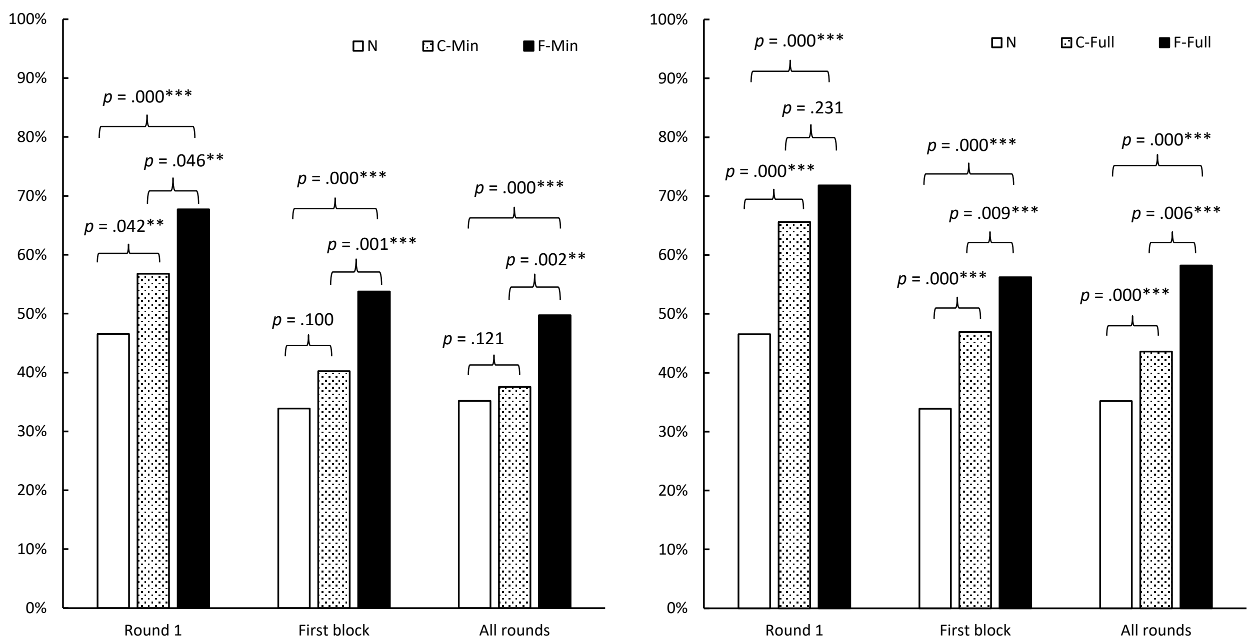
Condition $\frac{y}{1-\delta} > V_1$ reduces to: $\delta > \bar{\delta} \approx 0.431$ – essentially showing slightly lower threshold delta compared to A.1.1, due to information presence enhancing contagious spread.

Appendix B: Additional Tables and Figures

Figure B.1. *Average Cooperation Rate by Treatment* (supplementing Figure 2.2 of the main text)

To address concerns about session effects on subjects' decisions, we supplemented Figure 2.2's significance tests with p-values calculated via a mixed-effects linear regression. This approach used robust standard errors bootstrapped at the subject level and clustered by subject ID. We opted for a linear model over a probit model due to convergence issues when incorporating session effects. The linear model also serves as a more robust check for our experimental dataset. The forthcoming results are largely consistent with, or stronger than, those in Figure 2. The results shown below are qualitatively similar to (or somewhat stronger for some comparisons than) those reported in Figure 2 of the main text. Specifically, the test results suggest the following:

- Costly reporting in the C-Min treatment did not improve cooperation.
- However, free reporting in the F-Min treatment improved cooperation significantly.
- Subjects achieved a significantly higher level of cooperation in F-Min treatment than in C-Min.
- Under the Full condition, irrespective of whether reporting was costly, voluntary reporting improved cooperation more strongly, relative to the N treatment.
- Subjects achieved a significantly higher level of cooperation in the F-Full treatment than in the C-Full treatment.

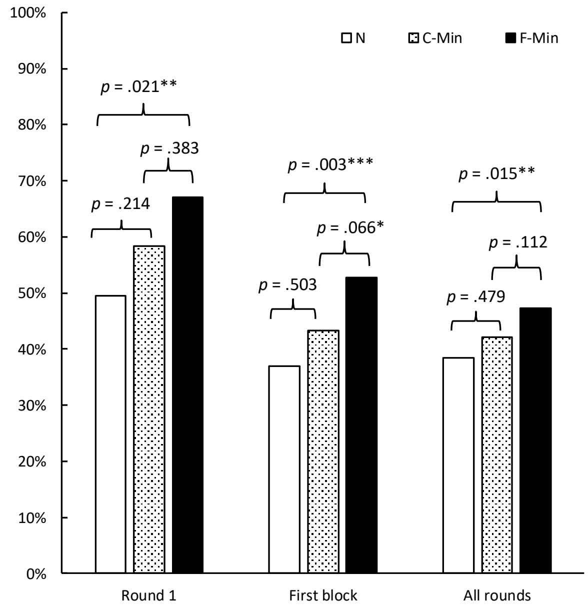


(*i*) C-Min and F-Min treatments

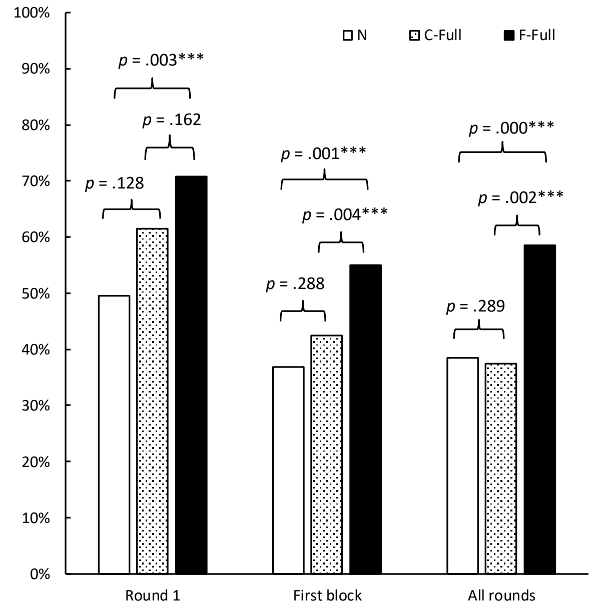
(*ii*) C-Full and F-Full treatments

Notes: p-values (two-sided) were calculated based on linear regressions with mixed effects (subject random effects and session random effects) and with robust standard errors bootstrapped at the subject level (300 replications) and clustered by subject ID. The first block refers to the first ten rounds of the supergames. In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, while also having a dummy that is equal to 1 for the first supergame (which makes it possible to control for cooperation behaviors without prior experience). *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

Figure B.2: *Average Cooperation Rate in the First and Second Halves of the Experiment (supplementing Figure 2.2 of the main text)*

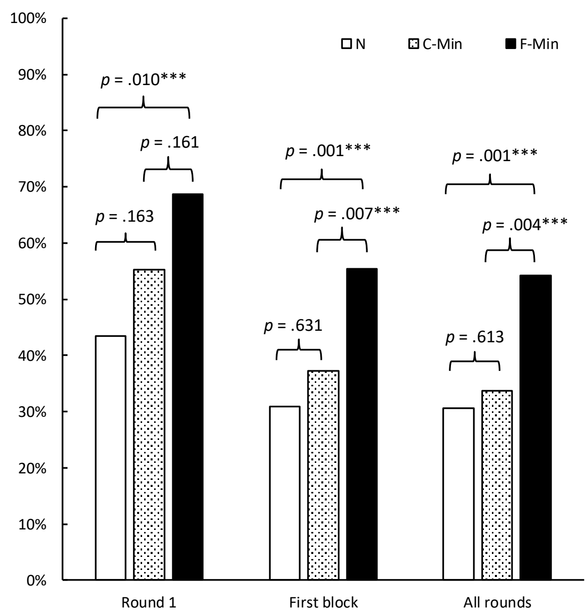


(*i*) C-Min and F-Min treatments

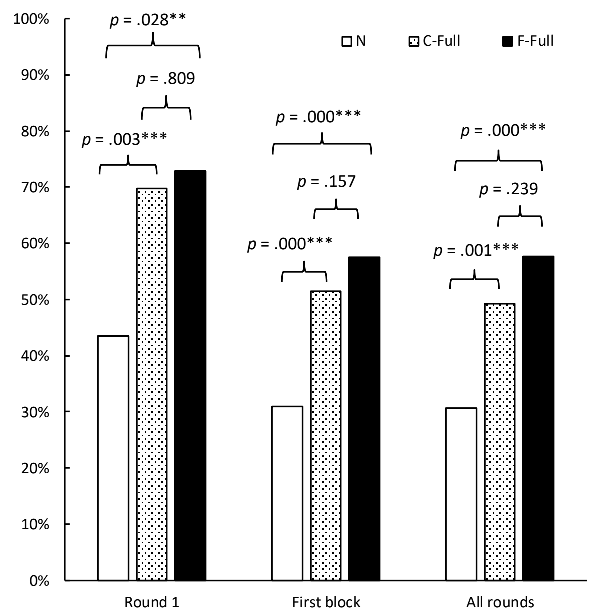


(*ii*) C-Full and F-Full treatments

(A) First Half of the Experiment (Supergames 1 to 3)



(*i*) C-Min and F-Min treatments

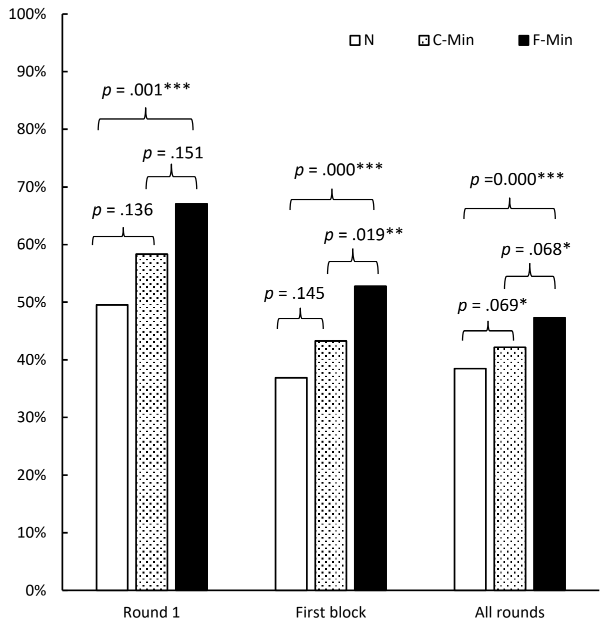


(*ii*) C-Full and F-Full treatments

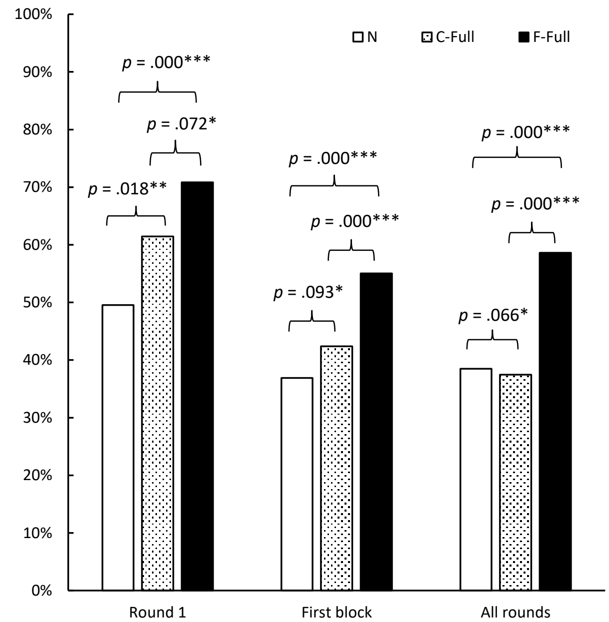
(B) Second Half of the Experiment (Supergames 4 to 6)

Notes: p-values (two-sided) were calculated based on subject random effects probit regressions with robust standard errors bootstrapped and clustered at the subject level (300 replications). In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, while also having a dummy that equals 1 for the first supergame. *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

As the subjects' decisions might have been affected by session effects, to supplement the significance tests reported on the previous page, p-values (two-sided) were also calculated using linear regressions with mixed effects (subject random effects and session random effects), with robust standard errors bootstrapped at the subject level and clustered by subject ID. The results summarized below show somewhat stronger significant differences with the same implications.

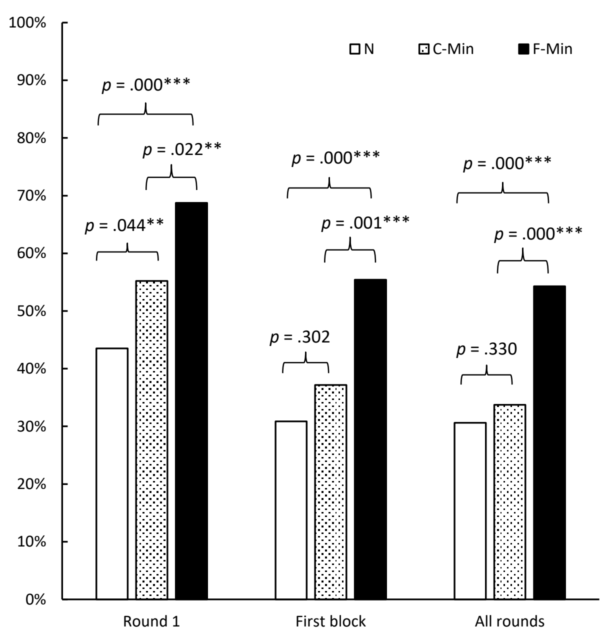


(*i*) C-Min and F-Min treatments

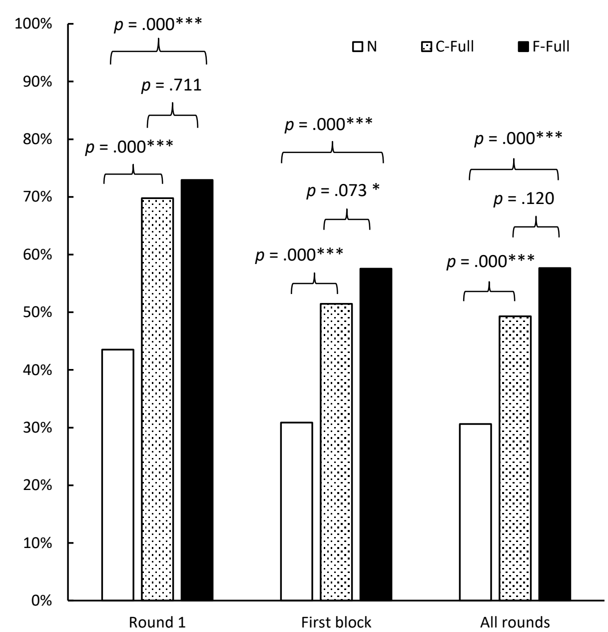


(*ii*) C-Full and F-Full treatments

(A') First Half of the Experiment (Supergames 1 to 3)



(*i*) C-Min and F-Min treatments

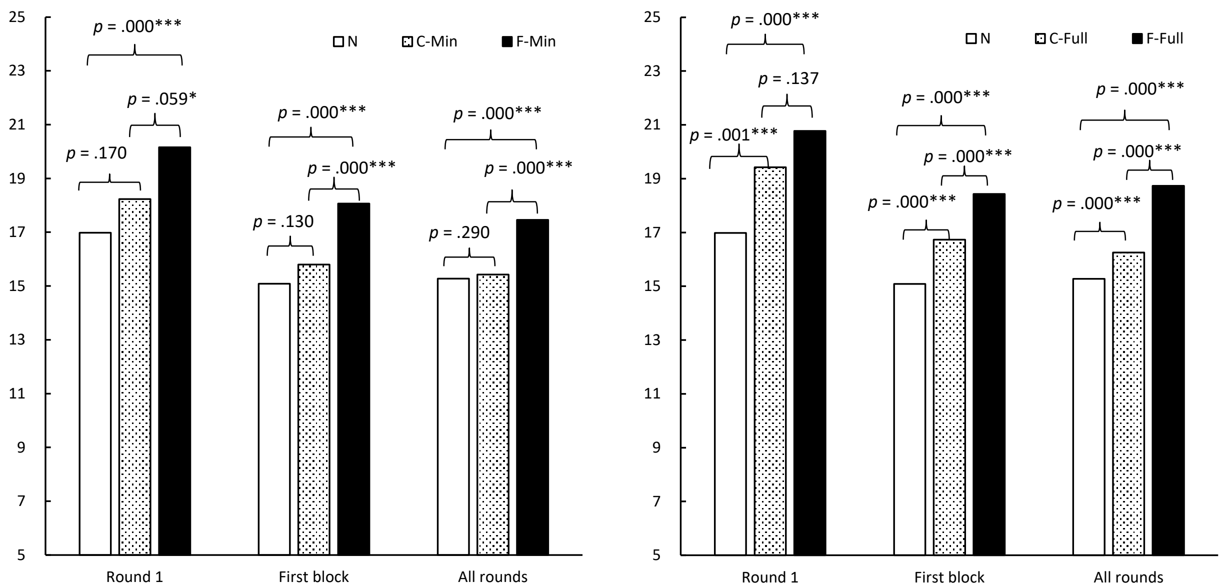


(*ii*) C-Full and F-Full treatments

(B') Second Half of the Experiment (Supergames 4 to 6)

Figure B.3: *Average Per-round Payoff by Treatment* (supplementing Figure 2.2 of the main text)

Subjects paid a fee each time they engaged in reporting in the C-Min and C-Full treatments. As such fee payments might have affected efficiency, the average per-round payoffs were calculated by treatment and were then compared across treatments in the same manner as in Figure 2 of the main text. The results summarized below indicate qualitatively almost the same patterns as those shown in Figure 2.2. This is not surprising as the reporting cost is very small–that is, just one point per report in the two costly-reporting treatments. It follows that the main treatment differences detected (Result 1) are robust to the efficiency measure we used, the cooperation rate, or the payoff.



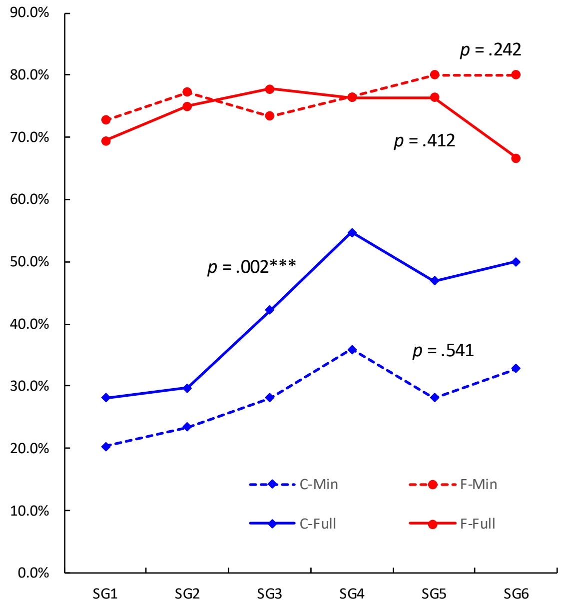
(*i*) C-Min and F-Min treatments

(*ii*) C-Full and F-Full treatments

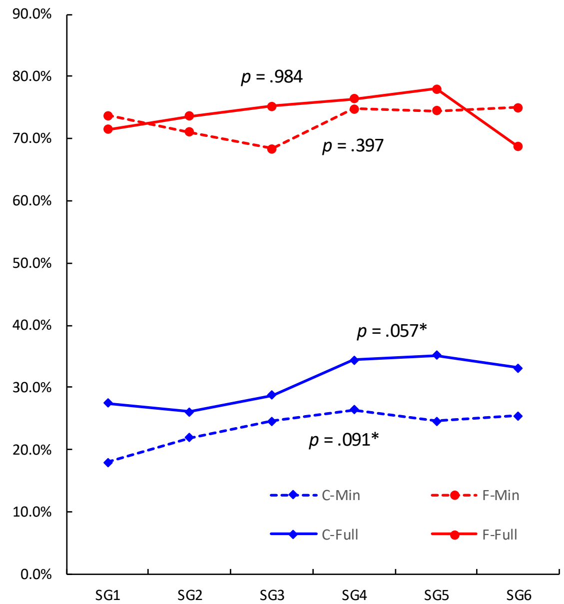
Notes: p-values (two-sided) were calculated based on subject random effects linear regressions with robust standard errors bootstrapped and clustered at the subject level (300 replications). The first block refers to the first ten rounds of the supergames. In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, while also having a dummy that is equal to 1 for the first supergame (which makes it possible to control for cooperation behaviors without prior experience). *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

<u>Remark</u>: As discussed in Figure B.1, one may be concerned that dynamic session effects might affect subjects' behavior. Thus, to supplement the econometric analysis results reported in the above figure, the same regression models were estimated by including session random effects. As in Figure 2 of the main text and Figure B.1 of the Appendix, the results are qualitatively similar to (or somewhat stronger for some comparisons than) those reported in the above figure. The results are omitted to conserve space.

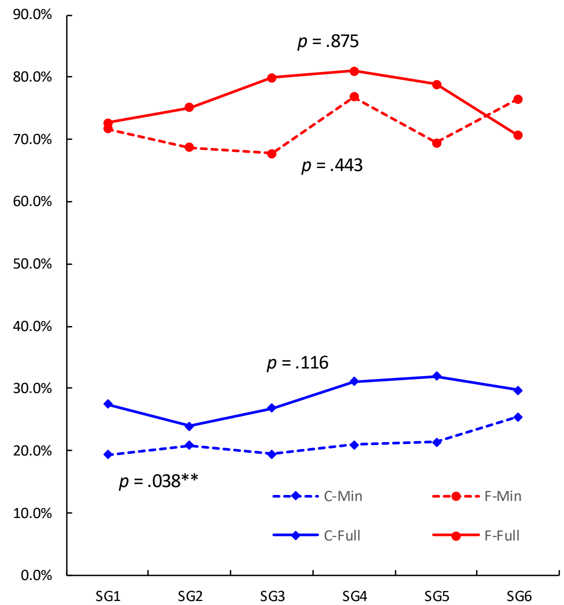
Figure B.4: *Average Reporting Rates, Supergame by Supergame (supplementing Table 2.3 of the main text)*



(*i*) Round 1



(*ii*) First block



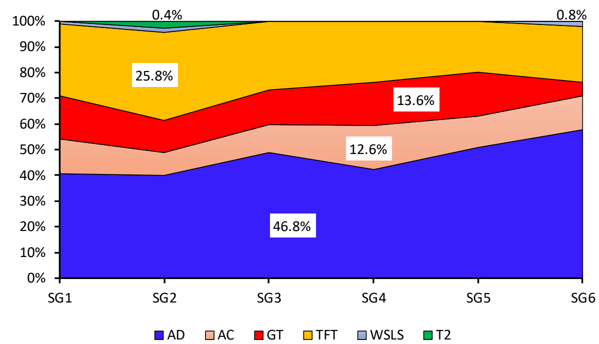
(*iii*) All rounds

Notes: p-values (two-sided) indicate the significance of the across-supergame trends in a given treatment. Each p-value was calculated based on a subject random effects probit regression with robust bootstrapped standard errors (300 replications), in which the dependent variable was a subject's decision to report in a given round, and the supergame number variable was an independent variable. For example, these calculations suggest that the subjects learned to engage in reporting in round 1 from supergame to supergame in the C-Full treatment (panel *i*). In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, while also having a dummy that equals 1 for the first supergame. Appendix Table B.3 reports the trends in supergame-average reporting rates by stage game outcome.

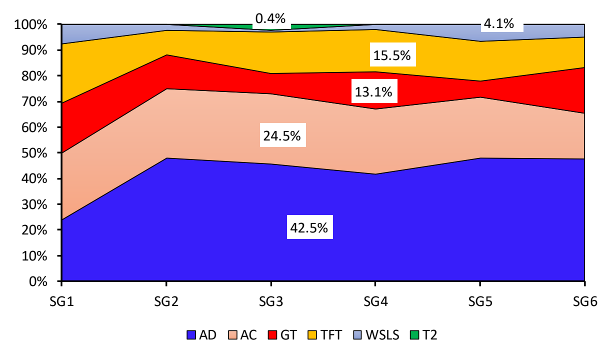
*, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01, respectively.

