Endogenous Reputation Formation

under the Shadow of the Future

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Abstract:

Recent research has shown that making people's decisions known to others may enhance cooperation in infinitely repeated prisoner's dilemma games with random matching. This paper experimentally studies whether people can cooperate with each other by endogenously showing their identities and building cooperative reputations when there is an option to hide the identities. Our experiment shows that a non-negligible fraction of subjects choose to conceal their identities and accordingly subjects fail to cooperate with each other in communities if hiding is cost-free. However, almost all subjects disclose their identities and successfully achieve cooperation if a cost is charged for the act of hiding. This finding has a broad methodological implication for the study of reputation mechanisms when infinitely repeated games are used in an experiment, as people's behavior may be determined by their ability to hide identities.

JEL classification: C73, C92, D70

Keywords: experiment, cooperation, prisoner's dilemma game, infinitely repeated game, reputation

Highlights

- An infinitely repeated prisoner’s dilemma game experiment with random matching was conducted.
- Subjects decided whether to show or hide their identities (IDs) at the onset of each period.
- Subjects’ IDs were shown to their partners if they decided to use their IDs.
- When hiding was cost-free, some subjects hid their IDs and cooperation did not evolve.
- When hiding involved a cost, almost all subjects showed their IDs and they achieved a high level of cooperation.

1. Introduction

How to sustain cooperation in repeated dilemma situations is one of the most sought-after questions in our society. Reputations play a key role in encouraging people to cooperate in such environments (e.g., Mailath and Samuelson 2006). While having a good reputation can significantly benefit people, having a bad reputation can be a disadvantage for establishing a successful business or personal relationship. One needs to be identified in order to build a reputation so that people can link one's past behavior and name (or one's face, or an identification number if the name is unknown) to one's future interactions. In other words, identity is a crucial element in building a reputation.

A growing body of literature has explored people's reputation-building behaviors in infinitely repeated prisoner's dilemma environments with random matching (e.g., Camera and Casari 2009, Schwartz *et al.* 2000, Stahl 2013). Under a random matching protocol, individuals are randomly matched with each other from round to round, and, therefore, often kept anonymous to each other. Theoretically, in such infinitely repeated dilemma situations, mutual cooperation, in addition to mutual defection, is an equilibrium outcome under some conditions even if people's identities are not revealed.[1] For instance, assuming that people act according to the so-called contagious strategy, mutual cooperation can theoretically be sustained even if people are not informed of their partners' identities or their partners' past behaviors (Kandori 1992, Ellison 1994). Therefore, the standard theory does not provide a point prediction about people's behavior in infinitely repeated situations.

[1] The other well-known matching protocol is a partner matching protocol. Under the partner matching protocol, players are always matched with the same partners. Conditions under which cooperation evolves under partner matching protocols have also been actively studied (e.g., Aoyagi and Fréchette 2009, Blonski *et al.* 2011, Dal Bó 2005, Dal Bó and Fréchette 2011 and 2013, Murnighan and Roth 1983). Mechanisms behind the evolution of cooperation for each matching protocol have also been of great interest to biologists and political scientists (e.g., Axelrod 2006).

Given the multiple equilibria in the economic theory, experimental investigations have been conducted in order to examine people's strategy choices and the evolution of cooperation in infinitely repeated prisoner's dilemma games (see the survey by Dal Bó and Fréchette forthcoming). The results of recent experimental work provide some evidence of the evolution of cooperation even when a random matching protocol is used. Camera and Casari (2009) experimentally showed that community enforcement as proposed by Kandori (1992) may hold. In their "Private Information" treatment, in which subjects are randomly matched with each other in every period without learning their partners' identities or past decisions, the subjects learn to cooperate from supergame to supergame.[2] The literature further suggests that institutions that make people's identities and past behaviors automatically known to their partners or others may be effective in encouraging people to achieve an equilibrium outcome of mutual cooperation under random matching (e.g., Camera and Casari 2009, Schwartz *et al.* 2000, Stahl 2013).[3] However, what happens if people are given an opportunity to decide whether to disclose their identity or to conceal it from their partners? Economists have recently started to study the effects of people's collection of reputational information and gossiping on the evolution of cooperation (Camera and Casari 2015, Duffy *et al.* 2013). For instance, Camera and Casari (2015) let subjects play an indefinitely repeated helping game with random matching, where subjects' identities were kept anonymous in the records. In one treatment, the helper subjects were given opportunities to purchase their partners' history information by paying a fee before deciding whether to transfer a good to the partners, and in another treatment, the recipient subjects were given opportunities to report their counterparts' actions by paying a fee at the end of each transaction. The levels of cooperation in the two treatments were similar to or lower than the