Figure B.5: *Strategy Choices, Supergame by Supergame (supplementing Figure 2.4 of the main text)*

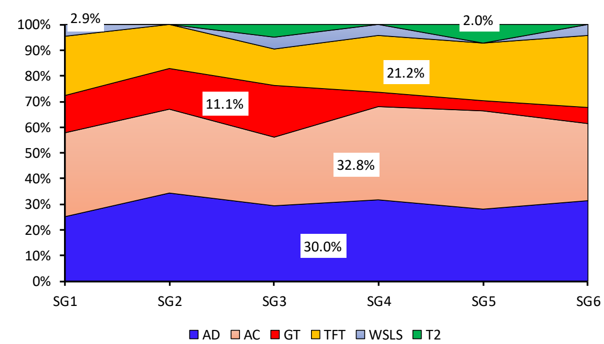
A structural estimation of the subjects' strategy choices was performed using exactly the same set of strategies included in Dal Bó and Fréchette (2011), i.e., AD, AC, TFT, GT, WSLS, and T2, as a preliminary analysis. The results are summarized as follows:



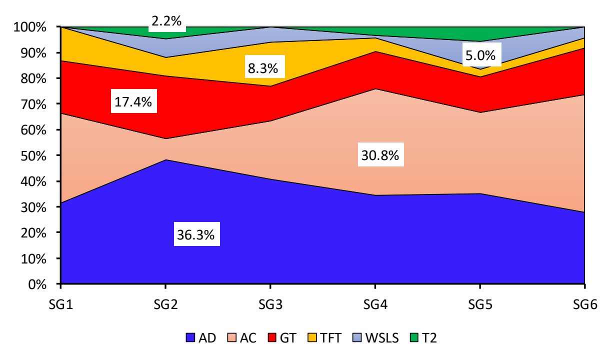
(*i*) N treatment



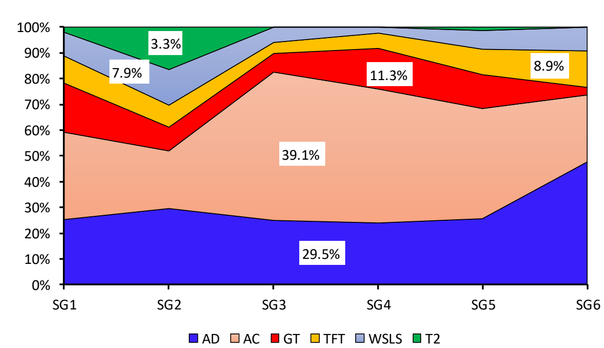
(*ii*) C-Min treatment



(*iii*) F-Min treatment



(*iv*) C-Full treatment



(*v*) F-Full treatment

Note: The percentage indicated in each region is the average percentage in which a given strategy was used by subjects across the six supergames. The detail of the estimation results is presented in Appendix Table B.7. As discussed in the main text of this main text, strategy choices were estimated while amending the set of strategies for endogenous monitoring by having strategies that assume a subject utilizes their partners' reputations (see Figure 2.4 of the main text for the results).

Table B.1. *Average Realized Supergame Lengths in the First, Middle and Final Thirds (Supplementing Table 2.1 of the main text)*

The table below summarizes the average realized supergame lengths in the first, middle, and final thirds of the experiment by treatment. This indicates that the subjects in the N treatment experienced the longest supergames on average in the first third of the experiment. Mengel *et al.* (2022) demonstrated that (a) the longer the supergames subjects experience in the first third, the more strongly they select cooperation in the middle and final thirds of an experiment. They also demonstrated that (b) the impact of long supergames in the first third is as strong as that in the middle third on cooperation in the final third (pages 6-7). The results of Mengel et al. (2022) also corroborate with those of Engle-Warnick and Slonim (2004) and Dal Bó and Fréchette (2018), who showed that having a longer supergame in the previous match positively affects the cooperation rate in the current match. Despite having the longest average supergame length in the first third of the experiment, the subjects in the N treatment failed to learn to cooperate (Figure 3).

The table below also shows that the average realized supergame lengths in the first and middle thirds in the C-Min treatment were much longer than those in the F-Min treatment. Despite this pattern, the subjects in the C-Min treatment failed to learn cooperation, whereas the subjects in the F-Min sustained a high level of cooperation from supergame to supergame (Figure 3.I).

The table further shows that the average supergame lengths in the first and middle thirds in the C-Full treatment were much smaller than those in the F-Full treatment. However, the subjects in the C-Full treatment gradually learned to cooperate, and achieved almost similar levels of cooperation to those in the F-Full treatment at the end (Figure 3.II).

In sum, although the realized supergame lengths differed by session by chance, considering the effects of realized supergame lengths based on Mengel *et al.* (2022) strengthens the main findings of the study.

Treatment: Timing:	N	C-Min	F-Min	C-Full	F-Full
The first third (supergames 1 and 2)	30.0	25.0	21.1	16.3	20.0
The middle third (supergames 3 and 4)	15.0	38.1	14.6	16.9	36.7
The final third (supergames 5 and 6)	12.0	16.9	15.0	17.5	17.5

Notes: The units are rounds.

Table B.2: *Cooperation Trends by Treatment (supplementing Figure 2.3 of the main text)*

Dependent variable: A dummy that equals 1(0) if a subject chose to cooperate (defect) in round *t*

Treatment: / Independent variables:	N treatment			C-Min treatment			F-Min treatment		
	Round 1	First block	All rounds	Round 1	First block	All rounds	Round 1	First block	All rounds
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Supergame number {= 1, 2, 3, 4, 5, 6}	-.142	-.116***	-.103***	.031	-.034	-.049	.030	.090**	.117**
	(.091)	(.043)	(.038)	(.086)	(.041)	(.040)	(.112)	(.046)	(.048)
Rounds within supergame	---	-.103***	-.012***	---	-.091***	-.011***	---	-.077***	-.028***
		(.017)	(.002)		(.013)	(.002)		(.012)	(.004)
1st supergame dummy {= 1 for the first supergame; 0, otherwise}	.007	-.146	-.278	.916**	.564***	.243	-.290	.488**	.424*
	(.401)	(.179)	(.172)	(.399)	(.173)	(.148)	(.459)	(.249)	(.242)
Previous supergame length	-.011*	-.0004	-.0005	-.002	.001	-.002	-.028*	.003	-.001
	(.006)	(.003)	(.003)	(.005)	(.002)	(.003)	(.017)	(.008)	(.009)
Constant	.522	.358	-.154	.190	.024	-.236	1.472**	.084	-.198
	(.510)	(.295)	(.236)	(.512)	(.286)	(.267)	(.743)	(.275)	(.293)
# of Observations	432	4,320	9,120	384	3,840	10,080	384	3,840	7,336
Wald chi-squared	8.30	41.54	57.48	10.31	63.53	47.79	4.22	46.39	57.91
Prob > Wald chi-squared	.0402	.0000	.0000	.0161	.0000	.0000	.2390	.0000	.0000

Notes: Subject random effects probit regressions with robust standard errors bootstrapped and clustered at the subject level (300 replications). *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

Independent variables: \ Treatment:	C-Full treatment			F-Full treatment		
	Round 1 (10)	First block (11)	All rounds (12)	Round 1 (13)	First block (14)	All rounds (15)
Supergame number {= 1, 2, 3, 4, 5, 6}	.179** (.076)	.110*** (.029)	.149*** (.030)	-.021 (.083)	.022 (.026)	.022 (.024)
Rounds within supergame	---	-.068*** (.012)	-.019*** (.003)	---	-.076*** (.009)	-.003* (.001)
1st supergame dummy {= 1 for the first supergame; 0, otherwise}	.530 (.380)	.283* (.154)	.401*** (.142)	.148 (.389)	.078 (.104)	-.093 (.094)
Previous supergame length	.002 (.009)	-.001 (.005)	-.002 (.004)	.009 (.008)	.007*** (.002)	.002 (.001)
Constant	-.026 (.413)	-.188 (.188)	-.626 (.157)	1.000*** (.467)	.406** (.160)	.037 (.129)
# of Observations	384	3,840	6,480	408	4,080	10,320
Wald chi-squared	5.53	43.01	66.43	1.52	73.67	25.30
Prob > Wald chi-squared	.1368	.0000	.0000	.6775	.0000	.0000

Table B.3: *Average Reporting Rates by Stage Game Outcome, Supergame by Supergame (supplementing Table 2.4 of the main text)*

(A) Average reporting rates in round 1

treatment		**Average**	SG1	SG2	SG3	SG4	SG5	SG6
F-Min	all data	**76.0%**	72.7%	77.3%	73.4%	76.6%	80.0%	80.0%
	cooperator-cooperator reporting	***86.3%***	*79.5%*	*77.8%*	*86.7%*	*90.6%*	*95.0%*	*100%*
	cooperator-defector reporting	***82.1%***	*94.4%*	*95.2%*	*83.3%*	*75.0%*	*62.5%*	*42.9%*
	defector-cooperator reporting	***59.0%***	*44.4%*	*66.7%*	*58.3%*	*50.0%*	*75.0%*	*71.4%*
	defector-defector reporting	***54.3%***	*50.0%*	*60.0%*	*40.0%*	*62.5%*	*50.0%*	*66.7%*
C-Min	all data	**28.1%**	20.3%	23.4%	28.1%	35.9%	28.1%	32.8%
	cooperator-cooperator reporting	***31.5%***	*15.6%*	*33.3%*	*22.7%*	*50.0%*	*37.5%*	*43.8%*
	cooperator-defector reporting	***47.9%***	*61.5%*	*46.2%*	*50.0%*	*47.1%*	*30.0%*	*58.8%*
	defector-cooperator reporting	***19.1%***	*0.0%*	*23.1%*	*21.4%*	*29.4%*	*20.0%*	*17.6%*
	defector-defector reporting	***8.3%***	*0.0%*	*0.0%*	*21.4%*	*0.0%*	*25.0%*	*7.1%*
F-Full	all data	**74.0%**	69.4%	75.0%	77.8%	76.4%	76.4%	66.7%
	cooperator-cooperator reporting	***82.0%***	*71.1%*	*80.6%*	*93.8%*	*85.7%*	*84.1%*	*71.4%*
	cooperator-defector reporting	***85.1%***	*100.0%*	*80.0%*	*88.9%*	*71.4%*	*90.9%*	*80.0%*
	defector-cooperator reporting	***44.8%***	*35.7%*	*53.3%*	*44.4%*	*50.0%*	*45.5%*	*40.0%*
	defector-defector reporting	***9.7%***	*66.7%*	*83.3%*	*50.0%*	*100.0%*	*50.0%*	*100.0%*
C-Full	all data	**41.9%**	28.1%	29.7%	42.2%	54.7%	46.9%	50.0%
	cooperator-cooperator reporting	***48.9%***	*18.8%*	*26.9%*	*61.5%*	*67.9%*	*55.9%*	*61.8%*
	cooperator-defector reporting	***77.8%***	*70.0%*	*90.9%*	*61.5%*	*81.3%*	*80.0%*	*83.3%*
	defector-cooperator reporting	***13.9%***	*40.0%*	*9.1%*	*15.4%*	*18.8%*	*0.0%*	*0.0%*
	defector-defector reporting	***11.7%***	*8.3%*	*6.3%*	*8.3%*	*0.0%*	*30.0%*	*16.7%*

(B) Average reporting rates in the first block

treatment		**Average**	SG1	SG2	SG3	SG4	SG5	SG6
F-Min	all data	**72.6%**	73.8%	71.0%	68.4%	74.8%	74.5%	75.0%
	cooperator-cooperator reporting	***86.5%***	*82.8%*	*81.5%*	*86.9%*	*92.7%*	*88.1%*	*91.8%*
	cooperator-defector reporting	***77.6%***	*82.6%*	*78.9%*	*74.5%*	*76.5%*	*72.2%*	*74.6%*
	defector-cooperator reporting	***67.3%***	*64.1%*	*70.2%*	*61.3%*	*73.5%*	*67.1%*	*67.8%*
	defector-defector reporting	***55.3%***	*58.6%*	*56.8%*	*50.5%*	*54.4%*	*54.1%*	*57.3%*
C-Min	all data	**23.5%**	18.0%	21.9%	24.5%	26.4%	24.5%	25.5%
	cooperator-cooperator reporting	***36.6%***	*15.8%*	*27.1%*	*42.6%*	*50.8%*	*45.9%*	*58.3%*
	cooperator-defector reporting	***42.4%***	*44.0%*	*44.8%*	*40.9%*	*42.5%*	*38.0%*	*44.3%*
	defector-cooperator reporting	***19.1%***	*8.0%*	*21.6%*	*17.4%*	*23.6%*	*20.9%*	*23.0%*
	defector-defector reporting	***9.4%***	*8.9%*	*9.1%*	*11.0%*	*7.4%*	*9.6%*	*10.3%*

F-Full	all data	**74.2%**	71.5%	73.6%	75.3%	76.4%	78.1%	68.8%
	cooperator-cooperator reporting	***84.8%***	*74.6%*	*82.6%*	*87.5%*	*86.8%*	*90.1%*	*82.5%*
	cooperator-defector reporting	***79.7%***	*83.3%*	*78.9%*	*77.0%*	*79.0%*	*83.2%*	*76.5%*
	defector-cooperator reporting	***52.9%***	*54.2%*	*61.0%*	*54.0%*	*58.1%*	*47.4%*	*39.2%*
	defector-defector reporting	***69.2%***	*71.9%*	*66.7%*	*68.6%*	*68.5%*	*67.6%*	*72.4%*
C-Full	all data	**30.8%**	27.5%	26.1%	28.8%	34.4%	35.2%	33.1%
	cooperator-cooperator reporting	**38.6%**	*23.8%*	*22.1%*	*42.5%*	*44.1%*	*44.4%*	*43.3%*
	cooperator-defector reporting	**59.8%**	*51.1%*	*61.6%*	*58.0%*	*66.3%*	*63.0%*	*62.0%*
	defector-cooperator reporting	**17.8%**	*23.4%*	*16.8%*	*13.2%*	*14.4%*	*21.5%*	*13.2%*
	defector-defector reporting	**17.0%**	*15.0%*	*14.4%*	*17.0%*	*19.6%*	*22.0%*	*20.7%*

(C) Average reporting rates for all rounds

treatment		**Average**	SG1	SG2	SG3	SG4	SG5	SG6
F-Min	all data	**71.7%**	71.7%	68.8%	67.7%	76.9%	69.5%	76.6%
	cooperator-cooperator reporting	***87.2%***	*84.4%*	*82.0%*	*88.5%*	*92.9%*	*86.0%*	*91.2%*
	cooperator-defector reporting	***75.6%***	*77.5%*	*74.2%*	*73.1%*	*77.1%*	*71.6%*	*77.4%*
	defector-cooperator reporting	***66.0%***	*64.1%*	*67.5%*	*56.6%*	*71.2%*	*65.1%*	*71.3%*
	defector-defector reporting	***57.5%***	*57.6%*	*59.6%*	*52.8%*	*58.7%*	*51.3%*	*59.3%*
C-Min	all data	**20.7%**	19.3%	20.8%	19.4%	21.0%	21.4%	25.5%
	cooperator-cooperator reporting	***35.5%***	*19.4%*	*30.0%*	*27.1%*	*50.7%*	*46.0%*	*58.3%*
	cooperator-defector reporting	***38.6%***	*40.7%*	*42.5%*	*41.8%*	*33.4%*	*39.3%*	*44.3%*
	defector-cooperator reporting	***17.7%***	*15.0%*	*20.1%*	*16.0%*	*22.3%*	*18.3%*	*23.0%*
	defector-defector reporting	***7.6%***	*9.3%*	*8.2%*	*8.3%*	*5.6%*	*8.6%*	*10.3%*
F-Full	all data	**77.5%**	72.7%	75.1%	79.9%	81.0%	78.9%	70.6%
	cooperator-cooperator reporting	***86.3%***	*78.5%*	*83.1%*	*87.1%*	*88.2%*	*90.7%*	*81.1%*
	cooperator-defector reporting	***79.3%***	*82.0%*	*82.2%*	*74.7%*	*81.0%*	*84.0%*	*76.5%*
	defector-cooperator reporting	***57.9%***	*55.0%*	*58.1%*	*65.2%*	*61.3%*	*54.0%*	*38.6%*
	defector-defector reporting	***73.6%***	*71.7%*	*72.5%*	*74.6%*	*78.1%*	*68.2%*	*75.1%*
C-Full	all data	**28.4%**	27.5%	23.9%	26.8%	31.1%	32.0%	29.7%
	cooperator-cooperator reporting	***39.2%***	*23.8%*	*31.2%*	*43.0%*	*46.5%*	*39.5%*	*40.5%*
	cooperator-defector reporting	***56.2%***	*51.1%*	*52.6%*	*53.6%*	*70.1%*	*54.4%*	*56.4%*
	defector-cooperator reporting	***18.0%***	*15.0%*	*17.4%*	*19.9%*	*14.3%*	*22.8%*	*18.6%*
	defector-defector reporting	***14.4%***	*9.3%*	*6.0%*	*6.1%*	*5.0%*	*9.3%*	*7.1%*

Table B.4: *Test Results for the Differences in Average Reporting Rates across the Treatments*

The following reports (two-sided) *p*-values for treatment differences. Table 2.4 of the main text presents the average reporting rates by treatment.

(*i*) Cooperator-cooperator reporting

	Data used for calculations								
	Round 1			First block			All rounds		
	F-Min	C-Full	F-Full	F-Min	C-Full	F-Full	F-Min	C-Full	F-Full
C-Min	.002***	.099*	.000***	.000***	.650	.000***	.000***	.528	.000***
F-Min	---	.000***	.229	---	.000***	.139	---	.000***	.067*
C-Full	---	---	.000***	---	---	.000***	---	---	0000***
F-Full	---	---	---	---	---	---	---	---	---

Summary: (a) Cooperator-cooperator reporting was significantly more frequent when reporting was free rather than costly. (b) There were no significant differences in reporting rates between the C-Min (F-Min) and C-Full (F-Full) treatments.

(*ii*) Cooperator-defector reporting

	Data used for calculations								
	Round 1			First block			All rounds		
	F-Min	C-Full	F-Full	F-Min	C-Full	F-Full	F-Min	C-Full	F-Full
C-Min	.012**	.048**	.014**	.000***	.016**	.000***	.000***	009***	.000***
F-Min	---	.612	.590	---	.000***	.604	---	.000***	.389
C-Full	---	---	.434	---	---	.000***	---	---	.000***
F-Full	---	---	---	---	---	---	---	---	---

Summary: (a) There were no significant differences in reporting rates between the F-Min and F-Full treatments, which means that cooperator-defector reporting was frequent when doing so was free. (b) The presence of a positive reporting cost significantly discouraged cooperator-defector reporting under the Min condition (C-Min vs. F-Min). On average, the same negative effect of positive reporting costs was detected in the Full condition (C-Full vs. F-Full). However, the average reporting rates in the first round of supergames were similar for the C-Full and F-Full treatments.

(*iii*) Defector-cooperator reporting

	Data used for calculations								
	Round 1			First block			All rounds		
	F-Min	C-Full	F-Full	F-Min	C-Full	F-Full	F-Min	C-Full	F-Full
C-Min	.044**	.666	.088*	.000***	.751	.000***	.000***	.808	.000***
F-Min	---	.014**	.246	---	.000***	.037**	---	.000***	.301
C-Full	---	---	.003***	---	---	.000***	---	---	.000***
F-Full	---	---	---	---	---	---	---	---	---

Summary: (a) The presence of positive reporting costs significantly discouraged defector-cooperator reporting (F-Min vs. C-Min, F-Full vs. C-Full). (b) Information structure does not significantly affect the frequency of defector-cooperator reporting. The only exception was the significant difference in the average reporting rate in the first block between the F-Min and F-Full treatments; however, both the frequencies were more than 50%.

(*iv*) Defector-defector reporting

	Data used for calculations								
	Round 1			First block			All rounds		
	F-Min	C-Full	F-Full	F-Min	C-Full	F-Full	F-Min	C-Full	F-Full
C-Min	.064*	.736	.184	.000***	.073*	.000***	.000***	.010***	.000***
F-Min	---	.216	.362	---	.000***	.035**	---	.000***	.024**
C-Full	---	---	.065*	---	---	.035**	---	---	.000***
F-Full	---	---	---	---	---	---	---	---	---

Summary: The presence of positive reporting costs, and the Min condition (relative to the Full condition) strongly discouraged defector-defector reporting, although no significant differences were detected when we compared reporting only in the first round across treatments.

Notes: The numbers in the table are two-sided *p*-values. Each treatment comparison was based on a subject random effects probit regression with robust standard errors bootstrapped and clustered at the subject level (300 replications), while also having a treatment dummy as the independent variable. In the regressions, the length of the previous supergame was controlled as an independent variable for observations after the first supergame, with also a dummy that equals 1 for the first supergame. The first block refers to the first ten rounds of the supergames.
*, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

Table B.5: *Partial Correlations between Received Information and Reporting*

(A) C-Min and F-Min treatments

	C-Min		F-Min	
	First block (1)	All rounds (2)	First block (3)	All rounds (4)
Pairwise correlation between *i*'s decision to report in round *t* {=1(0) if s/he reported (did not report)} and a dummy that indicates whether *i*'s round *t* partner was reported in round $t-1$ {=1(0) if the partner was (was not) reported}	.1285	.1740	.0968	.1068
Two-sided *p*-value[#1]	< .001***	< .001***	.007***	< .001***

(B) C-Full and F-Full treatments

	C-Full		F-Full	
	First block (5)	All rounds (6)	First block (7)	All rounds (8)
Pairwise correlation between *i*'s decision to report in round *t* {=1(0) if s/he reported (did not report)} and the quantity of *i*'s round *t* partner *j*'s reputation {the % of rounds in a given supergame where *j* was reported so far}	.1206	.1259	.0857	.1357
Two-sided *p*-value [#1]	.003***	< .001***	.012**	< .001***

Notes: All observations (except those in the first round of the supergames) were used. First block refers to the first ten rounds of the supergames. [#1] The two-sided *p*-value in each column was calculated based on a subject random effects probit regression with robust standard errors bootstrapped and clustered at the subject level (300 replications) in which the dependent variable is *i*'s decision to report in round *t*. A dummy that indicates whether *i* received a report for his/her round *t* partner's last-round action was included as an independent variable in columns (1) to (4). The quantity of *i*'s round *t* partner *j*'s reputation was included as an independent variable in columns (5) to (8). Considering that reporting decisions were affected by the stage game outcome (see Result 4), the cooperator-cooperator reporting dummy, the cooperator-defector reporting dummy and the defector-cooperator reporting dummy (the reference group was the defector-defector outcome) were included as controls. These three dummies indicate the subjects' stage game outcomes in the current round. Furthermore, the previous supergame length was controlled for in the regression.

The correlations are significant at $p < .001$ for all columns if the *p*-values are calculated based on the formula of the pairwise Pearson's correlation coefficients instead of using regressions.

*, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

Table B.6: *Effects of Partner's Reputational Information on Own Action Choices*

By what mechanism does endogenous monitoring help sustain cooperation in communities? Studying this question is meaningful as it is the driving force behind Results 1 and 2 of the main text.

The availability of reputational information may serve as a coordination device, enabling subjects to easily achieve mutual cooperation. One method to explore this question is to perform a regression analysis in which the dependent variable is the subject's decision to cooperate. The next table reports the estimation results. It reveals that irrespective of the treatment condition, subjects on average cooperated conditionally upon the *quality* of their partners' reputations. First, as shown in columns (1) to (4), subjects were significantly more (less) likely to select cooperation when matched with an unmasked cooperator (defector), compared to when matched with a masked individual, in the two Min treatments – see the coefficient estimates for variables (c) and (d). Here, the term "masked (unmasked) individual" refers to an individual whose previous action, cooperate or defect, was not (was) reported; thus, no history information of the masked individual is available to his/her partner. Columns (1) to (4) also indicate that a cooperator in round $t - 1$ was significantly more likely than a defector to select cooperation in round t. This suggests consistency in their cooperation decisions across rounds. A comparison between columns (1) and (3) (columns (2) and (4)) suggests that subjects responded to reputational information more strongly when reporting was costly than when cost-free. This can be explained by the difference in the marginal benefit of reported information: reporting was much less frequent in the C-Min treatment than in the F-Min treatment (Table 2.3 of the main text); hence the reported information was more valuable in the former than in the latter.

Columns (5) to (8) also show that the larger the fraction of cooperation his/her current-round partner had in the observable reputation record, the more likely a subject was to select cooperation in the C-Full and F-Full treatments (see variable (g)). This tendency was especially strong in the F-Full treatment: subjects in the F-Full treatment decided which action to take mainly based on the partners' reputation quality. In contrast, in the C-Full treatment, subjects weighed their own reputation quality, similarly to that of their partners. This suggests that, with less accurate reputational information, the subjects carefully contemplated how their partners would react to their own reputation scores (see variable (e)).

In the two Full treatments, the 'quantity' measure had only minor roles in the subjects' decisions to cooperate. While subjects in these treatments were aware of how frequently their current-round partners had been reported so far, they weighed the quantity of information much less than the quality of reputation in deciding on an action (see variables (f) and (h)).

In summary, these analyses suggest that, on average, subjects used the reported information as a device to coordinate with their peers by conditionally selecting cooperation based on quality.

Result: *(a) Subjects were significantly more (less) likely to select cooperation when matched with an unmasked cooperator (defector), compared with when matched with a masked individual, in the C-Min and F-Min treatments. (b) The larger fraction of cooperation his/her current-round partner had in the observable reputation record, the more likely a subject was to select cooperation in the C-Full and F-Full treatments.*

Dependent variable: a dummy that equals 1 (0) if subject *i* choose to cooperate (defect) in round *t*.

Treatment:	C-Min		F-Min		C-Full		F-Full	
Data:	1st block	All rounds	1st block	All rounds	1st block	All rounds	1st block	All rounds
Independent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Own choice in round $t-1$ {=1(0) when subject *i* cooperated (defected)}	1.077*** (.130)	1.161*** (.103)	.696*** (.123)	.762*** (.118)	---	---	---	---
(b) Variable (a) × reported dummy {= 1(0) if subject *i*'s round $t-1$ action was reported}	.182 (.121)	.156* (.91)	.186** (.093)	.188*** (.073)	---	---	---	---
(c) Cooperative partner dummy {=1 when subject *i*'s round *t* partner cooperated in round $t-1$ and it was reported; 0 otherwise}#1	.623*** (.162)	.654*** (.130)	.536*** (.083)	.529*** (.071)	---	---	---	---
(d) Uncooperative partner dummy {=1 when subject *i*'s round *t* partner defected in round $t-1$ and it was reported; 0 otherwise}#1	-.950*** (.185)	-.902*** (.163)	-.389*** (.089)	-.447*** (.090)	---	---	---	---
(e) Own reputation quality in round *t* {= % of cases in a given supergame where subject *i* cooperated in prior rounds when s/he was reported}	---	---	---	---	1.168*** (.213)	1.331*** (.217)	.365 (.233)	.343 (.293)
(f) Variable (e) × Amount of own reputation in round *t* {= % of prior rounds in a given supergame where subject *i* was reported so far}	---	---	---	---	.381 (.295)	.018 (.259)	.336* (.180)	.168 (.205)
(g) Round *t* partner *j*'s reputation quality {= % of cases in a given supergame where *j* cooperate in prior rounds when s/he was reported}	---	---	---	---	1.048*** (.174)	1.343*** (.181)	1.410*** (.200)	1.664*** (.221)
(h) Variable (g) × Amount of round *t* partner *j*'s reputation {= % of prior rounds in a given supergame where *j* was reported so far}	---	---	---	---	.342 (.244)	.332 (.225)	.146 (.166)	.424** (.193)
(i) First supergame dummy {= 1 for the first supergame; 0 otherwise}	.562*** (.098)	.401*** (.086)	.226 (.183)	.145 (.150)	-.005 (.158)	.145 (.185)	.140 (.089)	.069 (.079)
(j) Previous supergame length#2	.001 (.002)	.001 (.002)	.002 (.007)	-.000 (.006)	-.009 (.005)	-.006 (.004)	.005** (.002)	.000 (.001)
Constant	-1.086*** (.150)	-1.160*** (.161)	-.624*** (.200)	-.679*** (.172)	1.410*** (.184)	-1.700*** (.180)	-1.290*** (.165)	-1.305*** (.164)
# of Observations	3,456	9,696	3,456	6,952	2,206	4,738	3,382	9,574
Wald chi-squared	135.73	187.63	93.64	125.22	115.15	138.05	103.16	145.99
Prob > Wald chi-squared	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Notes: Subject random effects probit regressions with robust standard errors bootstrapped and clustered at the subject level (300 replications). All observations, except those in round 1 [i.e., variables (a) to (d) can be defined] were used in columns (1) to (4). Only observations in which both *i* and *j* were reported at least once [i.e., variables (e) and (g) can be defined] were used in columns (5) to (8). 1st block refers to the first ten rounds of the supergames.

#1 The reference group in columns (1) to (4) is the case in which *i* was matched with a masked partner in round *t*.

#2 Variable (j) is zero in the first supergame, whereas the first supergame dummy – variable (i) – was included to control for cooperation behaviors without any experience.

*, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

Table B.7: *Strategy Choices Regarding Cooperation, Supergame by Supergame (supplementing Figure B.5 of the Appendix)*

This table summarizes the detail of the structural estimation results reported in Figure B.5. Please refer to Dal Bó and Fréchette (2011) for the estimation method. This preliminary analysis was performed before estimating the amended version with more strategies (Table 2.5 of the main text).

	I. N treatment					**II. C-Min treatment**					**III. F-Min treatment**			
	a. 1st supergame					a. 1st supergame					a. 1st supergame			
	fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*
AD	0.407	0.064	6.366	0.000	AD	0.239	0.095	2.523	0.006	AD	0.251	0.121	2.072	0.019
AC	0.136	0.089	1.522	0.064	AC	0.261	0.116	2.254	0.012	AC	0.328	0.109	3.006	0.001
GT	0.168	0.074	2.281	0.011	GT	0.193	0.132	1.467	0.071	GT	0.145	0.102	1.419	0.078
TFT	0.278	0.107	2.591	0.005	TFT	0.230	0.092	2.500	0.006	TFT	0.230	0.081	2.851	0.002
WSLS	0.011	0.088	0.125	0.450	WSLS	0.077	0.094	0.825	0.205	WSLS	0.046	0.093	0.497	0.309
T2	0.000	0.025	0.000	0.500	T2	0.000	0.051	0.000	0.500	T2	0.000	0.038	0.000	0.500
Gamma	0.588	0.066	8.873	0.000	Gamma	0.659	0.104	6.342	0.000	Gamma	0.654	0.125	5.256	0.000
Beta	0.846				Beta	0.820				Beta	0.822			

	b. 2nd supergame					b. 2nd supergame					b. 2nd supergame			
	fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*
AD	0.399	0.065	6.111	0.000	AD	0.481	0.052	9.183	0.000	AD	0.345	0.082	4.190	0.000
AC	0.091	0.105	0.868	0.193	AC	0.269	0.109	2.464	0.007	AC	0.325	0.104	3.118	0.001
GT	0.124	0.074	1.659	0.049	GT	0.130	0.095	1.379	0.084	GT	0.160	0.118	1.359	0.087
TFT	0.344	0.085	4.068	0.000	TFT	0.097	0.085	1.141	0.127	TFT	0.170	0.112	1.516	0.065
WSLS	0.016	0.110	0.148	0.441	WSLS	0.023	0.078	0.298	0.383	WSLS	0.000	0.091	0.000	0.500
T2	0.026	0.027	0.964	0.168	T2	0.000	0.038	0.000	0.500	T2	0.000	0.028	0.000	0.500
Gamma	0.578	0.07297	7.926	0.000	Gamma	0.512	0.053	9.741	0.000	Gamma	0.622	0.089	7.029	0.000
Beta	0.849				Beta	0.876				Beta	0.833			

	c. 3rd supergame					c. 3rd supergame					c. 3rd supergame			
	fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*
AD	0.489	0.076	6.451	0.000	AD	0.455	0.081	5.621	0.000	AD	0.294	0.081	3.652	0.000
AC	0.110	0.124	0.887	0.188	AC	0.276	0.099	2.787	0.003	AC	0.266	0.107	2.478	0.007
GT	0.132	0.103	1.277	0.101	GT	0.077	0.117	0.657	0.255	GT	0.203	0.138	1.470	0.071
TFT	0.269	0.091	2.968	0.002	TFT	0.162	0.069	2.360	0.009	TFT	0.142	0.118	1.207	0.114
WSLS	0.000	0.129	0.000	0.500	WSLS	0.006	0.082	0.071	0.472	WSLS	0.046	0.076	0.605	0.273
T2	0.000	0.000	0.292	0.385	T2	0.024	0.022	1.073	0.142	T2	0.048	0.053	0.904	0.183
Gamma	0.526	0.085	6.184	0.000	Gamma	0.560	0.075	7.488	0.000	Gamma	0.509	0.079	6.455	0.000
Beta	0.870				Beta	0.856				Beta	0.877			

	d. 4th supergame					d. 4th supergame					d. 4th supergame			
	fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*
AD	0.424	0.049	8.731	0.000	AD	0.418	0.077	5.391	0.000	AD	0.317	0.066	4.812	0.000
AC	0.170	0.125	1.359	0.087	AC	0.252	0.091	2.754	0.003	AC	0.363	0.114	3.187	0.001
GT	0.168	0.107	1.566	0.059	GT	0.145	0.115	1.262	0.103	GT	0.058	0.121	0.475	0.317
TFT	0.238	0.105	2.273	0.012	TFT	0.165	0.080	2.064	0.019	TFT	0.221	0.051	4.299	0.000
WSLS	0.000	0.087	0.000	0.500	WSLS	0.021	0.083	0.254	0.400	WSLS	0.042	0.092	0.450	0.326
T2	0.000	0.003	0.000	0.500	T2	0.000	0.052	0.000	0.500	T2	0.000	0.093	0.000	0.500
Gamma	0.429	0.053	8.104	0.000	Gamma	0.657	0.078	8.450	0.000	Gamma	0.505	0.073	6.918	0.000
Beta	0.912				Beta	0.821				Beta	0.879			

	e. 5th supergame					e. 5th supergame					e. 5th supergame			
	fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*
AD	0.509	0.095	5.382	0.000	AD	0.480	0.080	5.989	0.000	AD	0.280	0.087	3.199	0.001
AC	0.121	0.183	0.662	0.254	AC	0.236	0.086	2.735	0.003	AC	0.385	0.125	3.086	0.001
GT	0.171	0.102	1.672	0.047	GT	0.063	0.079	0.795	0.213	GT	0.039	0.118	0.331	0.370
TFT	0.199	0.105	1.901	0.029	TFT	0.155	0.070	2.213	0.013	TFT	0.226	0.069	3.259	0.001
WSLS	0.000	0.132	0.000	0.500	WSLS	0.065	0.069	0.946	0.172	WSLS	0.000	0.090	0.000	0.500
T2	0.000	0.005	0.000	0.500	T2	0.000	0.058	0.000	0.500	T2	0.070	0.009	7.700	0.000
Gamma	0.523	0.116	4.520	0.000	Gamma	0.563	0.061	9.231	0.000	Gamma	0.590	0.073	8.064	0.000
Beta	0.871				Beta	0.855				Beta	0.845			

	f. 6th supergame					f. 6th supergame					f. 6th supergame			
	fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*		fraction	S.E.	z	*p (two-sided)*
AD	0.579	0.104	5.569	0.000	AD	0.476	0.053	8.914	0.000	AD	0.315	0.087	3.626	0.000
AC	0.129	0.128	1.008	0.157	AC	0.178	0.102	1.742	0.041	AC	0.299	0.170	1.759	0.039
GT	0.053	0.059	0.890	0.187	GT	0.177	0.067	2.636	0.004	GT	0.063	0.152	0.413	0.340
TFT	0.218	0.085	2.564	0.005	TFT	0.118	0.104	1.136	0.128	TFT	0.282	0.054	5.243	0.000
WSLS	0.022	0.125	0.173	0.431	WSLS	0.051	0.075	0.676	0.249	WSLS	0.042	0.086	0.489	0.313
T2	0.000	0.028	0.000	0.500	T2	0.000	0.062	0.000	0.500	T2	0.000	0.037	0.000	0.500
Gamma	0.532	0.114	4.651	0.000	Gamma	0.514	0.046	11.13	0.000	Gamma	0.650	0.103	6.297	0.000
Beta	0.868				Beta	0.875				Beta	0.823			

	IV. C-Full treatment				V. F-Full treatment			
	1st supergame				1st supergame			
	fraction	S.E.	z	*p (two-sided)*	fraction	S.E.	z	*p (two-sided)*
AD	0.315	0.161	1.952	0.025	0.253	0.147	1.724	0.042
AC	0.348	0.117	2.963	0.002	0.340	0.112	3.048	0.001
GT	0.203	0.178	1.144	0.126	0.190	0.186	1.026	0.152
TFT	0.134	0.110	1.219	0.112	0.103	0.133	0.770	0.221
WSLS	0.000	0.082	0.000	0.500	0.094	0.064	1.461	0.072
T2	0.000	0.030	0.000	0.500	0.020	0.108	0.183	0.427
Gamma	0.800	0.190	4.218	0.000	0.975	0.170	5.721	0.000
Beta	0.777				0.736	0.055		

	2nd supergame				2nd supergame			
	fraction	S.E.	z	*p (two-sided)*	fraction	S.E.	z	*p (two-sided)*
AD	0.481	0.123	3.902	0.000	0.296	0.182	1.624	0.052
AC	0.085	0.091	0.935	0.175	0.224	0.123	1.813	0.035
GT	0.242	0.073	3.311	0.000	0.091	0.148	0.615	0.269
TFT	0.071	0.101	0.709	0.239	0.084	0.084	1.007	0.157
WSLS	0.075	0.066	1.135	0.128	0.139	0.062	2.231	0.013
T2	0.046	0.060	0.761	0.223	0.166	0.080	2.062	0.020
Gamma	0.804	0.113	7.093	0.000	0.861	0.214	4.029	0.000
Beta	0.776				0.762			

	3rd supergame				3rd supergame			
	fraction	S.E.	z	*p (two-sided)*	fraction	S.E.	z	*p (two-sided)*
AD	0.409	0.182	2.241	0.013	0.250	0.176	1.417	0.078
AC	0.225	0.103	2.192	0.014	0.574	0.131	4.389	0.000
GT	0.136	0.114	1.191	0.117	0.073	0.185	0.393	0.347
TFT	0.169	0.102	1.666	0.048	0.045	0.076	0.591	0.277
WSLS	0.061	0.109	0.558	0.288	0.058	0.075	0.776	0.219
T2	0.000	0.078	0.000	0.500	0.000	0.093	0.000	0.500
Gamma	0.688	0.253	2.719	0.003	0.892	0.186	4.783	0.000
Beta	0.811				0.7543			

	4th supergame				4th supergame			
	fraction	S.E.	z	*p (two-sided)*	fraction	S.E.	z	*p (two-sided)*
AD	0.343	0.089	3.849	0.000	0.238	0.199	1.198	0.115
AC	0.417	0.086	4.847	0.000	0.520	0.124	4.190	0.000
GT	0.144	0.102	1.407	0.080	0.159	0.185	0.862	0.194
TFT	0.051	0.080	0.641	0.261	0.059	0.121	0.487	0.313
WSLS	0.011	0.088	0.127	0.449	0.024	0.060	0.396	0.346
T2	0.034	0.046	0.725	0.234	0.000	0.032	0.000	0.500
Gamma	0.568	0.093	6.125	0.000	0.846	0.194	4.367	0.000
Beta	0.853	0.034			0.765			

	5th supergame				5th supergame			
	fraction	S.E.	z	*p (two-sided)*	fraction	S.E.	z	*p (two-sided)*
AD	0.351	0.169	2.071	0.019	0.255	0.216	1.177	0.120
AC	0.315	0.126	2.504	0.006	0.428	0.121	3.547	0.000
GT	0.138	0.139	0.994	0.160	0.132	0.197	0.672	0.251
TFT	0.032	0.096	0.332	0.370	0.100	0.106	0.944	0.173
WSLS	0.109	0.048	2.285	0.011	0.070	0.067	1.057	0.145
T2	0.056	0.105	0.528	0.299	0.014	0.067	0.211	0.416
Gamma	0.771	0.145	5.337	0.000	0.745	0.248	3.007	0.001
Beta	0.785				0.793			

	6th supergame				6th supergame			
	fraction	S.E.	z	*p (two-sided)*	fraction	S.E.	z	*p (two-sided)*
AD	0.279	0.143	1.949	0.026	0.476	0.128	3.704	0.000
AC	0.456	0.108	4.236	0.000	0.259	0.101	2.557	0.005
GT	0.181	0.135	1.337	0.091	0.031	0.126	0.247	0.402
TFT	0.042	0.096	0.433	0.333	0.142	0.091	1.568	0.058
WSLS	0.043	0.053	0.815	0.208	0.091	0.071	1.288	0.099
T2	0.000	0.057	0.000	0.500	0.000	0.117	0.000	0.500
Gamma	0.739	0.155	4.766	0.000	0.905	0.082	10.99	0.000
Beta	0.795				0.751			

Note: $\beta = 1/(1 + \exp(-1/\gamma))$.

The following summarizes the test results comparing the subjects' strategy choices among the treatments based on the tables on the previous two pages:

	(*i*) % of the subjects who acted according to the AD strategy					(*ii*) % of the subjects who acted according to the AC strategy				
	N	C-Min	F-Min	C-Full	F-Full	N	C-Min	F-Min	C-Full	F-Full
N	---	.6141	.0295**	.2164	.0325**	---	.0726*	.0028***	.0095***	.0003***
C-Min	---	---	.1130	.4750	.1140	---	---	.2670	.4256	.0690*
F-Min	---	---	---	.4158	.9386	---	---	---	.7940	.4078
C-Full	---	---	---	---	.3967	---	---	---	---	.3117
F-Full	---	---	---	---	---	---	---	---	---	---

	(*iii*) % of the subjects who acted according to the GT strategy					(*iv*) % of the subjects who acted according to the TFT strategy				
	N	C-Min	F-Min	C-Full	F-Full	N	C-Min	F-Min	C-Full	F-Full
N	---	.9318	.6310	.5399	.6760	---	.1407	.4933	.0074***	.0074***
C-Min	---	---	.7073	.4987	.7484	---	---	.3745	.2084	.2372
F-Min	---	---	---	.2655	.9682	---	---	---	.0312**	.0332**
C-Full	---	---	---	---	.3086	---	---	---	---	.9010
F-Full	---	---	---	---	---	---	---	---	---	---

Notes: The numbers are *p*-values (two-sided) based on two-sample proportion tests. *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively. The percentages of those who selected the WSLS or T2 strategy were less than 10% in all treatments, making treatment comparisons meaningless.

Table B.8: *Strategy Choices Regarding Cooperation, Supergame by Supergame (supplementing Figure 2.4 of the main text)*

This table summarizes the details of the structural estimation results shown in Figure 2.4 of the main text. See Table 2.5 of the main text for the definition of each strategy. The p-values reported in the tables below are the results of two-sided z tests (z statistics were omitted to conserve space). The variables in bold represent the strategies reported in Figure 2.4.

As discussed in Dal Bó and Frechétte (2011), "gamma captures the amount of noise—as gamma goes to infinity response becomes purely random" (page 423). The estimated gamma in each structural estimation below shows that it is significant and is a sufficiently small number whose size is similar to the ones in Dal Bó and Frechétte (2011). This means that the model predicts the subjects' choices significantly better than purely random choices.

I. Estimation Results

(a) The N treatment

	1st supergame			2nd supergame			3rd supergame			4th supergame			5th supergame			6th supergame		
	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*
AD	**0.391**	**0.047**	**0.000**	**0.403**	**0.058**	**0.000**	**0.498**	**0.061**	**0.000**	**0.415**	**0.037**	**0.000**	**0.506**	**0.056**	**0.000**	**0.540**	**0.071**	**0.000**
AC	**0.101**	**0.093**	**0.278**	**0.040**	**0.093**	**0.670**	**0.074**	**0.089**	**0.407**	**0.063**	**0.081**	**0.436**	**0.056**	**0.179**	**0.755**	**0.100**	**0.143**	**0.484**
Grims	**0.188**			**0.244**			**0.241**			**0.148**			**0.206**			**0.178**		
Grim	*0.000*	*0.047*	*1.000*	*0.000*	*0.066*	*1.000*	*0.046*	*0.095*	*0.627*	*0.000*	*0.079*	*1.000*	*0.000*	*0.072*	*1.000*	*0.000*	*0.053*	*1.000*
Grim2	*0.039*	*0.058*	*0.496*	*0.120*	*0.000*	*n.a*	*0.081*	*0.063*	*0.202*	*0.000*	*0.000*	*n.a*	*0.036*	*0.000*	*n.a*	*0.098*	*0.000*	*n.a*
Grim3	*0.149*	*0.055*	*0.006*	*0.124*	*0.078*	*0.112*	*0.115*	*0.049*	*0.018*	*0.148*	*0.025*	*0.000*	*0.170*	*0.036*	*0.000*	*0.080*	*0.068*	*0.242*
TFTs	**0.260**			**0.282**			**0.187**			**0.219**			**0.132**			**0.165**		
TFT	*0.139*	*0.075*	*0.063*	*0.153*	*0.065*	*0.019*	*0.135*	*0.094*	*0.152*	*0.125*	*0.102*	*0.219*	*0.132*	*0.092*	*0.151*	*0.119*	*0.057*	*0.036*
TF2T	*0.035*	*0.091*	*0.702*	*0.040*	*0.057*	*0.479*	*0.052*	*0.105*	*0.617*	*0.058*	*0.101*	*0.564*	*0.000*	*0.111*	*1.000*	*0.000*	*0.089*	*1.000*
TF3T	*0.037*	*0.038*	*0.337*	*0.054*	*0.061*	*0.381*	*0.000*	*0.056*	*1.000*	*0.036*	*0.045*	*0.420*	*0.000*	*0.040*	*1.000*	*0.024*	*0.007*	*0.000*
2TFT	*0.050*	*0.047*	*0.288*	*0.036*	*0.035*	*0.312*	*0.000*	*0.050*	*1.000*	*0.000*	*0.053*	*1.000*	*0.000*	*0.010*	*1.000*	*0.022*	*0.047*	*0.632*
WSLS	**0.000**	**0.065**	**1.000**	**0.000**	**0.030**	**1.000**	**0.000**	**0.006**	**1.000**	**0.000**	**0.000**		**0.000**	**0.042**	**1.000**	**0.016**	**0.025**	**0.521**
TKs	**0.061**			**0.032**			**0.000**			**0.155**			**0.100**			**0.000**		
T2	*0.000*	*0.000*	*n.a*	*0.032*	*0.000*	*n.a*	*0.000*	*0.000*	*n.a*	*0.000*	*0.000*	*n.a*	*0.000*	*0.000*	*n.a*	*0.000*	*0.018*	*1.000*
T3	*0.061*	*0.024*	*0.013*	*0.000*	*0.031*	*1.000*	*0.000*	*0.040*	*1.000*	*0.037*	*0.015*	*0.013*	*0.000*	*0.004*	*1.000*	*0.000*	*0.029*	*1.000*
T4	*0.000*	*0.074*	*1.000*	*0.000*	*0.000*	*n.a*	*0.000*	*0.003*	*1.000*	*0.083*	*0.052*	*0.109*	*0.000*	*0.000*	*n.a*	*0.000*	*0.015*	*1.000*
T5	*0.000*	*0.038*	*1.000*	*0.000*	*0.010*	*1.000*	*0.000*	*0.003*	*1.000*	*0.035*	*0.094*	*0.711*	*0.100*	*0.028*	*0.000*	*0.000*	*0.016*	*1.000*
Gamma	0.517	0.047	0.000	0.506	0.058	0.000	0.470	0.061	0.000	0.397	0.037	0.000	0.448	0.056	0.000	0.465	0.071	0.000
Beta	0.874			0.878			0.894			0.926			0.903			0.896		

Notes: z statistics were omitted to conserve space. $\beta = 1/(1 + \exp(-1/\gamma))$.