[2] However, subjects' action choices seem to be sensitive to payoff matrices and continuation probabilities. Mutual cooperation did not evolve under a random matching protocol in Duffy and Ochs (2009).
[3] Similar effects of reputation mechanisms have been widely found also in finitely repeated prisoner's dilemma setups (e.g., Gong and Yang 2010) as well as finitely repeated trust games (e.g., Bolton *et al.* 2004 and 2005).

level of cooperation with no history information.[4,5] In contrast to recent research to study the effectiveness of such purchasing or gossiping, this paper is the first to study whether people attempt to build reputations by spreading information about their own behaviors through identity disclosure and how people's ability to hide affects the evolution of cooperation in communities.

This research question has realistic implications, as there are many occasions when hiding identities is possible in our everyday interactions. Examples include personal relationships in local communities. For instance, residents in a small community often know who their neighbors are, and they frequently interact with each other. News related to residents' behavior can quickly spread across such a small, close-knit community. But do some residents attempt to hide their identities and behave uncooperatively? How would people's hiding behavior change if hiding were costly?[6] In contrast, even if the community size is small, some communities are less closely-knit (e.g., relationships among residents in some apartment complexes) and may not have a reputation function. In an environment with poor reputation mechanisms, do some people decide to hide their identities and attempt to behave uncooperatively?

Our experiments are designed based on an infinitely repeated prisoner's dilemma game with random matching, where both mutual cooperation and mutual defection hold as equilibrium outcomes. We use a between-subjects design. Subjects play infinitely repeated prisoner's dilemma games under a single treatment condition. At the onset of the experiment, subjects are assigned unique identification numbers (IDs).

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[4] We note that the impact of collection of reputational information may depend on games and/or subject pools. In Duffy *et al.* (2013), subjects were provided with information on partners' past decisions for free or were given opportunities to purchase such information for a small fee in an infinitely repeated trust game. The data indicated that in both of the situations, not only trust but also reciprocity was enhanced, compared to a treatment without the partners' history information.

[5] In a simple one-shot experiment, Kamei and Putterman (forthcoming) found that acts of gossiping were more likely to be made by those who are exploited by defectors.

[6] In large-scale economies, such as online platforms, information does not automatically spread among communities, and people instead incur cost (e.g., time) to disseminate information (e.g., by updating their profile). This situation can be modeled by assuming that people incur some cost to build public reputations; this has recently been studied in a different setup by Kamei (2016).

This paper consists of two sets of experiments based on the same framework. The first set consists of three *No-Choice* treatments with different quantities of information made available to subjects. In one treatment, each subject is not informed of either their matched partner's ID or their past actions (cooperation or defection). In the second treatment, each subject is informed of their matched partner's ID and their past actions *chosen against the subject* in each round. Thus, each subject can keep track of their own experience with a specific partner. In the third treatment, each subject is informed of actions chosen by all group members, including members that are not their partners, along with their IDs. In the three No-Choice treatments, we ask: *Do subjects' levels of cooperation increase as the quantity of reputational information increases?*

The second set consists of four *Choice* treatments. In these Choice treatments, subjects decide whether to disclose or hide their IDs before the interactions begin in each period. When subject i hides her ID in period t, her period t partner is informed only that he is interacting with a randomly assigned player in his group. After i's interaction with the partner ends, the action choice of i will not be recorded, and it will not be available to anyone in any future periods. By contrast, when subject i discloses her ID in period t, her matched partner is informed of i's ID before choosing an action in that period, and i's action choice will also be recorded.

The four Choice treatments differ in two aspects. The first aspect is the amount of information made available to subjects. Specifically, we vary what past recorded action choices of a partner subject i can see when the partner reveals his ID: either those that were made against i only, or all of his past recorded actions in a given supergame. The second aspect is whether hiding the ID is free or costly. Thus, this part of our design is a 2×2 design. With the four Choice treatments, we address the following specific questions: *Does being able to hide one's identity hurt cooperation? What happens if there is a cost for hiding the identity?*

First, our experiment shows that increasing the quantity of information along with (automatically) revealing their IDs has positive effects on subjects' cooperation rates. Second, we find that having a free option to hide IDs significantly lessens subjects' cooperative behavior, especially when the subjects' IDs and action choices can be observed only by their matched partners. By sharp contrast, when subjects incur a cost for hiding, almost all the subjects choose to reveal their IDs and achieve a high level of cooperation. The average cooperation rates in the costly hiding treatments are significantly higher than those in the free hiding treatments, and are not significantly different from the high cooperation rates of the corresponding No-Choice treatments.

This paper offers two main contributions. First and most importantly, we provide the first experimental evidence that the level of cooperation may be significantly affected by a person's ability to hide. Second, we show that costly hiding mechanisms may be effective in preventing people from hiding their IDs and then selecting defection.

The rest of the paper proceeds as follows: Section 2 describes our experimental design. Section 3 provides theoretical considerations and discusses subjects' possible behaviors. Section 4 reports our results, and Section 5 concludes.

2. Experimental Design

The design framework of our study is an infinitely repeated prisoner's dilemma game. At the beginning of the experiment, each subject is assigned a unique identification number (ID). Our experiment consists of (i) three No-Choice treatments and (ii) four Choice treatments (see Table 1). The seven treatments are varied by (a) whether or not disclosing IDs involves subjects' decisions, (b) which member in a group learns the action choices (cooperate or defect) of those who have decided to disclose their IDs, and (c) whether a subject pays a cost to hide the assigned ID. Our design is based on the framework employed by Camera and Casari (2009), explained in Subsection 2.1. Two of the three No-Choice treatments are from their study. We add one new treatment as the third No-Choice treatment. We then set up four new treatments with choices.

2.1. Common Features in All Treatments

Subjects play five infinitely repeated prisoner's dilemma games. We call an "infinitely repeated prisoner's dilemma game" also a "supergame" in this paper. Subjects are randomly assigned to a group of four at the beginning of each supergame. The list of the four members' IDs is common knowledge in the group. Group assignment across the supergames follows a perfect stranger matching protocol. That is, once a supergame is over, subjects are randomly assigned to another group of four in the following supergame. No one has the same person as a group member in more than one supergame. Any information from a given supergame is not carried over to a future supergame.

Within a supergame, each subject is randomly paired with a group member in every period.[7] Subjects do not interact with subjects outside their groups within a supergame. Neither their decisions nor their interaction outcomes in the past affect the matching process. The duration of each supergame is not pre-determined. Subjects' interactions will be over (continue) with a probability of 5% (95%).[8] Thus, the expected length of each supergame is 20 (= 1/(1−.95)). The payoff matrix of the prisoner's dilemma game is shown in Figure 1.

2.2. The Three No-Choice Treatments

In the "<u>N</u>o Information" treatment, abbreviated as the N treatment, the IDs of subjects are not disclosed to their partners or anyone in the groups in each period. Subjects just know that they are randomly matched with one of the three group members when they choose an action. They learn their own pair's interaction results (the action choices of the matched partners and their payoffs) at the end of each period, without learning their partners' IDs.

[7] Since group size is four, the probability that a subject will interact with a specific member in a given period is 1/3.
[8] We can interpret that risk-neutral subjects have a discounting factor of .95 with this setup.

In the "Reputation within Group" treatment (the RG treatment), each subject is informed of their matched counterpart's ID when choosing an action in every period.[9] They are at the same time informed of all the past actions chosen by each of the three group members within a given supergame. At the end of each period, subjects learn the action choices of the three members, including those who are not matched with them.[10]

The last No-Choice treatment is called the "Reputation with Partner" treatment (the RP treatment). In the RP treatment, as in the RG treatment, each subject is informed of their matched counterpart's ID before choosing an action. They are also given the records of their interaction outcomes (i.e., actions chosen by the own partners in the past). However, subjects are *not* informed of any interaction outcomes of other players (i.e., actions chosen by those who have not been matched with them), unlike the RG treatment. This treatment is conducted to examine how having a fixed ID observable to one's own partners alone, without feedback systems, affects cooperation norms in the community.[11]

2.3. The Four Choice Treatments

We design two sets of two Choice treatments. In these Choice treatments, before engaging in an interaction, each subject can choose either to use their ID or to hide it so that the matched partner will not know with whom he is interacting. The two sets of Choice treatments are exactly the same, except the presence of a cost that a subject must pay when hiding her ID.