(b) The C-Min treatment

	1st supergame			2nd supergame			3rd supergame			4th supergame			5th supergame			6th supergame		
	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*
AD	**0.210**	**0.102**	**0.039**	**0.415**	**0.043**	**0.000**	**0.377**	**0.057**	**0.000**	**0.341**	**0.054**	**0.000**	**0.429**	**0.078**	**0.000**	**0.394**	**0.040**	**0.000**
AC	**0.243**	**0.113**	**0.031**	**0.167**	**0.125**	**0.180**	**0.171**	**0.106**	**0.108**	**0.146**	**0.073**	**0.047**	**0.135**	**0.097**	**0.163**	**0.104**	**0.105**	**0.325**
Grims	**0.311**			**0.170**			**0.111**			**0.237**			**0.183**			**0.271**		
Grim	*0.135*	*0.134*	0.313	*0.000*	*0.099*	*1.000*	*0.000*	*0.070*	*1.000*	*0.000*	*0.125*	*1.000*	*0.000*	*0.066*	*1.000*	*0.000*	*0.063*	*1.000*
Grim2	*0.039*	*0.078*	0.615	*0.097*	*0.012*	*0.000*	*0.009*	*0.000*	*0.000*	*0.055*	*0.020*	*0.006*	*0.000*	*0.000*	*0.964*	*0.130*	*0.047*	*0.006*
Grim3	*0.136*	*0.042*	0.001	*0.051*	*0.062*	*0.415*	*0.102*	*0.021*	*0.000*	*0.183*	*0.035*	*0.000*	*0.183*	*0.047*	*0.000*	*0.047*	*0.082*	*0.565*
SGT	*0.000*	*0.047*	1.000	*0.022*	*0.126*	*0.863*	*0.000*	*0.094*	*1.000*	*0.000*	*0.078*	*1.000*	*0.000*	*0.030*	*1.000*	*0.094*	*0.055*	*0.089*
TFTs	**0.155**			**0.184**			**0.219**			**0.121**			**0.169**			**0.090**		
TFT	*0.103*	*0.081*	*0.201*	*0.079*	*0.053*	*0.135*	*0.064*	*0.051*	*0.215*	*0.031*	*0.090*	*0.730*	*0.061*	*0.072*	*0.400*	*0.047*	*0.041*	*0.248*
TF2T	*0.052*	*0.067*	*0.439*	*0.000*	*0.052*	*1.000*	*0.032*	*0.041*	*0.439*	*0.045*	*0.052*	*0.386*	*0.021*	*0.058*	*0.714*	*0.000*	*0.043*	*1.000*
TF3T	*0.000*	*0.057*	*1.000*	*0.105*	*0.006*	*0.000*	*0.088*	*0.042*	*0.036*	*0.045*	*0.046*	*0.330*	*0.042*	*0.029*	*0.150*	*0.036*	*0.019*	*0.053*
2TFT	*0.000*	*0.059*	*1.000*	*0.000*	*0.057*	*1.000*	*0.036*	*0.085*	*0.675*	*0.000*	*0.057*	*1.000*	*0.044*	*0.044*	*0.318*	*0.007*	*0.044*	*0.877*
WSLS	**0.049**	**0.000**	**0.000**	**0.000**	**0.009**	**1.000**	**0.011**	**0.039**	**0.778**	**0.023**	**0.032**	**0.462**	**0.050**	**0.041**	**0.231**	**0.038**	**0.031**	**0.221**
TKs	**0.000**			**0.000**			**0.000**			**0.016**			**0.020**			**0.000**		
T2	*0.000*	*0.039*	*1.000*	*0.000*	*0.037*	*1.000*	*0.000*	*0.029*	*1.000*	*0.000*	*0.049*	*1.000*	*0.000*	*0.050*	*1.000*	*0.000*	*0.043*	*1.000*
T3	*0.000*	*0.115*	*1.000*	*0.000*	*0.000*	*0.966*	*0.000*	*0.031*	*1.000*	*0.016*	*0.065*	*0.805*	*0.000*	*0.028*	*1.000*	*0.000*	*0.019*	*1.000*
T4	*0.000*	*0.015*	*1.000*	*0.000*	*0.000*	*0.997*	*0.000*	*0.001*	*1.000*	*0.000*	*0.025*	*1.000*	*0.000*	*0.000*	*0.995*	*0.000*	*0.000*	*0.922*
T5	*0.000*	*0.000*	*0.990*	*0.000*	*0.000*	*1.000*	*0.000*	*0.000*	*0.979*	*0.000*	*0.000*	*0.584*	*0.020*	*0.000*	*0.000*	*0.000*	*0.000*	*1.000*
Reps	**0.032**			**0.064**			**0.112**			**0.115**			**0.015**			**0.103**		
RepL	*0.032*	*0.073*	0.663	*0.064*	*0.001*	*0.000*	*0.112*	*0.000*	*0.000*	*0.115*	*0.021*	*0.000*	*0.015*	*0.045*	*0.744*	*0.103*	*0.022*	*0.000*
Gamma	0.613	0.102	0.000	0.464	0.043	0.000	0.488	0.057	0.000	0.568	0.054	0.000	0.498	0.078	0.000	0.441	0.040	0.000
Beta	0.836			0.896			0.886			0.853			0.882			0.906		

Notes: z statistics were omitted to conserve space. $\beta = 1/(1 + \exp(-1/\gamma))$.

(c) the F-Min treatment

	1st supergame			2nd supergame			3rd supergame			4th supergame			5th supergame			6th supergame		
	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*
AD	**0.232**	**0.080**	**0.004**	**0.331**	**0.066**	**0.000**	**0.278**	**0.084**	**0.001**	**0.283**	**0.050**	**0.000**	**0.260**	**0.062**	**0.000**	**0.264**	**0.074**	**0.000**
AC	**0.172**	**0.087**	**0.048**	**0.207**	**0.091**	**0.023**	**0.165**	**0.098**	**0.093**	**0.276**	**0.093**	**0.003**	**0.282**	**0.152**	**0.063**	**0.174**	**0.111**	**0.118**
Grims	**0.271**			**0.118**			**0.222**			**0.118**			**0.182**			**0.387**		
Grim	*0.000*	*0.106*	*1.000*	*0.000*	*0.127*	*1.000*	*0.000*	*0.094*	*1.000*	*0.000*	*0.132*	*1.000*	*0.000*	*0.107*	*1.000*	*0.000*	*0.078*	*1.000*
Grim2	*0.014*	*0.016*	*0.369*	*0.118*	*0.007*	*0.000*	*0.071*	*0.079*	*0.368*	*0.085*	*0.000*	*0.000*	*0.057*	*0.000*	*0.000*	*0.077*	*0.000*	*0.000*
Grim3	*0.257*	*0.051*	*0.000*	*0.000*	*0.057*	*1.000*	*0.096*	*0.092*	*0.295*	*0.000*	*0.106*	*1.000*	*0.125*	*0.052*	*0.017*	*0.218*	*0.061*	*0.000*
SGT	*0.000*	*0.042*	*1.000*	*0.000*	*0.093*	*1.000*	*0.054*	*0.071*	*0.446*	*0.033*	*0.048*	*0.495*	*0.000*	*0.000*	*0.930*	*0.091*	*0.045*	*0.044*
TFTs	**0.196**			**0.164**			**0.111**			**0.208**			**0.212**			**0.111**		
TFT	*0.148*	*0.101*	*0.141*	*0.061*	*0.056*	*0.282*	*0.061*	*0.053*	*0.253*	*0.079*	*0.000*	*0.000*	*0.159*	*0.097*	*0.101*	*0.097*	*0.060*	*0.108*
TF2T	*0.048*	*0.096*	*0.620*	*0.025*	*0.070*	*0.724*	*0.008*	*0.052*	*0.881*	*0.100*	*0.057*	*0.083*	*0.000*	*0.120*	*1.000*	*0.012*	*0.054*	*0.828*
TF3T	*0.000*	*0.076*	*1.000*	*0.060*	*0.056*	*0.280*	*0.042*	*0.035*	*0.227*	*0.000*	*0.089*	*1.000*	*0.053*	*0.077*	*0.491*	*0.000*	*0.092*	*1.000*
2TFT	*0.000*	*0.037*	*1.000*	*0.018*	*0.050*	*0.718*	*0.000*	*0.040*	*1.000*	*0.029*	*0.105*	*0.783*	*0.000*	*0.059*	*1.000*	*0.002*	*0.010*	*0.811*
WSLS	**0.033**	**0.000**	**0.000**	**0.000**	**0.042**	**1.000**	**0.020**	**0.007**	**0.005**	**0.000**	**0.063**	**1.000**	**0.000**	**0.044**	**1.000**	**0.000**	**0.021**	**1.000**
TKs	**0.054**			**0.000**			**0.114**			**0.000**			**0.064**			**0.000**		
T2	*0.000*	*0.034*	*1.000*	*0.000*	*0.001*	*1.000*	*0.000*	*0.032*	*1.000*	*0.000*	*0.044*	*1.000*	*0.064*	*0.000*	*0.000*	*0.000*	*0.000*	*0.694*
T3	*0.000*	*0.020*	*1.000*	*0.000*	*0.068*	*1.000*	*0.114*	*0.025*	*0.000*	*0.000*	*0.055*	*1.000*	*0.000*	*0.089*	*1.000*	*0.000*	*0.031*	*1.000*
T4	*0.054*	*0.000*	*0.000*	*0.000*	*0.000*	*0.982*	*0.000*	*0.062*	*1.000*	*0.000*	*0.000*	*0.912*	*0.000*	*0.000*	*0.948*	*0.000*	*0.000*	*0.876*
T5	*0.000*	*0.097*	*1.000*	*0.000*	*0.000*	*1.000*	*0.000*	*0.000*	*0.959*	*0.000*	*0.000*	*0.802*	*0.000*	*0.000*	*0.941*	*0.000*	*0.000*	*0.832*
Reps	**0.042**			**0.179**			**0.090**			**0.116**			**0.000**			**0.064**		
RepL	*0.042*	*0.018*	*0.019*	*0.179*	*0.013*	*0.000*	*0.090*	*0.013*	*0.000*	*0.116*	*0.011*	*0.000*	*0.000*	*0.000*	*0.960*	*0.064*	*0.014*	*0.000*
Gamma	0.605	0.080	0.000	0.529	0.066	0.000	0.441	0.084	0.000	0.461	0.050	0.000	0.526	0.062	0.000	0.533	0.074	0.000
Beta	0.839			0.869			0.906			0.898			0.870			0.867		

Notes: z statistics were omitted to conserve space. $\beta = 1/(1 + \exp(-1/\gamma))$.

(d) The C-Full treatment

	1st supergame			2nd supergame			3rd supergame			4th supergame			5th supergame			6th supergame		
	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*
AD	**0.281**	**0.113**	**0.013**	**0.326**	**0.070**	**0.000**	**0.351**	**0.069**	**0.000**	**0.281**	**0.063**	**0.000**	**0.236**	**0.050**	**0.000**	**0.199**	**0.055**	**0.000**
AC	**0.151**	**0.095**	**0.111**	**0.000**	**0.096**	**1.000**	**0.109**	**0.114**	**0.342**	**0.218**	**0.086**	**0.012**	**0.113**	**0.100**	**0.259**	**0.213**	**0.090**	**0.018**
Grims	**0.238**			**0.169**			**0.161**			**0.074**			**0.121**			**0.042**		
Grim	*0.096*	*0.117*	*0.414*	*0.000*	*0.042*	*1.000*	*0.000*	*0.096*	*1.000*	*0.000*	*0.114*	*1.000*	*0.000*	*0.096*	*1.000*	*0.000*	*0.113*	*1.000*
Grim2	*0.089*	*0.095*	*0.349*	*0.038*	*0.038*	*0.315*	*0.099*	*0.000*	*0.000*	*0.000*	*0.000*	*0.996*	*0.077*	*0.000*	*0.000*	*0.000*	*0.032*	*1.000*
Grim3	*0.053*	*0.067*	*0.434*	*0.091*	*0.059*	*0.127*	*0.000*	*0.069*	*1.000*	*0.074*	*0.009*	*0.000*	*0.008*	*0.070*	*0.912*	*0.008*	*0.021*	*0.689*
SGT	*0.000*	*0.001*	*1.000*	*0.040*	*0.046*	*0.377*	*0.062*	*0.039*	*0.114*	*0.000*	*0.000*	*0.969*	*0.036*	*0.027*	*0.177*	*0.033*	*0.009*	*0.000*
TFTs	**0.248**			**0.041**			**0.127**			**0.055**			**0.050**			**0.000**		
TFT	*0.105*	*0.066*	*0.114*	*0.041*	*0.051*	*0.423*	*0.034*	*0.053*	*0.524*	*0.029*	*0.117*	*0.804*	*0.001*	*0.051*	*0.991*	*0.000*	*0.041*	*1.000*
TF2T	*0.054*	*0.068*	*0.423*	*0.000*	*0.044*	*1.000*	*0.000*	*0.035*	*1.000*	*0.000*	*0.059*	*1.000*	*0.050*	*0.027*	*0.067*	*0.000*	*0.000*	*0.834*
TF3T	*0.088*	*0.051*	*0.083*	*0.000*	*0.000*	*0.976*	*0.093*	*0.005*	*0.000*	*0.000*	*0.001*	*1.000*	*0.000*	*0.044*	*1.000*	*0.000*	*0.036*	*1.000*
2TFT	*0.000*	*0.150*	*1.000*	*0.000*	*0.000*	*0.985*	*0.000*	*0.087*	*1.000*	*0.026*	*0.001*	*0.000*	*0.000*	*0.011*	*1.000*	*0.000*	*0.110*	*1.000*
WSLS	**0.000**	**0.013**	**1.000**	**0.005**	**0.000**	**0.000**	**0.000**	**0.000**	**0.990**	**0.020**	**0.029**	**0.498**	**0.007**	**0.000**	**0.000**	**0.040**	**0.031**	**0.189**
TKs	**0.008**			**0.087**			**0.000**			**0.070**			**0.117**			**0.072**		
T2	*0.000*	*0.000*	*0.363*	*0.064*	*0.020*	*0.001*	*0.000*	*0.029*	*1.000*	*0.000*	*0.038*	*1.000*	*0.070*	*0.020*	*0.000*	*0.000*	*0.039*	*1.000*
T3	*0.000*	*0.113*	*1.000*	*0.023*	*0.048*	*0.632*	*0.000*	*0.016*	*1.000*	*0.070*	*0.000*	*0.000*	*0.000*	*0.059*	*1.000*	*0.000*	*0.041*	*1.000*
T4	*0.008*	*0.000*	*0.000*	*0.000*	*0.068*	*1.000*	*0.000*	*0.000*	*0.958*	*0.000*	*0.048*	*1.000*	*0.000*	*0.000*	*0.979*	*0.000*	*0.015*	*1.000*
T5	*0.000*	*0.072*	*1.000*	*0.000*	*0.000*	*0.895*	*0.000*	*0.030*	*1.000*	*0.000*	*0.007*	*1.000*	*0.047*	*0.000*	*0.000*	*0.072*	*0.018*	*0.000*
Reps	**0.074**			**0.371**			**0.253**			**0.282**			**0.355**			**0.434**		
RepL	*0.000*	*0.105*	*1.000*	*0.011*	*0.049*	*0.817*	*0.018*	*0.015*	*0.223*	*0.000*	*0.016*	*1.000*	*0.020*	*0.053*	*0.701*	*0.000*	*0.058*	*1.000*
6Rep100	*0.000*	*0.000*	*0.994*	*0.000*	*0.000*	*0.980*	*0.030*	*0.012*	*0.011*	*0.000*	*0.016*	*1.000*	*0.025*	*0.016*	*0.113*	*0.020*	*0.069*	*0.766*
6Rep50	*0.000*	*0.064*	*1.000*	*0.000*	*0.037*	*1.000*	*0.000*	*0.064*	*1.000*	*0.000*	*0.000*	*0.882*	*0.000*	*0.065*	*1.000*	*0.000*	*0.043*	*1.000*
Rep100	*0.000*	*0.000*	*0.992*	*0.141*	*0.070*	*0.044*	*0.027*	*0.040*	*0.494*	*0.068*	*0.046*	*0.138*	*0.055*	*0.037*	*0.137*	*0.042*	*0.051*	*0.416*
Rep75	*0.000*	*0.028*	*1.000*	*0.000*	*0.098*	*1.000*	*0.033*	*0.028*	*0.238*	*0.000*	*0.074*	*1.000*	*0.094*	*0.051*	*0.068*	*0.030*	*0.052*	*0.559*
Rep50	*0.000*	*0.008*	*1.000*	*0.129*	*0.017*	*0.000*	*0.144*	*0.067*	*0.032*	*0.117*	*0.051*	*0.023*	*0.086*	*0.069*	*0.215*	*0.296*	*0.061*	*0.000*
Rep25	*0.074*	*0.034*	*0.031*	*0.090*	*0.079*	*0.252*	*0.000*	*0.077*	*1.000*	*0.096*	*0.089*	*0.280*	*0.075*	*0.068*	*0.269*	*0.046*	*0.129*	*0.724*
Gamma	0.710	0.113	0.000	0.651	0.070	0.000	0.541	0.069	0.000	0.419	0.063	0.000	0.501	0.050	0.000	0.534	0.055	0.000
Beta	0.804			0.823			0.864			0.916			0.880			0.867		

Notes: z statistics were omitted to conserve space. $\beta = 1/(1 + \exp(-1/\gamma))$.

(e) The F-Full treatment

	1st supergame			2nd supergame			3rd supergame			4th supergame			5th supergame			6th supergame		
	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*	fraction	S.E	*p value*
AD	**0.130**	**0.128**	**0.309**	**0.213**	**0.092**	**0.020**	**0.150**	**0.066**	**0.022**	**0.177**	**0.084**	**0.035**	**0.145**	**0.093**	**0.119**	**0.205**	**0.066**	**0.002**
AC	**0.116**	**0.089**	**0.191**	**0.000**	**0.097**	**1.000**	**0.027**	**0.104**	**0.792**	**0.133**	**0.115**	**0.249**	**0.000**	**0.108**	**1.000**	**0.000**	**0.076**	**1.000**
Grims	**0.188**			**0.119**			**0.012**			**0.021**			**0.274**			**0.084**		
Grim	*0.000*	*0.076*	*1.000*	*0.000*	*0.095*	*1.000*	*0.000*	*0.069*	*1.000*	*0.021*	*0.093*	*0.820*	*0.000*	*0.000*	*0.804*	*0.000*	*0.028*	*1.000*
Grim2	*0.035*	*0.021*	*0.089*	*0.062*	*0.000*	*0.000*	*0.012*	*0.019*	*0.533*	*0.000*	*0.031*	*1.000*	*0.009*	*0.000*	*0.000*	*0.000*	*0.000*	*0.964*
Grim3	*0.000*	*0.035*	*1.000*	*0.022*	*0.057*	*0.692*	*0.000*	*0.036*	*1.000*	*0.000*	*0.033*	*1.000*	*0.192*	*0.039*	*0.000*	*0.000*	*0.000*	*0.985*
SGT	*0.153*	*0.051*	*0.003*	*0.035*	*0.041*	*0.399*	*0.000*	*0.031*	*1.000*	*0.000*	*0.049*	*0.998*	*0.072*	*0.048*	*0.134*	*0.084*	*0.000*	*0.000*
TFTs	**0.089**			**0.186**			**0.119**			**0.137**			**0.165**			**0.185**		
TFT	*0.089*	*0.079*	*0.262*	*0.000*	*0.134*	*1.000*	*0.006*	*0.005*	*0.278*	*0.033*	*0.009*	*0.000*	*0.032*	*0.131*	*0.809*	*0.010*	*0.007*	*0.178*
TF2T	*0.000*	*0.065*	*1.000*	*0.093*	*0.022*	*0.000*	*0.000*	*0.034*	*1.000*	*0.059*	*0.052*	*0.263*	*0.000*	*0.040*	*1.000*	*0.100*	*0.049*	*0.041*
TF3T	*0.000*	*0.000*	*0.000*	*0.063*	*0.092*	*0.490*	*0.073*	*0.023*	*0.002*	*0.045*	*0.064*	*0.483*	*0.088*	*0.000*	*0.000*	*0.075*	*0.065*	*0.254*
2TFT	*0.000*	*0.055*	*1.000*	*0.029*	*0.042*	*0.488*	*0.040*	*0.062*	*0.522*	*0.000*	*0.097*	*1.000*	*0.045*	*0.124*	*0.716*	*0.000*	*0.057*	*1.000*
WSLS	**0.051**	**0.000**	**0.000**	**0.093**	**0.047**	**0.049**	**0.024**	**0.061**	**0.698**	**0.000**	**0.000**	**0.944**	**0.051**	**0.038**	**0.179**	**0.036**	**0.000**	**0.000**
TKs	**0.054**			**0.000**			**0.000**			**0.015**			**0.000**			**0.018**		
T2	*0.046*	*0.061*	*0.455*	*0.000*	*0.067*	*1.000*	*0.000*	*0.039*	*1.000*	*0.000*	*0.000*	*0.850*	*0.000*	*0.046*	*1.000*	*0.000*	*0.038*	*1.000*
T3	*0.008*	*0.065*	*0.897*	*0.000*	*0.037*	*1.000*	*0.000*	*0.008*	*1.000*	*0.000*	*0.000*	*0.998*	*0.000*	*0.010*	*1.000*	*0.018*	*0.000*	*0.000*
T4	*0.000*	*0.071*	*1.000*	*0.000*	*0.000*	*0.761*	*0.000*	*0.041*	*1.000*	*0.000*	*0.017*	*1.000*	*0.000*	*0.000*	*0.805*	*0.000*	*0.037*	*1.000*
T5	*0.000*	*0.057*	*1.000*	*0.000*	*0.000*	*0.931*	*0.000*	*0.033*	*1.000*	*0.015*	*0.006*	*0.013*	*0.000*	*0.000*	*0.337*	*0.000*	*0.000*	*0.954*
Reps	**0.372**			**0.389**			**0.668**			**0.517**			**0.366**			**0.471**		
RepL	*0.028*	*0.017*	*0.112*	*0.015*	*0.000*	*0.000*	*0.025*	*0.027*	*0.355*	*0.038*	*0.033*	*0.249*	*0.064*	*0.061*	*0.287*	*0.000*	*0.000*	*0.966*
6Rep100	*0.027*	*0.101*	*0.786*	*0.000*	*0.035*	*1.000*	*0.000*	*0.056*	*1.000*	*0.058*	*0.060*	*0.333*	*0.000*	*0.092*	*1.000*	*0.000*	*0.028*	*1.000*
6Rep50	*0.100*	*0.109*	*0.361*	*0.020*	*0.045*	*0.658*	*0.033*	*0.000*	*0.000*	*0.066*	*0.050*	*0.186*	*0.189*	*0.098*	*0.055*	*0.000*	*0.079*	*1.000*
Rep100	*0.000*	*0.045*	*1.000*	*0.000*	*0.019*	*1.000*	*0.061*	*0.000*	*0.000*	*0.000*	*0.054*	*1.000*	*0.049*	*0.023*	*0.037*	*0.097*	*0.000*	*0.000*
Rep75	*0.000*	*0.032*	*1.000*	*0.022*	*0.000*	*0.000*	*0.066*	*0.044*	*0.132*	*0.118*	*0.000*	*0.000*	*0.027*	*0.041*	*0.499*	*0.007*	*0.084*	*0.929*
Rep50	*0.176*	*0.000*	*0.000*	*0.149*	*0.046*	*0.001*	*0.362*	*0.044*	*0.000*	*0.237*	*0.089*	*0.008*	*0.000*	*0.060*	*1.000*	*0.244*	*0.032*	*0.000*
Rep25	*0.041*	*0.092*	*0.656*	*0.183*	*0.082*	*0.026*	*0.120*	*0.098*	*0.220*	*0.000*	*0.105*	*1.000*	*0.037*	*0.024*	*0.126*	*0.123*	*0.071*	*0.083*
Gamma	0.739	0.128	*0.000*	0.673	0.092	*0.000*	0.672	0.066	*0.000*	0.620	0.084	*0.000*	0.683	0.093	*0.000*	0.651	0.066	*0.000*
Beta	0.795			0.816			0.816			0.834			0.812			0.823		

Notes: z statistics were omitted to conserve space. $\beta = 1/(1 + \exp(-1/\gamma))$.

II. Across-Treatment Comparison

The following summarizes the test results comparing the subjects' overall strategy choices across treatments based on the averages reported in Figure 2.4 of the main text.

	(*i*) % of the subjects who acted according to the AD strategy					(*ii*) % of the subjects who acted according to the AC strategy				
	N	C-Min	F-Min	C-Full	F-Full	N	C-Min	F-Min	C-Full	F-Full
N	---	.2466	.0157**	.0304**	.0002***	---	.1042	.0132**	.2338	.5067
C-Min	---	---	.2582	.3200	.0112	---	---	.4230	.6666	.0260**
F-Min	---	---	---	.9566	.1151	---	---	---	.2118	.0024***
C-Full	---	---	---	---	.1264	---	---	---	---	.0704*
F-Full	---	---	---	---	---	---	---	---	---	---

	(*iii*) % of the subjects who acted according to the Grims strategy					(*iv*) % of the subjects who acted according to the TFTs strategy				
	N	C-Min	F-Min	C-Full	F-Full	N	C-Min	F-Min	C-Full	F-Full
N	---	.8527	.8122	.3004	.1644	---	.4384	.5107	.0495**	.3393
C-Min	---	---	.9713	.2345	.1233	---	---	.8572	.2307	.8798
F-Min	---	---	---	.1949	.0948*	---	---	---	.1513	.7273
C-Full	---	---	---	---	.7524	---	---	---	---	.2807
F-Full	---	---	---	---	---	---	---	---	---	---

	(*v*) % of the subjects who acted according to the Reps strategy			
	C-Min	F-Min	C-Full	F-Full
C-Min	---	.8473	.0012***	.0000***
F-Min	---	---	.0006***	.0000***
C-Full	---	---	---	.0432**
F-Full	---	---	---	---

Notes: The numbers are *p*-values (two-sided) based on two-sample proportion tests. *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

Table B.9: *Strategy Choices Regarding Cooperation using (a) All Data or (b) the Second half of the Experiment (supplementing Figure 2.4 of the main text, and Table B.8 of the Appendix)*

Figure 2.4 and Table B.8 reported the structural estimation results by supergame. Such supergame-by-supergame estimation is useful because it usually takes time for subjects to learn the strategic environment they face, as infinitely repeated interactions are quite complex. For this reason, Dal Bó and Fréchette (2011) focused on repeated games that started only after 110 interactions in their experiments for structural estimations. The present study adopted a random matching environment and had only six matches (phases), while each supergame had many more observations with a larger continuation probability than in Dal Bó and Fréchette (2011). The distribution of strategies taken after gaining sufficient experience can be seen from the estimation results in a later supergame, for example, the sixth phase, and the estimation results from phases 1 to 6 show the transition of subjects' strategy choices over time. The gamma value in each estimation, summarized in Figure 2.4 and Table B.8, is small and significant, which means that the estimation predicts the behavior quite well (significantly better than a purely random choice).

However, as summarized below, as a robustness check, we also estimated the distributions of subjects' strategy choices using the data from all phases. Doing so allows sufficient variation in behavior with a large dataset, which is an advantage for estimating distributions, although it can include behavioral data before converging to certain strategy choices. Note that there is no clear way to determine how quickly the distribution of strategy choices converges.

We further estimated the distributions of the subjects' strategy choices using data from the second half of the experiment (phases 4 to 6). Here, the last three phases were selected ad hoc by the authors. However, the strategy choices in the second half could be considered stable after gaining experience with the interactions in the first half of the experiment. Consistent with this logic, the estimated gamma values in the C-Full and F-Full treatments (see next page) are much lower when using the data from the second half of the experiment than when using all the data.

The estimation results, summarized on the next page, show qualitatively similar patterns to those shown in Figure 2.4 and Table B.8:

(a) The AD strategy was the most popular strategy in the N treatment. The popularity of the AD strategy was lower under endogenous monitoring than under the N treatment.

(b) The AC strategy was often adopted in the F-Min strategy, unlike in the N or C-Min treatment.

(c) The Reps strategy gained popularity in the C-Full and F-Full treatments, whose sizes were similar to those reported in Figure 2.4 and Table B.8. In contrast, the Reps strategy was used much less frequently used in the Min than in the Full treatments.

(d) The Rep50 strategy was by far the most popular reputation strategy in the Full treatments.

[Estimation results when using all data:]

	N treatment			C-Min treatment			F-Min treatment			C-Full treatment			F-Full treatment		
	fraction	S.E.	*p* (2-sided)	fraction	S.E.	*p* (2-sided)	fraction	S.E.	*p* (2-sided)	fraction	S.E.	*p* (2-sided)	fraction	S.E.	*p* (2-sided)
AD	**0.381**	**0.050**	**0.000**	**0.332**	**0.068**	**0.000**	**0.276**	**0.054**	**0.000**	**0.305**	**0.067**	**0.000**	**0.184**	**0.099**	**0.064**
AC	**0.044**	**0.114**	**0.700**	**0.062**	**0.065**	**0.339**	**0.177**	**0.077**	**0.022**	**0.031**	**0.103**	**0.767**	**0.062**	**0.085**	**0.468**
Grims	**0.287**			**0.296**			**0.338**			**0.216**			**0.106**		
Grim	*0.041*	*0.051*	*0.422*	*0.000*	*0.034*	*1.000*	*0.000*	*0.063*	*1.000*	*0.000*	*0.047*	*1.000*	*0.000*	*0.044*	*1.000*
Grim2	*0.127*	*0.045*	*0.005*	*0.049*	*0.000*	*0.000*	*0.119*	*0.000*	*0.000*	*0.040*	*0.000*	*0.000*	*0.012*	*0.031*	*0.704*
Grim3	*0.119*	*0.059*	*0.044*	*0.247*	*0.032*	*0.000*	*0.214*	*0.063*	*0.001*	*0.176*	*0.042*	*0.000*	*0.031*	*0.030*	*0.298*
SGT	*n.a.*	*n.a.*		*0.000*	*0.043*	*1.000*	*0.005*	*0.036*	*0.887*	*0.000*	*0.000*	*0.958*	*0.062*	*0.044*	*0.156*
TFTs	**0.261**			**0.212**			**0.164**			**0.065**			**0.080**		
TFT	*0.172*	*0.074*	*0.021*	*0.103*	*0.075*	*0.168*	*0.117*	*0.060*	*0.051*	*0.000*	*0.064*	*1.000*	*0.028*	*0.029*	*0.346*
TF2T	*0.010*	*0.094*	*0.917*	*0.000*	*0.048*	*1.000*	*0.000*	*0.050*	*1.000*	*0.000*	*0.009*	*1.000*	*0.004*	*0.032*	*0.911*
TF3T	*0.040*	*0.025*	*0.111*	*0.094*	*0.015*	*0.000*	*0.047*	*0.029*	*0.112*	*0.065*	*0.000*	*0.000*	*0.049*	*0.015*	*0.001*
2TFT	*0.039*	*0.033*	*0.234*	*0.015*	*0.069*	*0.827*	*0.000*	*0.042*	*1.000*	*0.000*	*0.035*	*1.000*	*0.000*	*0.042*	*1.000*
WSLS	**0.000**	**0.033**	**1.000**	**0.000**	**0.020**	**1.000**	**0.000**	**0.000**	**0.941**	**0.015**	**0.011**	**0.181**	**0.037**	**0.016**	**0.022**
TKs	**0.028**			**0.047**			**0.018**			**0.062**			**0.044**		
T2	*0.000*	*0.000*	*0.905*	*0.016*	*0.000*	*0.000*	*0.005*	*0.000*	*0.000*	*0.017*	*0.021*	*0.411*	*0.000*	*0.049*	*1.000*
T3	*0.028*	*0.000*	*0.000*	*0.000*	*0.017*	*1.000*	*0.000*	*0.017*	*1.000*	*0.000*	*0.027*	*1.000*	*0.000*	*0.000*	*0.328*
T4	*0.000*	*0.042*	*1.000*	*0.000*	*0.015*	*1.000*	*0.000*	*0.000*	*0.902*	*0.000*	*0.000*	*1.000*	*0.000*	*0.006*	*1.000*
T5	*0.000*	*0.000*	*0.999*	*0.031*	*0.013*	*0.017*	*0.013*	*0.009*	*0.152*	*0.045*	*0.000*	*0.000*	*0.044*	*0.018*	*0.015*
Reps	**n.a.**	**n.a.**	**n.a.**	**0.051**			**0.027**			**0.306**			**0.488**		
RepL	---	---	---	*0.051*	*0.048*	*0.283*	*0.027*	*0.014*	*0.054*	*0.000*	*0.031*	*1.000*	*0.027*	*0.044*	*0.538*
6Rep100	---	---	---	---	---	---	---	---	---	*0.006*	*0.000*	*0.000*	*0.001*	*0.050*	*0.984*
6Rep50	---	---	---	---	---	---	---	---	---	*0.000*	*0.000*	*1.000*	*0.038*	*0.058*	*0.510*
Rep100	---	---	---	---	---	---	---	---	---	*0.051*	*0.029*	*0.081*	*0.033*	*0.013*	*0.010*
Rep75	---	---	---	---	---	---	---	---	---	*0.049*	*0.049*	*0.311*	*0.054*	*0.034*	*0.108*
Rep50	---	---	---	---	---	---	---	---	---	*0.153*	*0.066*	*0.021*	*0.250*	*0.048*	*0.000*
Rep25	---	---	---	---	---	---	---	---	---	*0.048*	*0.062*	*0.435*	*0.084*	*0.116*	*0.466*
Gamma	0.544	0.050	0.000	0.638	0.068	0.000	0.632	0.054	0.000	0.732	0.067	0.000	0.779	0.099	0.000
Beta	0.863			0.827			0.829			0.797			0.783		

Notes: z statistics were omitted to conserve space. $\beta = 1/(1 + \exp(-1/\gamma))$.

[Estimation results when using data from phases 4 to 6 (2nd half of the experiment):]

	N treatment			C-Min treatment			F-Min treatment			C-Full treatment			F-Full treatment		
	fraction	S.E.	*p* (2-sided)	fraction	S.E.	*p* (2-sided)	fraction	S.E.	*p* (2-sided)	fraction	S.E.	*p* (2-sided)	fraction	S.E.	*p* (2-sided)
AD	**0.477**	**0.043**	**0.000**	**0.356**	**0.085**	**0.000**	**0.315**	**0.064**	**0.000**	**0.283**	**0.057**	**0.000**	**0.199**	**0.097**	**0.041**
AC	**0.044**	**0.137**	**0.748**	**0.041**	**0.076**	**0.588**	**0.202**	**0.100**	**0.044**	**0.179**	**0.100**	**0.075**	**0.085**	**0.081**	**0.289**
Grims	**0.234**			**0.332**			**0.182**			**0.096**			**0.074**		
Grim	*0.000*	*0.049*	*1.000*	*0.000*	*0.050*	*1.000*	*0.000*	*0.076*	*1.000*	*0.000*	*0.076*	*1.000*	*0.000*	*0.079*	*1.000*
Grim2	*0.109*	*0.013*	*0.000*	*0.029*	*0.028*	*0.307*	*0.063*	*0.000*	*0.000*	*0.035*	*0.011*	*0.001*	*0.014*	*0.003*	*0.000*
Grim3	*0.125*	*0.063*	*0.045*	*0.249*	*0.038*	*0.000*	*0.104*	*0.055*	*0.058*	*0.060*	*0.035*	*0.088*	*0.000*	*0.028*	*1.000*
SGT				*0.055*	*0.051*	*0.285*	*0.016*	*0.043*	*0.711*	*0.000*	*0.000*	*0.896*	*0.060*	*0.023*	*0.009*
TFTs	**0.215**			**0.144**			**0.225**			**0.021**			**0.107**		
TFT	*0.198*	*0.071*	*0.005*	*0.040*	*0.089*	*0.651*	*0.101*	*0.083*	*0.226*	*0.000*	*0.050*	*1.000*	*0.018*	*0.000*	*0.000*
TF2T	*0.000*	*0.105*	*1.000*	*0.000*	*0.032*	*1.000*	*0.071*	*0.049*	*0.147*	*0.000*	*0.000*	*0.906*	*0.021*	*0.023*	*0.376*
TF3T	*0.017*	*0.026*	*0.512*	*0.104*	*0.043*	*0.016*	*0.044*	*0.060*	*0.466*	*0.000*	*0.000*	*0.861*	*0.068*	*0.030*	*0.024*
2TFT	*0.000*	*0.022*	*1.000*	*0.000*	*0.060*	*1.000*	*0.010*	*0.054*	*0.849*	*0.021*	*0.000*	*0.000*	*0.000*	*0.055*	*1.000*
WSLS	**0.000**	**0.012**	**1.000**	**0.017**	**0.007**	**0.015**	**0.000**	**0.019**	**1.000**	**0.000**	**0.028**	**1.000**	**0.018**	**0.000**	**0.000**
TKs	**0.029**			**0.054**			**0.000**			**0.018**			**0.000**		
T2	*0.000*	*0.009*	*1.000*	*0.045*	*0.039*	*0.242*	*0.000*	*0.000*	*0.505*	*0.000*	*0.004*	*1.000*	*0.000*	*0.027*	*1.000*
T3	*0.029*	*0.009*	*0.001*	*0.008*	*0.041*	*0.837*	*0.000*	*0.000*	*0.903*	*0.000*	*0.020*	*1.000*	*0.000*	*0.000*	*0.916*
T4	*0.000*	*0.041*	*1.000*	*0.000*	*0.034*	*1.000*	*0.000*	*0.000*	*0.735*	*0.000*	*0.005*	*1.000*	*0.000*	*0.000*	*0.929*
T5	*0.000*	*0.012*	*1.000*	*0.000*	*0.000*	*0.857*	*0.000*	*0.000*	*0.000*	*0.018*	*0.000*	*0.000*	*0.000*	*0.000*	*0.988*
Reps	**n.a.**	**n.a.**	**n.a.**	**0.057**			**0.075**			**0.404**			**0.516**		
RepL	---	---	---	*0.057*	*0.013*	*0.000*	*0.075*	*0.021*	*0.000*	*0.000*	*0.018*	*1.000*	*0.000*	*0.021*	*1.000*
6Rep100	---	---	---	---	---	---	---	---	---	*0.017*	*0.007*	*0.019*	*0.026*	*0.069*	*0.703*
6Rep50	---	---	---	---	---	---	---	---	---	*0.000*	*0.000*	*0.897*	*0.063*	*0.066*	*0.341*
Rep100	---	---	---	---	---	---	---	---	---	*0.063*	*0.025*	*0.011*	*0.038*	*0.035*	*0.277*
Rep75	---	---	---	---	---	---	---	---	---	*0.051*	*0.044*	*0.250*	*0.099*	*0.043*	*0.022*
Rep50	---	---	---	---	---	---	---	---	---	*0.190*	*0.055*	*0.001*	*0.269*	*0.115*	*0.020*
Rep25	---	---	---	---	---	---	---	---	---	*0.083*	*0.076*	*0.277*	*0.019*	*0.099*	*0.844*
Gamma	0.488	0.043	0.000	0.593	0.085	0.000	0.531	0.064	0.000	0.559	0.057	0.000	0.679	0.097	0.000
Beta	0.886			0.844			0.868			0.857			0.813		

Notes: z statistics were omitted to conserve space. $\beta = 1/(1 + \exp(-1/\gamma))$.

Table B.10: *Reporting Strategy Choices, Supergame by Supergame (supplementing Figure 2.5 of the main text)*

This table summarizes the details of the structural estimation results shown in Figure 2.5 of the main text. See the main text for the definition of each strategy.

I. C-Min treatment

a. 1st supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.549	0.059	9.221	0.000
AR	0.047	0.106	0.446	0.328
CR	0.017	0.039	0.448	0.327
IA	0.207	0.028	7.451	0.000
RR	0.050	0.097	0.515	0.303
PD	0.130	0.062	2.108	0.018
Gamma	0.453	0.045	9.991	0.000
Beta	0.901			

b. 2nd supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.604	0.059	10.220	0.000
AR	0.025	0.117	0.214	0.415
CR	0.025	0.030	0.849	0.198
IA	0.137	0.038	3.657	0.000
RR	0.078	0.107	0.729	0.233
PD	0.131	0.061	2.156	0.016
Gamma	0.445	0.059	7.563	0.000
Beta	0.905			

c. 3rd supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.528	0.042	12.538	0.000
AR	0.063	0.113	0.555	0.290
CR	0.054	0.049	1.084	0.139
IA	0.093	0.040	2.311	0.010
RR	0.168	0.096	1.746	0.040
PD	0.095	0.085	1.116	0.132
Gamma	0.417	0.042	9.829	0.000
Beta	0.917			

d. 4th supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.557	0.057	9.739	0.000
AR	0.067	0.110	0.608	0.272
CR	0.073	0.037	1.985	0.024
IA	0.123	0.058	2.119	0.017
RR	0.165	0.069	2.401	0.008
PD	0.016	0.055	0.286	0.387
Gamma	0.507	0.060	8.424	0.000
Beta	0.878			

e. 5th supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.569	0.057	10.020	0.000
AR	0.104	0.115	0.907	0.182
CR	0.038	0.046	0.826	0.204
IA	0.104	0.041	2.518	0.006
RR	0.158	0.113	1.406	0.080
PD	0.027	0.091	0.296	0.384
Gamma	0.486	0.050	9.761	0.000
Beta	0.887			

f. 6th supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.525	0.070	7.537	0.000
AR	0.050	0.122	0.413	0.340
CR	0.084	0.051	1.634	0.051
IA	0.065	0.073	0.889	0.187
RR	0.216	0.095	2.283	0.011
PD	0.059	0.148	0.398	0.345
Gamma	0.496	0.066	7.494	0.000
Beta	0.882			

II. F-Min treatment

a. 1st supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.089	0.086	1.026	0.152
AR	0.647	0.078	8.247	0.000
CR	0.033	0.080	0.414	0.339
IA	0.053	0.027	1.945	0.026
RR	0.131	0.044	2.954	0.002
PD	0.046	0.080	0.583	0.280
Gamma	0.582	0.085	6.813	0.000
Beta	0.848			

b. 2nd supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.144	0.101	1.419	0.078
AR	0.644	0.080	8.059	0.000
CR	0.000	0.073	0.000	0.500
IA	0.035	0.002	16.264	0.000
RR	0.109	0.039	2.780	0.003
PD	0.069	0.068	1.012	0.156
Gamma	0.479	0.102	4.676	0.000
Beta	0.890			

c. 3rd supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.160	0.049	3.266	0.001
AR	0.543	0.076	7.141	0.000
CR	0.041	0.069	0.586	0.279
IA	0.000	0.037	0.000	0.500
RR	0.213	0.000	> 100	0.000
PD	0.043	0.082	0.525	0.300
Gamma	0.419	0.051	8.273	0.000
Beta	0.916			

d. 4th supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.116	0.041	2.843	0.002
AR	0.677	0.062	10.935	0.000
CR	0.024	0.075	0.325	0.373
IA	0.039	0.037	1.049	0.147
RR	0.103	0.031	3.350	0.000
PD	0.041	0.078	0.527	0.299
Gamma	0.385	0.043	8.860	0.000
Beta	0.931			

e. 5th supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.181	0.062	2.930	0.002
AR	0.664	0.088	7.573	0.000
CR	0.063	0.093	0.683	0.247
IA	0.000	0.045	0.000	0.500
RR	0.092	0.000	> 100	0.000
PD	0.000	0.071	0.000	0.500
Gamma	0.519	0.063	8.233	0.000
Beta	0.873			

f. 6th supergame

	fraction	S.E	z	*p (two-sided)*
AN	0.083	0.049	1.671	0.047
AR	0.723	0.045	16.148	0.000
CR	0.004	0.067	0.057	0.477
IA	0.000	0.016	0.000	0.500
RR	0.191	0.000	> 100	0.000
PD	0.000	0.077	0.000	0.500
Gamma	0.470	0.049	9.651	0.000
Beta	0.893			

III. C-Full treatment

	fraction	S.E	z	*p (two-sided)*
1st supergame				
AN	0.498	0.080	6.248	0.000
AR	0.050	0.087	0.574	0.283
CR	0.007	0.049	0.147	0.442
IA	0.294	0.044	6.637	0.000
RR	0.078	0.128	0.609	0.271
PD	0.073	0.062	1.178	0.119
Gamma	0.551	0.076	7.241	0.000
Beta	0.860			
2nd supergame	fraction	S.E	z	*p (two-sided)*
AN	0.505	0.080	6.310	0.000
AR	0.089	0.118	0.752	0.226
CR	0.000	0.045	0.000	0.500
IA	0.211	0.017	12.372	0.000
RR	0.173	0.110	1.564	0.059
PD	0.023	0.096	0.237	0.406
Gamma	0.507	0.069	7.329	0.000
Beta	0.878			
3rd supergame	fraction	S.E	z	*p (two-sided)*
AN	0.413	0.070	5.924	0.000
AR	0.109	0.100	1.093	0.137
CR	0.037	0.059	0.627	0.265
IA	0.251	0.040	6.284	0.000
RR	0.167	0.123	1.349	0.089
PD	0.023	0.110	0.207	0.418
Gamma	0.488	0.065	7.511	0.000
Beta	0.886			
4th supergame	fraction	S.E	z	*p (two-sided)*
AN	0.396	0.096	4.137	0.000
AR	0.164	0.131	1.249	0.106
CR	0.000	0.083	0.000	0.500
IA	0.325	0.015	20.981	0.000
RR	0.115	0.136	0.848	0.198
PD	0.000	0.112	0.000	0.500
Gamma	0.485	0.093	5.200	0.000
Beta	0.887			
5th supergame	fraction	S.E	z	*p (two-sided)*
AN	0.400	0.137	2.924	0.002
AR	0.168	0.079	2.134	0.016
CR	0.047	0.077	0.616	0.269
IA	0.131	0.097	1.344	0.090
RR	0.185	0.090	2.050	0.020
PD	0.069	0.080	0.857	0.196
Gamma	0.575	0.126	4.570	0.000
Beta	0.851			
6th supergame	fraction	S.E	z	*p (two-sided)*
AN	0.465	0.080	5.795	0.000
AR	0.162	0.091	1.785	0.037
CR	0.032	0.075	0.434	0.332
IA	0.228	0.040	5.771	0.000
RR	0.112	0.112	1.005	0.157
PD	0.000	0.080	0.000	0.500
Gamma	0.502	0.078	6.460	0.000
Beta	0.880			

IV. F-Full treatment

	fraction	S.E	z	*p (two-sided)*
1st supergame				
AN	0.115	0.091	1.270	0.102
AR	0.634	0.064	9.833	0.000
CR	0.014	0.098	0.146	0.442
IA	0.000	0.055	0.000	0.500
RR	0.089	0.045	1.964	0.025
PD	0.148	0.063	2.352	0.009
Gamma	0.589	0.096	6.164	0.000
Beta	0.845			
2nd supergame	fraction	S.E	z	*p (two-sided)*
AN	0.109	0.068	1.592	0.056
AR	0.624	0.054	11.553	0.000
CR	0.055	0.093	0.588	0.278
IA	0.024	0.073	0.331	0.370
RR	0.113	0.056	2.024	0.021
PD	0.076	0.070	1.084	0.139
Gamma	0.506	0.072	7.014	0.000
Beta	0.878			
3rd supergame	fraction	S.E	z	*p (two-sided)*
AN	0.111	0.051	2.202	0.014
AR	0.679	0.059	11.561	0.000
CR	0.044	0.090	0.491	0.312
IA	0.017	0.056	0.296	0.384
RR	0.068	0.060	1.137	0.128
PD	0.081	0.063	1.271	0.102
Gamma	0.446	0.047	9.521	0.000
Beta	0.904			
4th supergame	fraction	S.E	z	*p (two-sided)*
AN	0.085	0.064	1.327	0.092
AR	0.750	0.057	13.121	0.000
CR	0.000	0.084	0.000	0.500
IA	0.000	0.033	0.000	0.500
RR	0.035	0.000	> 100	0.000
PD	0.129	0.050	2.575	0.005
Gamma	0.472	0.067	7.021	0.000
Beta	0.893			
5th supergame	fraction	S.E	z	*p (two-sided)*
AN	0.048	0.066	0.716	0.237
AR	0.662	0.039	16.964	0.000
CR	0.000	0.077	0.000	0.500
IA	0.000	0.025	0.000	0.500
RR	0.151	0.020	7.531	0.000
PD	0.139	0.082	1.710	0.044
Gamma	0.431	0.067	6.442	0.000
Beta	0.910			
6th supergame	fraction	S.E	z	*p (two-sided)*
AN	0.114	0.051	2.258	0.012
AR	0.565	0.067	8.397	0.000
CR	0.000	0.099	0.000	0.500
IA	0.022	0.006	3.869	0.000
RR	0.068	0.025	2.674	0.004
PD	0.231	0.028	8.213	0.000
Gamma	0.501	0.052	9.599	0.000
Beta	0.880			

Notes: z statistics were omitted to conserve space. $\beta = 1/(1 + \exp(-1/\gamma))$.

The following summarizes the test results to compare the subjects' reporting strategy choices among the treatments based on the overall averages reported in Figure 2.5 of the main text.

	(*i*) % of the subjects who acted according to the AN strategy				(*ii*) % of the subjects who acted according to the AR strategy			
	C-Min	F-Min	C-Full	F-Full	C-Min	F-Min	C-Full	F-Full
C-Min	---	.0000***	.2045	.0000***	---	.0000***	.1935	.0000***
F-Min	---	---	.0000***	.5423	---	---	.0000***	.9796
C-Full	---	---	---	.0000***	---	---	---	.0000***
F-Full	---	---	---	---	---	---	---	---

	(*iii*) % of the subjects who acted according to the CR strategy				(*iv*) % of the subjects who acted according to the IA strategy			
	C-Min	F-Min	C-Full	F-Full	C-Min	F-Min	C-Full	F-Full
C-Min	---	.5158	.3838	.3619	---	.0123**	.0738*	.0111**
F-Min	---	---	.7772	.7215	---	---	.0000***	.5977
C-Full	---	---	---	.9338	---	---	---	.0001***
F-Full	---	---	---	---	---	---	---	---

	(*v*) % of the subjects who acted according to the RR strategy				(*vi*) % of the subjects who acted according to the PD strategy			
	C-Min	F-Min	C-Full	F-Full	C-Min	F-Min	C-Full	F-Full
C-Min	---	.9860	.9866	.3528	---	.2346	.2388	.2845
F-Min	---	---	.9710	.3167	---	---	.9431	.0200**
C-Full	---	---	---	.3503	---	---	---	.0266**
F-Full	---	---	---	---	---	---	---	---

Notes: The numbers are *p*-values (two-sided) based on two-sample proportion tests. *, **, and *** indicate significance at the .10 level, at the .05 level, and at the .01 level, respectively.

Table B.11: *Supergame-round realisations across sessions for Chapter 3 (supplementing Table. 3.1 of the main text)*

Number of rounds played in each supergame of the experiment

Supergame: / Session:	Supergame (Phase) (1)	(2)	(3)	(4)	(5)	(6)
Session #1	10	10	10	20	10	10
Session #2	30	20	53	-	-	-
Session #3	10	10	10	20	10	10
Session #4	10	10	10	10	10	20
Session #5	30	10	20	10	20	10
Session #6	10	10	10	20	10	10
Session #7	20	10	20	10	20	10
Session #8	10	30	20	20	10	10
Session #9	10	10	10	10	20	10

Notes: The units are rounds. This experiment had lower delta (0.9) than Chapter 2 experiment (0.95)
Session 2: Interrupted due to forced Windows Update on one of the computers.

Appendix C: Sample Instructions

Sample Instructions Used in the Experiment for Chapter 2

This part of the Appendix includes instructions for the C-Min and F-Full treatments as examples.

C.1. The C-Min treatment

[The following instructions were read aloud to the subjects at the onset of the experiment:]

Instructions

You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. Please switch off all of your electronic devices (e.g., mobile phone). If you have a question, please raise your hand.

In the experiment, your earnings will be calculated in points. During the experiment, you can accumulate earnings through your decisions explained below. At the end of the experiment, points will be converted to UK pounds at the following rate:

150 points = 1 pound.

Your total earnings (including the £3 for participation) will be paid out to you in cash once the experiment is over. Your payment will be rounded to the nearest 10 pence (e.g., £12.30 if it is £12.33; and £12.40 if it is £12.37).

There are **6 phases** in the experiment. In each phase, all participants are randomly divided into **groups of 8 individuals**. This means that you are in a group with 7 other participants and play with them in that phase. Once a phase is over, your group composition will randomly change (you will be randomly assigned to a group with 7 participants in this room). Each phase consists of multiple periods. You will interact with your 7 group members in each period. You will not interact with participants outside your group in each period. No one knows which other participants are in their group, and no one will be informed who was in which group after the experiment. The following sections will first explain the details of each period in a phase. We will then explain the duration of each phase.

Your decisions in each phase:

In each phase, participants are randomly given an identification number. However, this is private information of participants. All periods have the same structure. At the onset of a given period, each participant is randomly matched with a member in his or her group. The pairing is random. Neither your decisions in previous periods in this phase nor your decisions in previous phases affect the pairing process. In each period, participants will not be informed of the identification numbers of their partners in each period. In other words, you might have already interacted with the current partner, or you might not have interacted with that person so far. Since there are 8 individuals in your group, the probability that you will be matched with the same individual in 2 consecutive periods of a given phase is 1/7.

Each period consists of **two** stages. The first stage is an interaction stage. The second stage is a reporting-decision stage.

Stage 1: *Making binary choice between Y or Z*

At the onset of a given period, **you and your partner simultaneously choose Y or Z**. As both you and your partner make binary choices, there are 4 possible interaction outcomes. The earnings consequence of each scenario will be summarized as below:

(a) If you choose Y and your counterpart also chooses Y, <u>you earn 25 points</u>.
(b) If you choose Z and your counterpart also chooses Z, <u>you earn 10 points</u>.
(c) If you choose Y and your counterpart chooses Z, <u>you earn 5 points</u>.
(d) If you choose Z and your counterpart chooses Y, <u>you earn 30 points</u>.

Your partner has the same earnings formulas as yours (see also screen shots on the next page).

When you make binary choice, you <u>will be informed of your counterpart's choice of Y or Z in the last period if that person's last interaction counterpart reported that person's choice</u> (You will not be informed of the choice if that person's last interaction counterpart did not report it). No such information is available in period 1 as there is no previous round. We will explain the detail of the reporting process in Stage 2 below.

Once all participants in a session make decisions and click the "Submit" button, you will be informed of the outcome of the interactions in a given period. Specifically, you will be informed of (1) your partner's choice and (2) your earnings in that period.

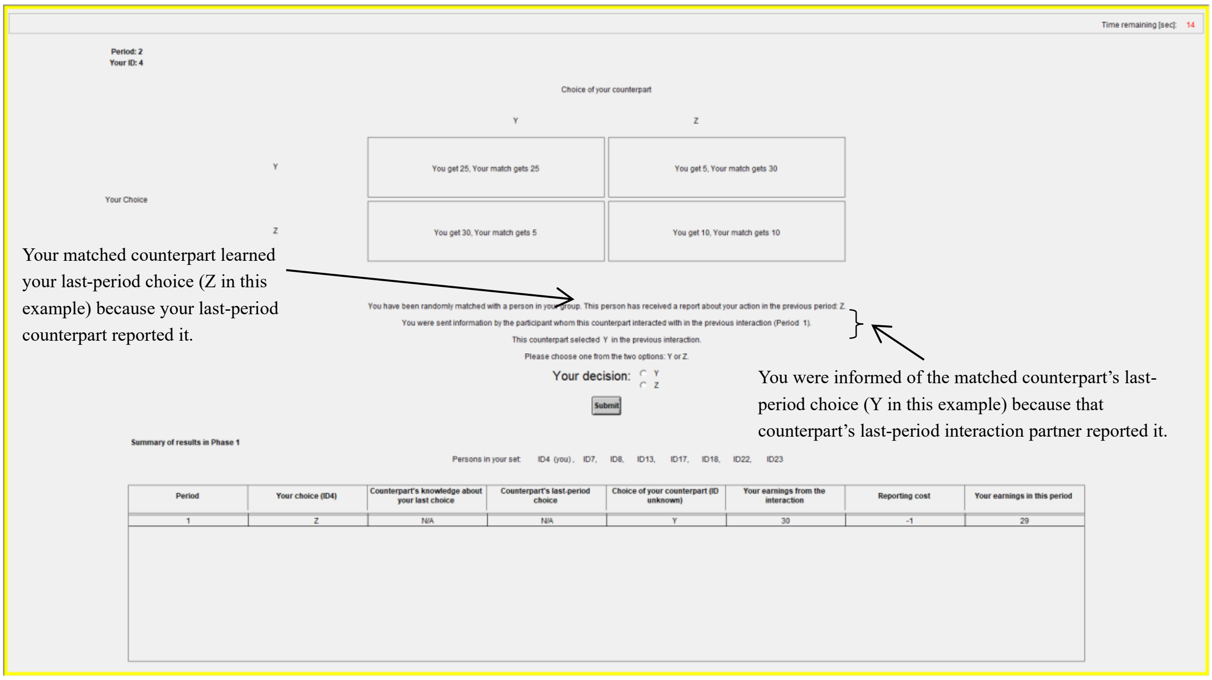
Stage 2: *Choosing whether to report your counterpart's action*

Once you review the interaction outcome in Stage 1, you will be asked to decide whether you wish to report your interaction counterpart's choice, Y or Z, to that person's next-period interaction counterpart. Reporting is costly. If you report it in a given period, one point will be deducted from your payoff at the end of that period. If you do not report it, no points will be deducted.

If you decide <u>to</u> report it in period *t*, the counterpart's next-period counterpart will make binary choice of Y or Z in period *t* + 1 knowing that the partner selected Y or Z in the interaction with you in period *t*.

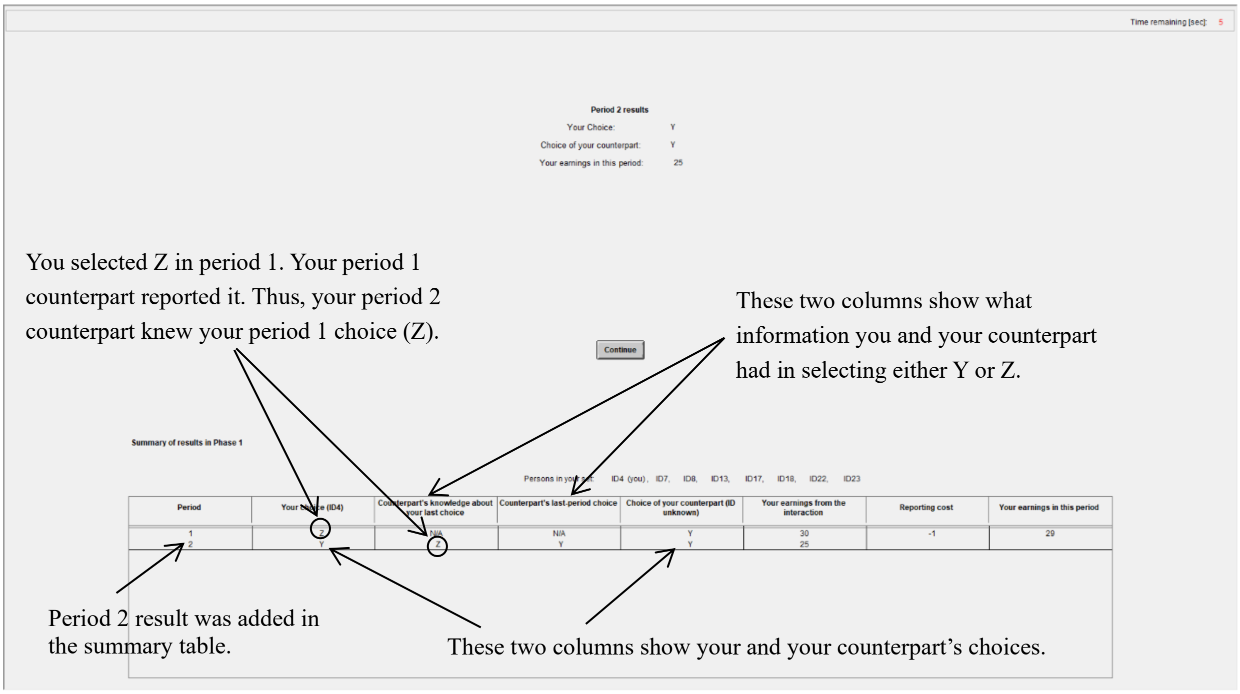
By contrast, if you decide <u>not to</u> report it in period *t*, the counterpart's next-period counterpart will not be informed of the counterpart's choice when making decision in period *t* + 1.

An Example of Computer Screen 1: (when making decisions)



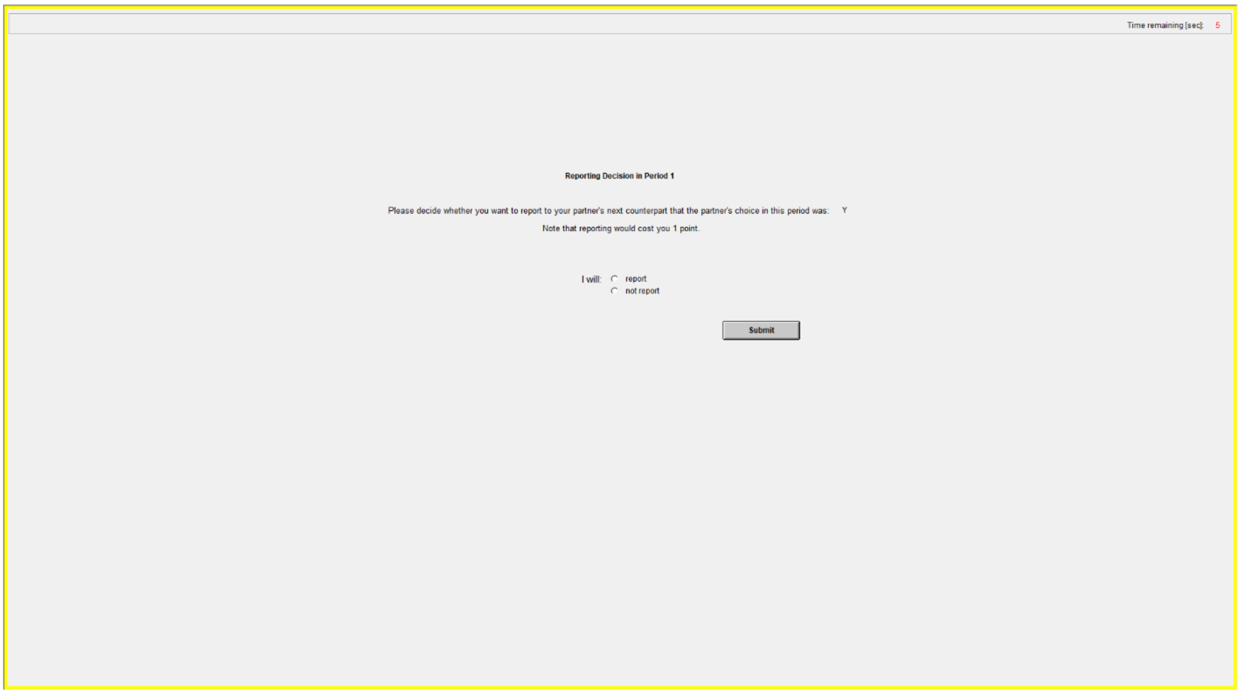
Note: Period 2. Decisions here are for illustration only.

An Example of Computer Screen 2: (the outcome screen)



Note: Period 2. Decisions here are for illustration only.

An Example of Computer Screen 3: (the reporting decision)



Note: Decisions here are for illustration only.

The Number of Periods in Each Phase:

The number of periods is not predetermined. **The probability that you will have another period in a given phase is 95%**. Specifically, at the end of each period, the computer randomly draws an integer between 1 and 100 for this session. <u>If the drawn integer is less than or equal to 95, your interaction in the present phase continues. If the drawn integer is greater than 95, then the present phase is over</u>.

Nevertheless, the experimental procedure is different. Operationally, you will play **blocks of 10 periods** in sequence as follows:

1. At the onset of a given phase, you will play 10 periods, assuming the random continuation rule described above. In each period, you will randomly be paired with an individual in your group and will interact with each other by selecting Y or Z. However, you will <u>not</u> be informed of an integer randomly drawn in each period until the end of the tenth period.

2. Once you finish the interaction in period 10, you will be informed of integers randomly drawn in all the 10 periods. For example suppose that the ten randomly drawn integers were: 1, 84, 34, 56, 32, 3, 72, 45, 14, 32 in sequence. In this situation, <u>you will move on to the next block of 10 periods because the ten randomly drawn integers were all less than or equal to 95</u>. In each period in the next block, you will be randomly paired with an individual in your group and will interact with each other as in the previous block; once you play the ten interactions, you will be informed of ten realized integers at the end of the 10 periods, as in the previous block.

   For another example suppose that the ten randomly drawn integers were: 4, 34, 98, 56, 32, 93, 2, 45, 14, 32 in sequence. In this situation, your total payoff in this phase is calculated by your interaction outcomes and costs of reporting in periods 1 to 3 because an integer greater than 95 was first realized at the end of period 3. Your interaction outcomes and costs for reporting from period 4 will not be counted in calculating your total payoff in that phase; and you will not move on to the next block of 10 periods in the phase. Instead you will move on to the next phase, will be randomly given a new identification number, and will be randomly assigned to a group of 8. The nature of interactions in the next phase is exactly the same as the present one.

Mathematically, since the probability that you have the next period is 95%, the expected number of periods that are used for payment in a given phase is 20 periods. However, since the decision to discontinue your interactions in each phase is randomly exerted by the computer, you may have a phase with valid periods that are much longer or shorter than 20. In case that the total number of periods across the six phases reaches 220 (it could happen although the likelihood is very small), the experiment will be finished due to operational reasons (the experiment duration becomes longer than what was announced in the recruiting message for this experiment).

Your Earnings:

At the end of the experiment, you will be paid privately based on your accumulated earnings across the six phases.

If you have any questions at this time, please raise your hand. If all questions have been answered, we will move on to the experiment.

Comprehension questions:

Please answer the following questions to check your understanding of the instructions. Please raise your hand if you have any questions.

1. How many phases do you have? ____________________

2. How many individuals are there in your group in a given phase?

____

3. Suppose that you choose Y and your partner chooses Z in a period of a given phase. What are your earnings in that period? What are your partner's earnings in that period?

a) Your earnings ____________________

b) Your partner's earnings ____________________

4. How much does it cost you to report your interaction partner's choice to that partner's next interaction partner?

____

5. What is the probability that your interaction continues within your group in a given period?

____

Any questions?

[Once everyone finished answering the comprehension questions and the experimenter explained the answers, the experiment began.]

C.2. The F-Full treatment

[The following instructions were read aloud to the subjects at the onset of the experiment:]

Instructions

You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. Please switch off all of your electronic devices (e.g., mobile phone). If you have a question, please raise your hand.

In the experiment, your earnings will be calculated in points. During the experiment, you can accumulate earnings through your decisions as explained below. At the end of the experiment, points will be converted to UK pounds at the following rate:

150 points = 1 pound.

Your total earnings (including the £3 for participation) will be paid out to you in cash once the experiment is over. Your payment will be rounded to the nearest 10 pence (e.g., £12.30 if it is £12.33; and £12.40 if it is £12.37).

There are <u>**6 phases**</u> in the experiment. In each phase, all participants are randomly divided into **groups of 8 individuals**. This means that you are in a group with 7 other participants and play with them in that phase. Once a phase is over, your group composition will randomly change (you will be randomly assigned <u>to a group with 7 participants</u> in this room). Each phase consists of multiple periods. You will interact with the 7 group members in each period. You will <u>not</u> interact with participants outside your group in each period. No one knows which other participants are in their group, and no one will be informed who was in which group after the experiment. The following sections will first explain the details of each period in a phase. We will then explain the duration of each phase.

Your decisions in each phase:

In each phase, participants are randomly given an identification number. However, this is private information of participants. All periods have the same structure. At the onset of a given period, each participant is randomly matched with a member in his or her group. The pairing is random. Neither your decisions in previous periods in this phase nor your decisions in previous phases affect the pairing process. Participants will not be informed of the identification numbers of their partners in each period. In other words, you might have already interacted with the current partner, or you might not have interacted with that person so far. Since there are 8 individuals in your group, the probability that you will be matched with the same individual in 2 consecutive periods of a given phase is 1/7.

Each period consists of **two** stages. The first stage is an interaction stage. The second stage is a reporting-decision stage.

Stage 1: *Making binary choice between Y or Z*

At the onset of a given period, **you and your partner simultaneously choose Y or Z**. As both you and your partner make binary choices, there are 4 possible interaction outcomes. The earnings consequence of each scenario will be summarized as below:

(a) If you choose Y and your counterpart also chooses Y, you earn 25 points.
(b) If you choose Z and your counterpart also chooses Z, you earn 10 points.
(c) If you choose Y and your counterpart chooses Z, you earn 5 points.
(d) If you choose Z and your counterpart chooses Y, you earn 30 points.

Your partner has the same earnings formulas as yours (see also the screen shots on the next page).

When you make binary choice, you will be informed of your counterpart's choices of Y or Z in the previous periods in that given phase if that person's interaction counterparts reported that person's choices (You will not be informed of the choices that counterpart made in periods where that person's interaction counterparts did not report). You will learn the average percentage in which the counterpart selected Y in the past based on the reporting. For example, suppose that it is now in period 8. Also suppose that your counterpart's interaction partners in periods 1, 4, and 7 reported the choices your counterpart made in those periods. Also suppose that that counterpart selected Y, Z and Y in those three periods. Then you will be informed that your counterpart's frequency of selecting Y is 66.7%, along with the counterparts' choices in periods 1, 4 and 7. Such information is not available in period 1 as there is no previous round. We will explain the detail of the reporting process in Stage 2 below.

Once all participants in a session make decisions and click the "Submit" button, you will be informed of the outcome of the interactions in a given period. Specifically, you will be informed of (1) your partner's choice and (2) your earnings in that period.

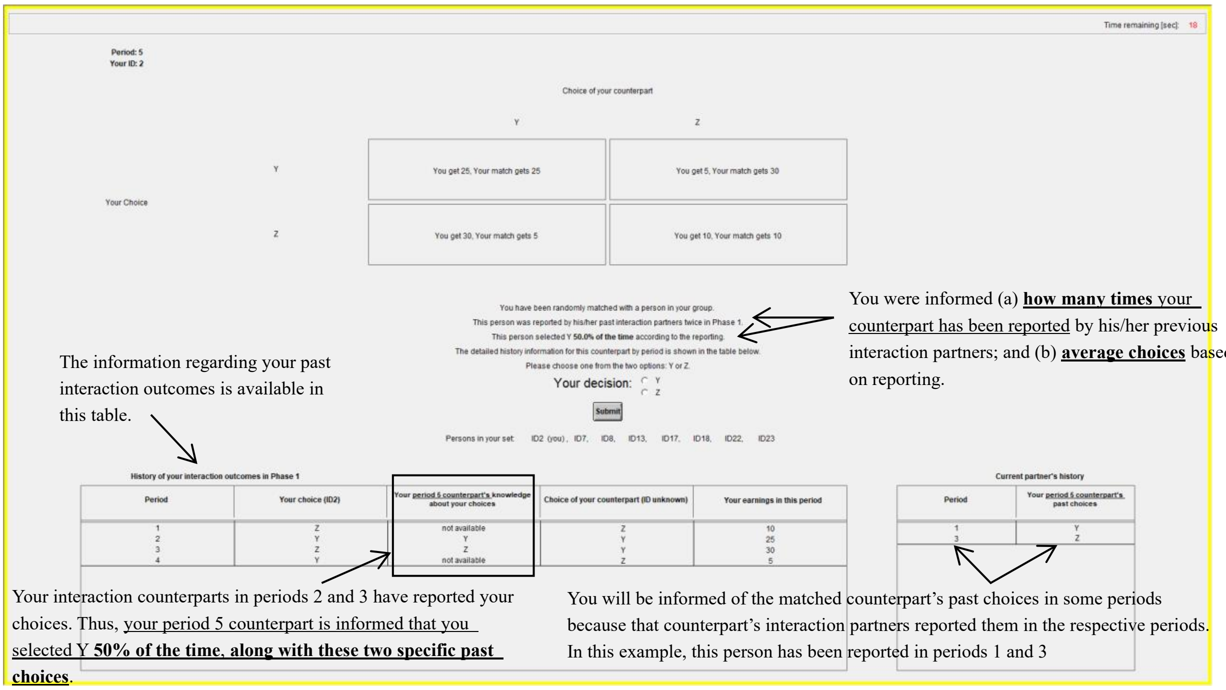
Stage 2: *Choosing whether to report your counterpart's action*

Once you review the interaction outcome in Stage 1, you will be asked to decide whether you wish to report your interaction counterpart's choice, Y or Z, to that person's future-period interaction counterparts. Reporting would not cost you.

If you decide to report it in period *t*, the counterpart's interaction counterparts in all periods after period *t* will be informed of that choice before making binary choice of Y or Z.

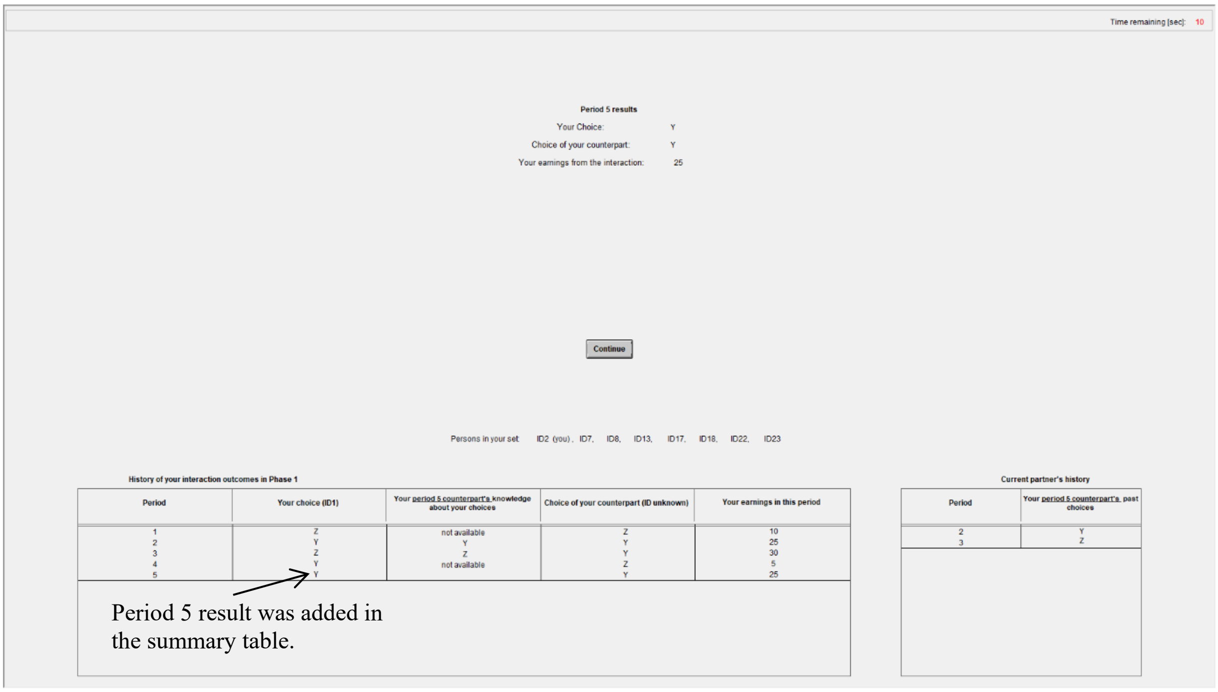
By contrast, if you decide not to report it in period *t*, the counterpart's future counterparts will not be informed of the period *t* counterpart's choice when making binary decision of Y or Z.

An Example of Computer Screen 1: (when making decisions)



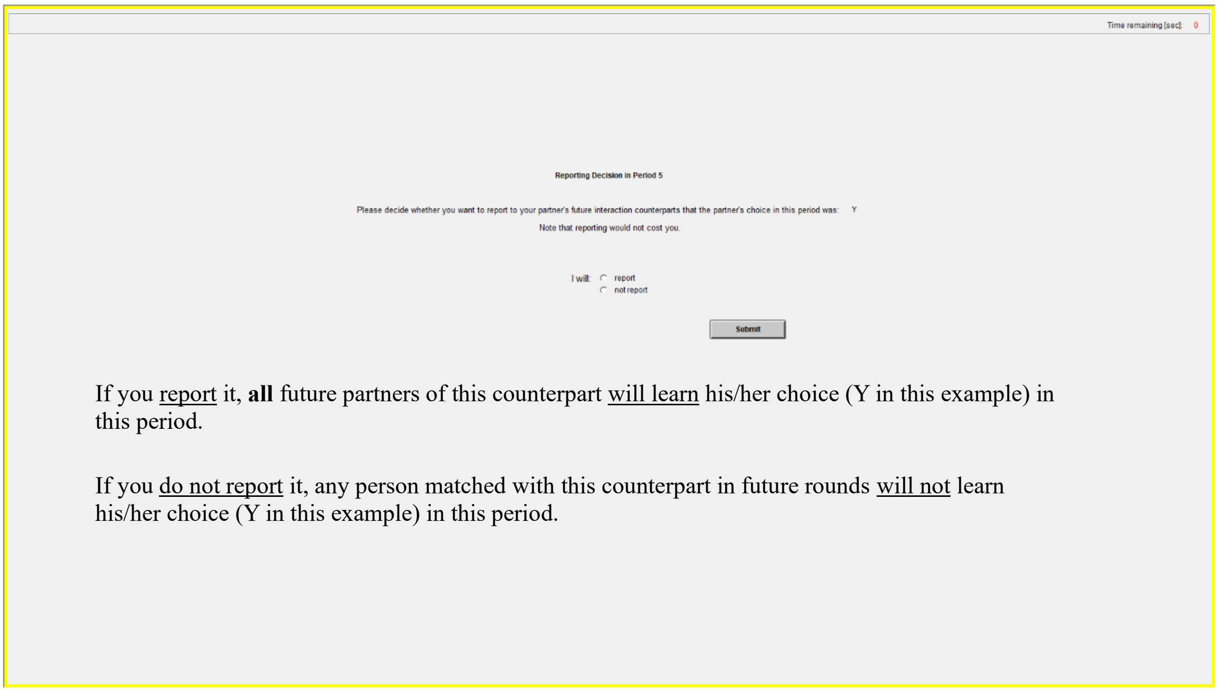
Note: Period 5. Decisions here are for illustration only.

An Example of Computer Screen 2: (the outcome screen)



Note: Period 5. Decisions here are for illustration only.

An Example of Computer Screen 3: (the reporting decision)



Note: Period 5. Decisions here are for illustration only.

The Number of Periods in Each Phase:

The number of periods is not predetermined. **The probability that you will have another period in a given phase is 95%**. Specifically, at the end of each period, the computer randomly draws an integer between 1 and 100 for this session. If the drawn integer is less than or equal to 95, your interaction in the present phase continues. If the drawn integer is greater than 95, then the present phase is over.

Nevertheless, the experimental procedure is different. Operationally, you will play **blocks of 10 periods** in sequence as follows:

1. At the onset of a given phase, you will play 10 periods, assuming the random continuation rule described above. In each period, you will randomly be paired with an individual in your group and will interact with each other by selecting Y or Z. However, you will not be informed of an integer randomly drawn in each period until the end of the tenth period.

2. Once you finish the interaction in period 10, you will be informed of integers randomly drawn in all the 10 periods. For example, suppose that the ten randomly drawn integers were: 1, 84, 34, 56, 32, 3, 72, 45, 14, 32 in sequence. In this situation, you will move on to the next block of 10 periods because the ten randomly drawn integers were all less than or equal to 95. In each period in the next block, you will be randomly paired with an individual in your group and will interact with each other as in the previous block; once you play the ten interactions, you will be informed of the ten realized integers at the end of the 10 periods, as in the previous block.

   For another example, suppose that the ten randomly drawn integers were: 4, 34, 98, 56, 32, 93, 2, 45, 14, 32 in sequence. In this situation, your total payoff in this phase is calculated by your interaction outcomes in periods 1 to 3 because an integer greater than 95 was first realized at the end of period 3. Your interaction outcomes from period 4 will not be counted in calculating your total payoff in that phase; and you will not move on to the next block of 10 periods in the phase. Instead you will move on to the next phase, will be randomly given a new identification number, and will be randomly assigned to a group of 8. The nature of interactions in the next phase is exactly the same as the present one.

Mathematically, since the probability that you have the next period is 95%, the expected number of periods that are used for payment in a given phase is 20 periods. However, since the decision to discontinue your interactions in each phase is randomly exerted by the computer, you may have a phase with valid periods that are much longer or shorter than 20. In case that the total number of periods across the six phases reaches 220 (it could happen although the likelihood is very small), the experiment will be finished due to operational reasons (the experiment duration becomes longer than what was announced in the recruiting message for this experiment).

Your Earnings:

At the end of the experiment, you will be paid privately based on your accumulated earnings across the six phases.

If you have any questions at this time, please raise your hand. If all questions have been answered, we will move on to the experiment.

Comprehension questions:

Please answer the following questions to check your understanding of the instructions. Please raise your hand if you have any questions.

1. How many phases do you have? ____________________

2. How many individuals are there in your group in a given phase?

____

3. Suppose that you choose Y and your partner chooses Z in a period of a given phase. What are your earnings in that period? What are your partner's earnings in that period?

a) Your earnings ____________________

b) Your partner's earnings ____________________

4. How much does it cost you to report your interaction partner's choice to that partner's future interaction partners?

____

5. What is the probability that your interaction continues within your group in a given period?

____

Any questions?

[Once everyone finished answering the comprehension questions and the experimenter explained the answers, the experiment began.]

Sample Instructions Used in the Experiment for Chapter 3

This part of the Appendix includes instructions for the Rating and Feedback treatments as examples.

C.3. The Rating treatment

[The following instructions were read aloud to the subjects at the onset of the experiment:]

Instructions
You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. Please switch off all of your electronic devices (e.g., mobile phone). If you have a question, please raise your hand.

In the experiment, your earnings will be calculated in points. During the experiment, you can accumulate earnings through your decisions as explained below. At the end of the experiment, points will be converted to UK pounds at the following rate:

125 points = 1 pound.

Your total earnings (including the £3 for participation) will be paid out to you in cash once the experiment is over. Your payment will be rounded to the nearest 10 pence (e.g., £12.30 if it is £12.33; and £12.40 if it is £12.37).

There are **6 phases** in the experiment. In each phase, all participants are randomly divided into **groups of 6 individuals**. This means that you are in a group with 5 other participants and play with them in that phase. Once a phase is over, your group composition will randomly change (you will be randomly assigned to a group with 5 participants in this room). Each phase consists of multiple periods. You will interact with the 5 group members in each period. You will not interact with participants outside your group in each period. No one knows which other participants are in their group, and no one will be informed who was in which group after the experiment. The following sections will first explain the details of each period in a phase. We will then explain the duration of each phase.

Your decisions in each phase:

In each phase, participants are randomly given an identification number. However, this is private information of participants. All periods have the same structure. At the onset of a given period, each participant is randomly matched with a member in his or her group. The pairing is random. Neither your decisions in previous periods in this phase nor your decisions in previous phases affect the pairing process. Participants will not be informed of the identification numbers of their partners in each period. In other words, you might have already interacted with the current partner, or you might not have interacted with that person so far. Since there are 6 individuals in your group, the probability that you will be matched with the same individual in 2 consecutive periods of a given phase is 1/5.

Each period consists of **two** stages. The first stage is an interaction stage. The second stage is a rating stage.

Stage 1: *Making binary choice between Y or Z*

At the onset of a given period, **you and your partner simultaneously choose Y or Z**. As both you and your partner make binary choices, there are 4 possible interaction outcomes. The earnings consequence of each scenario will be summarized as below:

(e) If you choose Y and your counterpart also chooses Y, you earn 25 points.
(f) If you choose Z and your counterpart also chooses Z, you earn 10 points.
(g) If you choose Y and your counterpart chooses Z, you earn 5 points.
(h) If you choose Z and your counterpart chooses Y, you earn 30 points.

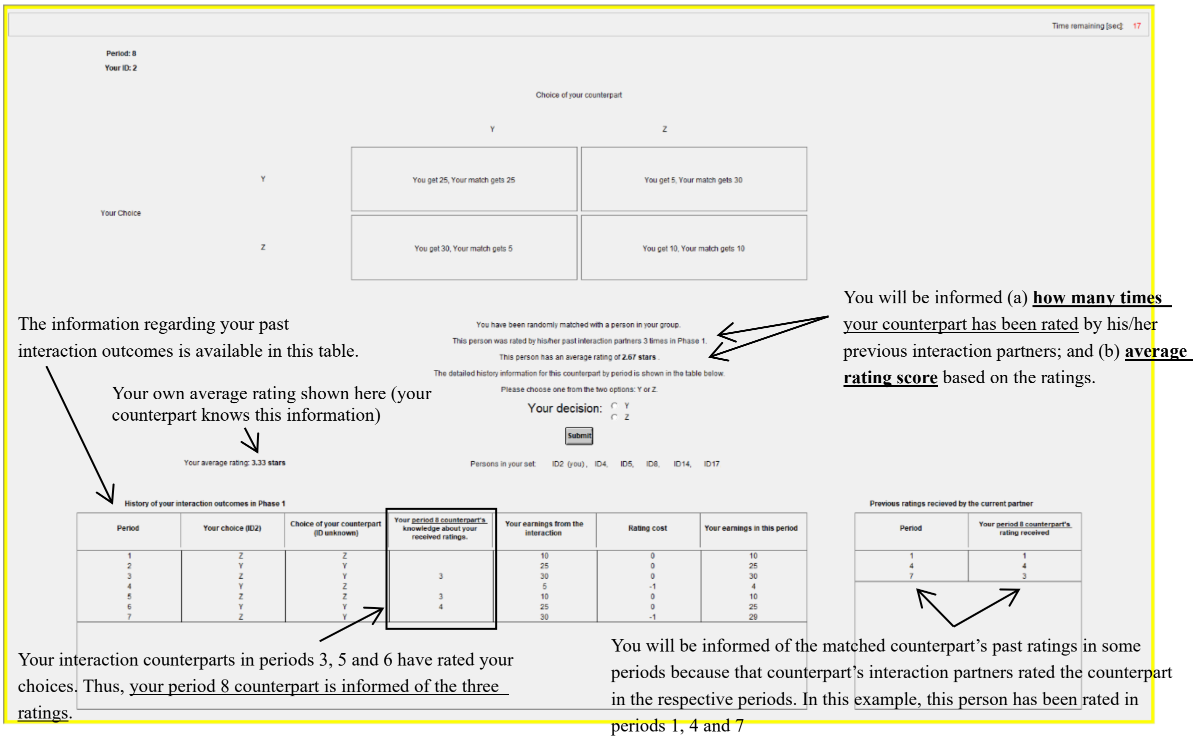
Your partner has the same earnings formulas as yours (see also the screen shots on the next page).

When you make binary choice, you will be informed of all of the ratings your counterpart has received so far in the previous periods. As will be explained below, each of you will be given an opportunity to rate partners on a five-point scale, i.e., from 1 star ("very poor") to 5 stars ("very good"), at the end of the period. You will also learn the **average rating** of the partner. For example, suppose that it is now in period 8. Also suppose that your counterpart's previously-matched partners in periods 1, 4, and 7 gave 1 star, 4 stars and 3 stars, respectively, to the counterpart in those periods. Then you will be informed that your counterpart's average rating is 2.67 stars (see the screen shot below). Rating information is not available in period 1 as there is no previous round. We will explain the detail of the rating process in Stage 2 below.

Note that while you are aware of the rating information of your partner, you are **not** informed of the counterparts' action choices themselves in the past periods.

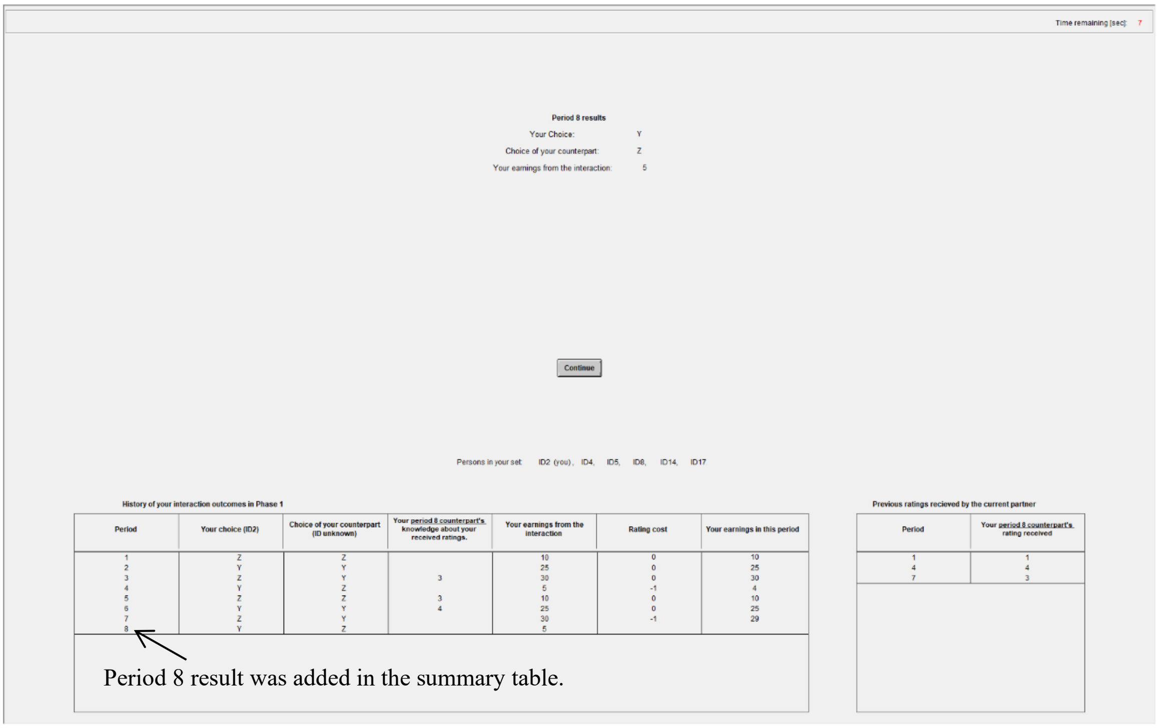
Once all participants in a session make decisions and click the "Submit" button, you will be informed of the outcome of the interactions in a given period. Specifically, you will be informed of (1) your partner's choice and (2) your earnings in that period.

An Example of Computer Screen 1: (when making decisions)



Note: Period 8. Decisions here are for illustration only.

An Example of Computer Screen 2: (the outcome screen)



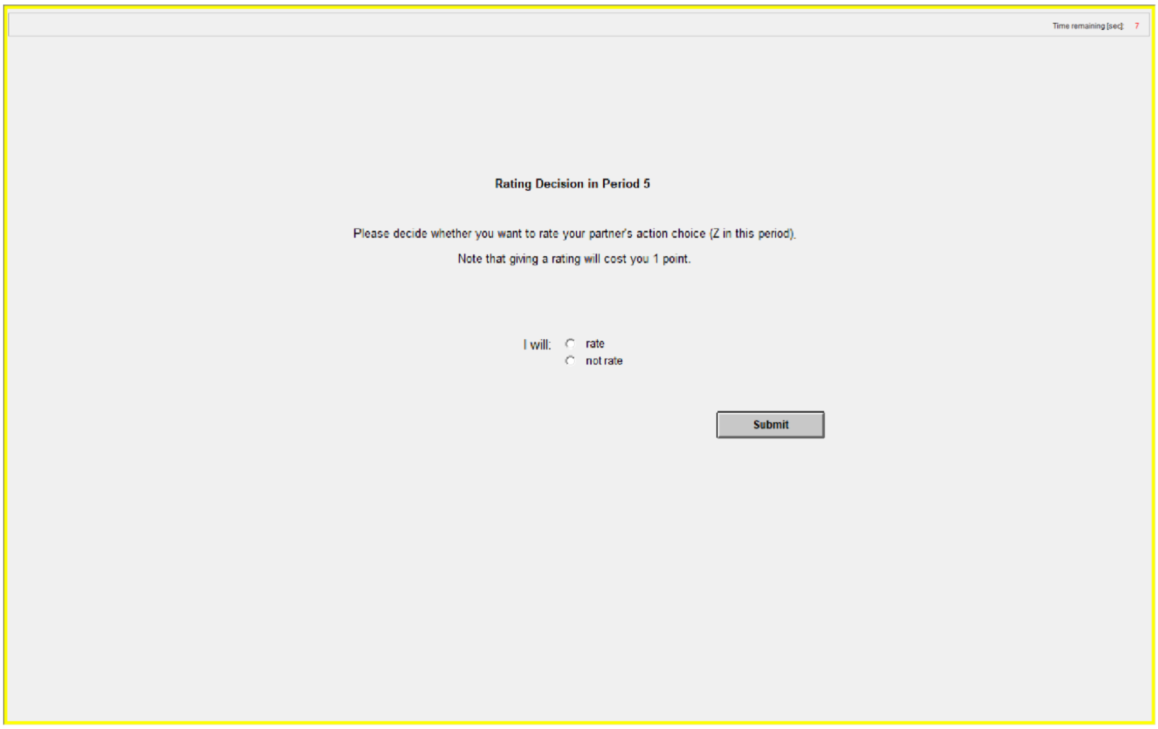
Note: Period 8. Decisions here are for illustration only.

Stage 2: *Deciding whether to rate your counterpart's action*

Once you review the interaction outcome in Stage 1, you will be asked to decide whether you wish to rate your interaction counterpart's behavior (i.e., Y or Z) on a five-point scale. 1 star means "very poor," 2 stars means "poor," 3 stars means "neutral" (neither good nor poor), 4 stars means "good," and 5 stars means "very good." Rating is costly. If you decide to rate your partner in a given period, **one point will be deducted** from your payoff at the end of that period. If you do not rate, no points will be deducted.

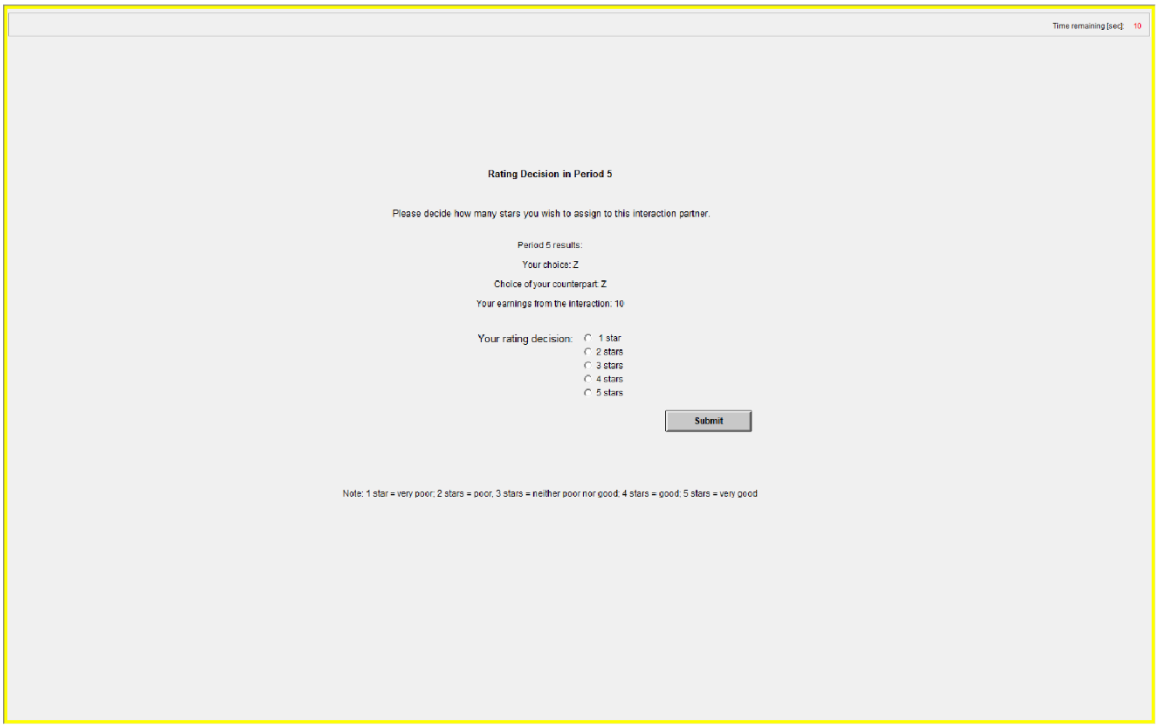
If you rate your partner in period *t*, the partner's counterparts matched in all periods after period *t* will be informed of the rating before making binary choice of Y or Z. By contrast, if you do not rate your partner, the partner's counterparts in all the future period will not have any information on that partner's behavior in period *t*.

Example of Computer Screen 3: (the rating decision)



Note: Period 5. Decisions here are for illustration only.

Example of Computer Screen 4: (decision regarding how many stars to give)



Note: Period 5. Decisions here are for illustration only.

The Number of Periods in Each Phase:

The number of periods is not predetermined. **The probability that you will have another period in a given phase is 90%**. Specifically, at the end of each period, the computer randomly draws an integer between 1 and 100 for this session. <u>If the drawn integer is less than or equal to 90, your interaction in the present phase continues. If the drawn integer is greater than 90, then the present phase is over</u>.

Nevertheless, the experimental procedure is different. Operationally, you will play **blocks of 10 periods** in sequence as follows:

1. In a given phase, you will first play 10 periods, assuming the random continuation rule described above. In each period, you will randomly be paired with an individual in your group and will interact with each other by selecting Y or Z. However, you will <u>not</u> be informed of an integer randomly drawn in each period until the end of the tenth period.

2. Once you finish the interaction in period 10, you will be informed of integers randomly drawn in all the 10 periods. For example, suppose that the ten randomly drawn integers were: 1, 84, 34, 56, 32, 3, 72, 45, 14, 32 in sequence. In this situation, <u>you will move on to the next block of 10 periods because the ten randomly drawn integers were all less than or equal to 90</u>. In each period in the next block, you will be randomly paired with an individual in your group and will interact with each other as in the previous block; once you play the ten interactions, you will be informed of the ten realized integers at the end of the 10 periods, as in the previous block.

   For another example, suppose that the ten randomly drawn integers were: 4, 34, 98, 56, 32, 93, 2, 45, 14, 32 in sequence. In this situation, your total payoff in this phase is calculated by your interaction outcomes <u>and costs of rating in periods 1 to 3</u> because an integer greater than 90 was first realized at the end of period 3. Your interaction outcomes and costs of rating from period 4 will not be counted in calculating your total payoff in that phase; and you will not move on to the next block of 10 periods in the phase. Instead you will move on to the next phase, will be randomly given a new identification number, and will be randomly assigned to a group of 6. The nature of interactions in the next phase is exactly the same as the present one.

Mathematically, since the probability that you have the next period is 90%, the expected number of periods that are used for payment in a given phase is 10 periods. However, since the decision to discontinue your interactions in each phase is randomly exerted by the computer, you may have a phase with valid periods that are much longer or shorter than 10. In case that the total number of periods across the six phases reaches 200 (it could happen although the likelihood is very small), the experiment will be finished due to operational reasons (the experiment duration becomes longer than what was announced in the recruiting message for this experiment).

Your Earnings:

At the end of the experiment, you will be paid privately based on your accumulated earnings across the six phases.

If you have any questions at this time, please raise your hand. If all questions have been answered, we will move on to the experiment.

Comprehension questions:

Please answer the following questions to check your understanding of the instructions. Please raise your hand if you have any questions.

1. How many phases do you have? ____________________

2. How many individuals are there in your group in a given phase?

____

3. Suppose that you choose Y and your partner chooses Z in a period of a given phase. What are your earnings in that period? What are your partner's earnings in that period?

a) Your earnings ____________________

b) Your partner's earnings ____________________

4. How much does it cost you to rate your interaction partner in a given period?

____

5. What is the probability that your interaction continues within your group in a given period?

____

Any questions?

[Once everyone finished answering the comprehension questions and the experimenter explained the answers, the experiment began.]

C.4. The Feedback treatment

[The following instructions were read aloud to the subjects at the onset of the experiment:]

Instructions
You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. Please switch off all of your electronic devices (e.g., mobile phone). If you have a question, please raise your hand.

In the experiment, your earnings will be calculated in points. During the experiment, you can accumulate earnings through your decisions as explained below. At the end of the experiment, points will be converted to UK pounds at the following rate:

125 points = 1 pound.

Your total earnings (including the £3 for participation) will be paid out to you in cash once the experiment is over. Your payment will be rounded to the nearest 10 pence (e.g., £12.30 if it is £12.33; and £12.40 if it is £12.37).

There are **6 phases** in the experiment. In each phase, all participants are randomly divided into **groups of 6 individuals**. This means that you are in a group with 5 other participants and play with them in that phase. Once a phase is over, your group composition will randomly change (you will be randomly assigned to a group with 5 participants in this room). Each phase consists of multiple periods. You will interact with the 5 group members in each period. You will not interact with participants outside your group in each period. No one knows which other participants are in their group, and no one will be informed who was in which group after the experiment. The following sections will first explain the details of each period in a phase. We will then explain the duration of each phase.

Your decisions in each phase:

In each phase, participants are randomly given an identification number. However, this is private information of participants. All periods have the same structure. At the onset of a given period, each participant is randomly matched with a member in his or her group. The pairing is random. Neither your decisions in previous periods in this phase nor your decisions in previous phases affect the pairing process. Participants will not be informed of the identification numbers of their partners in each period. In other words, you might have already interacted with the current partner, or you might not have interacted with that person so far. Since there are 6 individuals in your group, the probability that you will be matched with the same individual in 2 consecutive periods of a given phase is 1/5.

Each period consists of **two** stages. The first stage is an interaction stage. The second stage is a rating stage.

Stage 1: *Making binary choice between Y or Z*

At the onset of a given period, **you and your partner simultaneously choose Y or Z**. As both you and your partner make binary choices, there are 4 possible interaction outcomes. The earnings consequence of each scenario will be summarized as below:

(a) If you choose Y and your counterpart also chooses Y, <u>you earn 25 points</u>.
(b) If you choose Z and your counterpart also chooses Z, <u>you earn 10 points</u>.
(c) If you choose Y and your counterpart chooses Z, <u>you earn 5 points</u>.
(d) If you choose Z and your counterpart chooses Y, <u>you earn 30 points</u>.

Your partner has the same earnings formulas as yours (see also the screen shots on the next page).

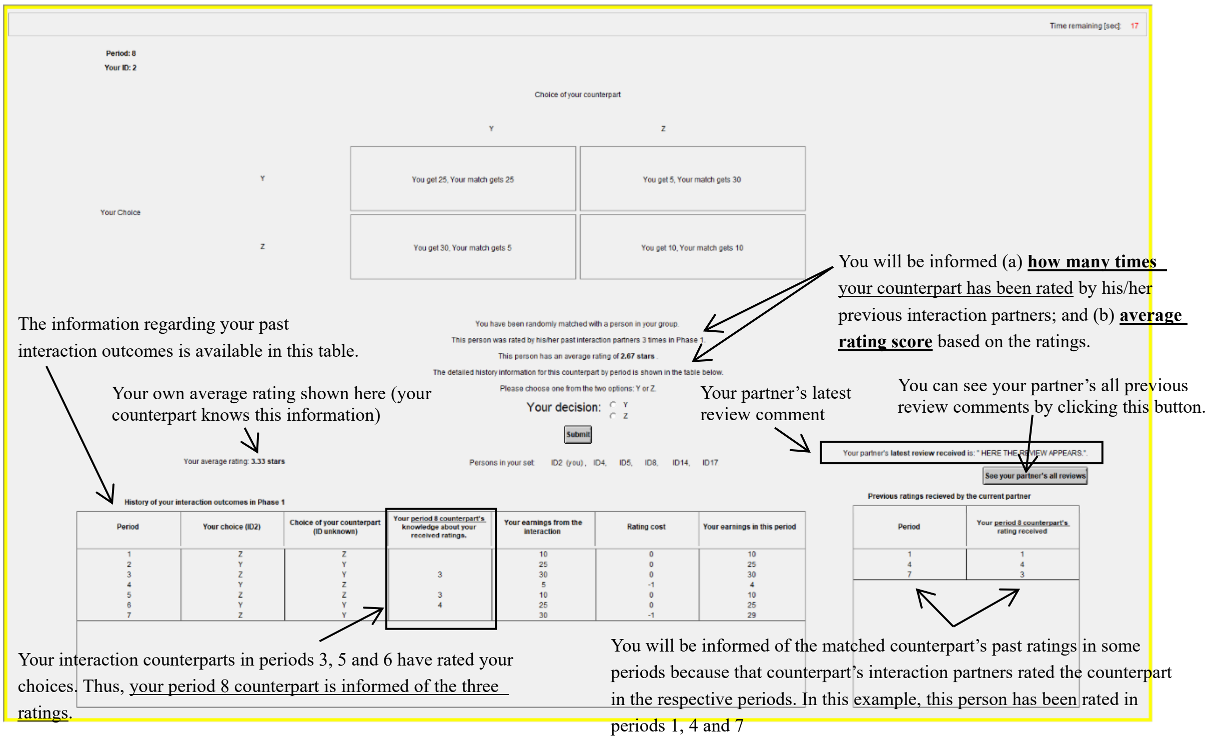
When you make binary choice, you <u>will be informed of all of the rating scores and feedback comments your counterpart has received so far in the previous periods</u>. As will be explained below, each of you will be given an opportunity to rate partners on a five-point scale, i.e., from 1 star ("very poor") to 5 stars ("very good"), and write a feedback comment at the end of the period. You will also learn the **average rating** of the partner. For example, suppose that it is now in period 8. Also suppose that your counterpart's previously-matched partners in periods 1, 4, and 7 gave 1 star, 4 stars and 3 stars, respectively, to the counterpart in those periods. Then you will be informed that your counterpart's average rating is 2.67 stars (see the screen shot on the next page). Rating information is not available in period 1 as there is no previous round.

The partner's latest verbal feedback comment appears on the decision screen (the screenshot on the next page). You can check all the partner's review comments by clicking on the "See your partner's all reviews" button. We will explain the detail of the rating process below.

Note that while you are aware of the rating information of your partner, you <u>are **not** informed of</u> the counterparts' action choices themselves in the past periods.

Once all participants in a session make decisions and click the "Submit" button, you will be informed of the outcome of the interactions in a given period. Specifically, you will be informed of (1) your partner's choice and (2) your earnings in that period.

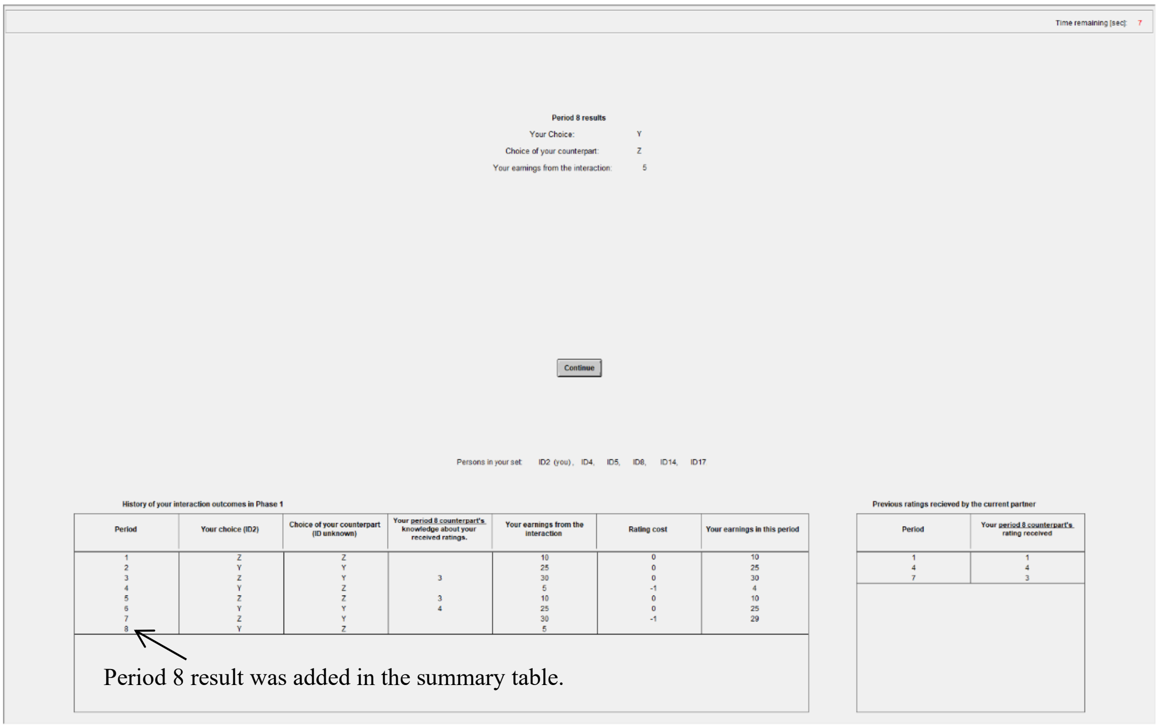
An Example of Computer Screen 1: (when making decisions)



Note: Period 8. Decisions here are for illustration only.

Example of Computer Screen 2: (the screen layout when a subject clicks the "See your partner's all reviews" button)

An Example of Computer Screen 3: (the outcome screen)



Time remaining [sec]: 7

Period 8 results

Your Choice: Y

Choice of your counterpart: Z

Your earnings from the interaction: 5

Continue

Persons in your set: ID2 (you), ID4, ID5, ID8, ID14, ID17

History of your interaction outcomes in Phase 1

Period	Your choice (ID2)	Choice of your counterpart (ID unknown)	Your period 8 counterpart's knowledge about your received ratings.	Your earnings from the interaction	Rating cost	Your earnings in this period
1	Z	Z		10	0	10
2	Y	Y		25	0	25
3	Z	Y	3	30	0	30
4	Y	Z		5	-1	4
5	Z	Z	3	10	0	10
6	Y	Y	4	25	0	25
7	Z	Y		30	-1	29
8	Y	Z		5		

Period 8 result was added in the summary table.

Previous ratings recieved by the current partner

Period	Your period 8 counterpart's rating received
1	1
4	4
7	3

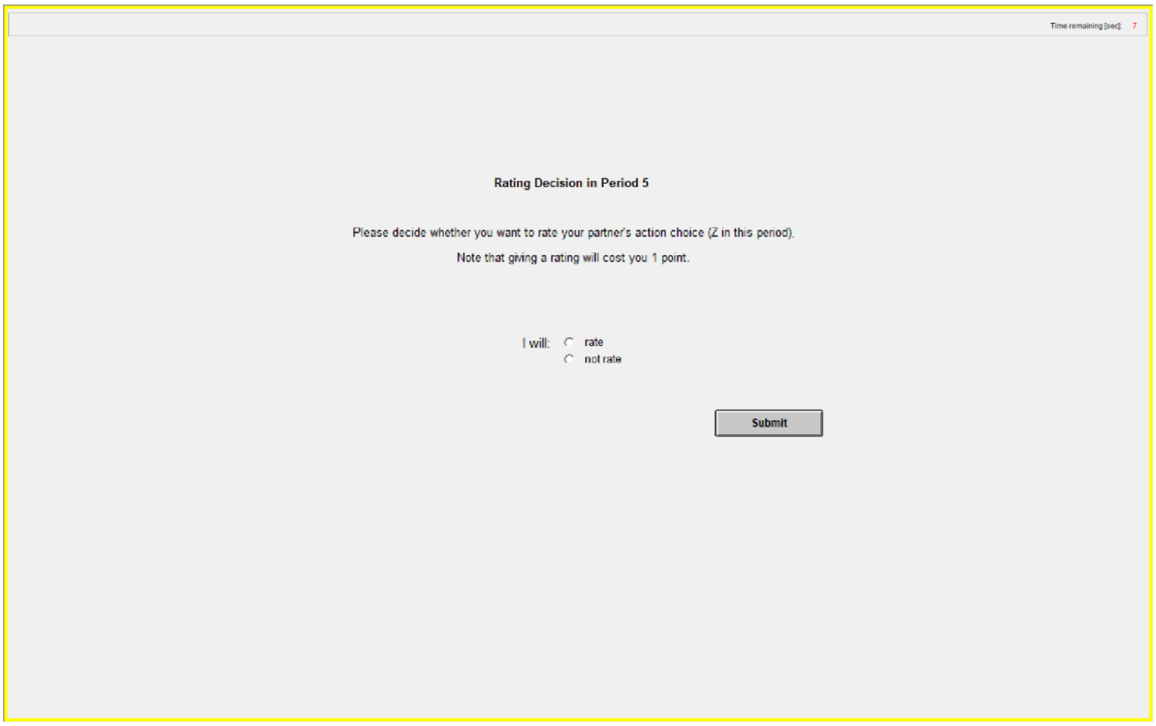
Note: Period 8. Decisions here are for illustration only.

Stage 2: *Deciding whether to rate your counterpart's action*

Once you review the interaction outcome in Stage 1, you will be asked to decide whether you wish to rate your interaction counterpart's behavior (i.e., Y or Z) on a five-point scale. 1 star means "very poor," 2 stars means "poor," 3 stars means "neutral" (neither good nor poor), 4 stars means "good," and 5 stars means "very good." You can also leave a verbal feedback comment for this person. The verbal feedback process is subject to two limits. First, your comment must be less than or equal to 150 characters. Second, you cannot write any personal information that may identify yourself. A clear violation of the second restriction leads to a penalty of £5. Rating is costly. If you decide to rate your partner in a given period, **one point will be deducted** from your payoff at the end of that period. If you do not rate, no points will be deducted.

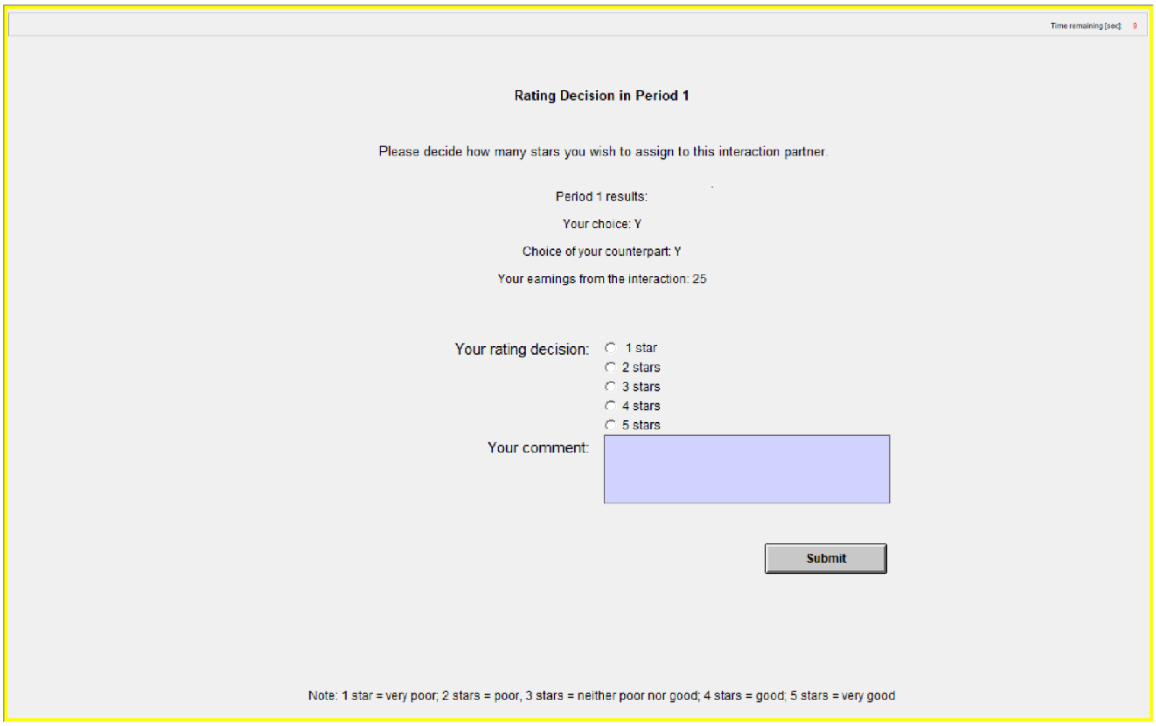
If you rate your partner in period *t*, the partner's counterparts matched in all periods after period *t* will be informed of the rating score and all feedback comments before making binary choice of Y or Z. By contrast, if you do not rate your partner, the partner's counterparts in all the future period will not have any information on that partner's behavior in period *t*.

Example of Computer Screen 4: (the rating decision)



Note: Period 5. Decisions here are for illustration only.

Example of Computer Screen 5: (decision to leave a rating score and a verbal feedback comment)



Note: Period 1. Decisions here are for illustration only.

The Number of Periods in Each Phase:

The number of periods is not predetermined. **The probability that you will have another**

period in a given phase is 90%. Specifically, at the end of each period, the computer randomly draws an integer between 1 and 100 for this session. If the drawn integer is less than or equal to 90, your interaction in the present phase continues. If the drawn integer is greater than 90, then the present phase is over.

Nevertheless, the experimental procedure is different. Operationally, you will play **blocks of 10 periods** in sequence as follows:

1. In a given phase, you will first play 10 periods, assuming the random continuation rule described above. In each period, you will randomly be paired with an individual in your group and will interact with each other by selecting Y or Z. However, you will not be informed of an integer randomly drawn in each period until the end of the tenth period.

2. Once you finish the interaction in period 10, you will be informed of integers randomly drawn in all the 10 periods. For example, suppose that the ten randomly drawn integers were: 1, 84, 34, 56, 32, 3, 72, 45, 14, 32 in sequence. In this situation, you will move on to the next block of 10 periods because the ten randomly drawn integers were all less than or equal to 90. In each period in the next block, you will be randomly paired with an individual in your group and will interact with each other as in the previous block; once you play the ten interactions, you will be informed of the ten realized integers at the end of the 10 periods, as in the previous block.

   For another example, suppose that the ten randomly drawn integers were: 4, 34, 98, 56, 32, 93, 2, 45, 14, 32 in sequence. In this situation, your total payoff in this phase is calculated by your interaction outcomes and costs of rating in periods 1 to 3 because an integer greater than 90 was first realized at the end of period 3. Your interaction outcomes and costs of rating from period 4 will not be counted in calculating your total payoff in that phase; and you will not move on to the next block of 10 periods in the phase. Instead you will move on to the next phase, will be randomly given a new identification number, and will be randomly assigned to a group of 6. The nature of interactions in the next phase is exactly the same as the present one.

Mathematically, since the probability that you have the next period is 90%, the expected number of periods that are used for payment in a given phase is 10 periods. However, since the decision to discontinue your interactions in each phase is randomly exerted by the computer, you may have a phase with valid periods that are much longer or shorter than 10. In case that the total number of periods across the six phases reaches 200 (it could happen although the likelihood is very small), the experiment will be finished due to operational reasons (the experiment duration becomes longer than what was announced in the recruiting message for this experiment).

Your Earnings:

At the end of the experiment, you will be paid privately based on your accumulated earnings across the six phases.

If you have any questions at this time, please raise your hand. If all questions have been answered, we will move on to the experiment.

Comprehension questions:

Please answer the following questions to check your understanding of the instructions. Please raise your hand if you have any questions.

1. How many phases do you have? ____________________

2. How many individuals are there in your group in a given phase?
____

3. Suppose that you choose Y and your partner chooses Z in a period of a given phase. What are your earnings in that period? What are your partner's earnings in that period?

a) Your earnings ____________________

b) Your partner's earnings ____________________

4. How much does it cost you to rate your interaction partner in a given period?
____

5. What is the probability that your interaction continues within your group in a given period?
____

Any questions?

[Once everyone finished answering the comprehension questions and the experimenter explained the answers, the experiment began.]

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