In the "Reputation with Partner, Free Hiding" treatment (the RP-F treatment), subjects decide whether to use or hide IDs without any cost in each period. If subject *i* decides to use her ID in a period, *i's* matched partner *j* will be informed of *i*'s ID before *j* chooses an action. In

[9] The N and RG treatments are the same as the "Private Information" and the "Public Monitoring (non-anonymous)" treatments, respectively, in Camera and Casari (2009).
[10] Thus, subjects in the RG treatment can build cooperative reputations within their groups.
[11] The difference in subjects' cooperation behavior between the N and RP treatments can be attributed to the effects of having the fixed IDs; and the difference between the RP and RG treatments can be attributed to the effects of the reputation system that makes people's decisions known to others.

addition, subject *i*'s past actions in periods where *i* was matched with *j* and *i* used her ID will be shown on *j*'s computer screen. By contrast, if subject *i* decides not to use her ID, her matched partner *j* only knows that he is playing with one of the three group members. The "Reputation with Partner, Costly Hiding" treatment (the RP-C treatment) is identical to the RP-F treatment, except that a subject incurs a cost of two points each time he conceals his ID.[12]

In the "Reputation within Group, Free Hiding" treatment (the RG-F treatment) and the "Reputation within Group, Costly Hiding" treatment (the RG-C treatment), subjects decide whether to disclose IDs as in the RP-F and RP-C treatments. While a subject can hide his ID without any cost in the RG-F treatment, a subject must pay a fee of two points each time the subject hides her ID in the RG-C treatment. The consequence of a subject's ID disclosure is the same as that in the RG treatment. Suppose that subject *i* decides to use her ID in period *t* of a supergame. Then, her period *t* partner *j* will be informed of the ID of subject *i* before *j* chooses an action. In addition, after the interaction between subject *i* and partner *j* ends, all three members in that group will learn the action choice of subject *i* along with *i*'s ID in that period. Also, the subject's action in period *t* will always be available to the three group members in any future rounds within the supergame, along with her ID.

2.4. Experimental Procedure

We conducted 14 sessions (two sessions per treatment) at the University of Michigan in Ann Arbor from July to October in 2014. A total of 236 subjects participated in the experiment.[13] This experiment was computerized and programmed using ztree (Fischbacher 2007). Only

[12] As shown in Figure 1, the per-period gain of deviating from mutual cooperation is 5 (= 30 – 25) under the assumption that the others continue to select cooperation. A hiding cost of two points accounts for 40% of the deviation gain.
[13] All subjects were recruited using solicitation emails sent through the University of Michigan online recruiting system, the Online Recruitment System for Economic Experiments (developed by Greiner (2015)). There were 134 female subjects (56.8% of the total subjects). The average earnings (excluding the participation fee) were $21.80.

neutrally-framed words were used in the instructions (see Appendix B).[14] No subjects participated in more than one experimental session. No communication among the subjects was allowed after entering the laboratory and before the experiment ended. The instructions were read aloud by the researcher. Subjects were asked to answer a few control questions to check their understanding of the experiment before the experiment began.

Each session consisted of either 16 subjects (four groups) or 20 subjects (five groups). The average duration of the experiment (including giving the payment to the subjects) was about two hours. The average supergame lengths were 16, 14, 20, 29, 14, 15 and 22 periods in the N, RP, RG, RP-F, RP-C, RG-F and RG-C treatments, respectively.

3. Theoretical Considerations and Discussions

A wide range of outcomes can be rationalized by standard economic theory, as we use an infinitely repeated prisoner's dilemma game as a framework. Both mutual cooperation and mutual defection hold as equilibrium outcomes in all treatments including the N treatment. The continuation probability (δ) is .95 in our setting, and the threshold value of the continuation probabilities that support mutual cooperation as an equilibrium outcome in the N treatment (δ_N^*) is equal to .443 (page 986 in Camera and Casari 2009). As discussed in Camera and Casari (2009), mutual cooperation is more easily attained in the RG treatment than in the N treatment if the grim trigger strategy is used. The threshold δ in the RG treatment (δ_{RG}^*) is .25. The grim trigger strategy also predicts that the threshold value in the RP treatment (δ_{RP}^*) is .443, the same as that in the N treatment. This is because subjects in the RP treatment only learn their matched partners' action choices.[15]

[14] Any words with a positive or negative connotation (e.g., cooperate) were avoided.
[15] With the grim trigger strategy, a subject chooses to defect from anyone as soon as one of the three members in her group chooses defection to the subject.

OBSERVATION 1: $\delta_N^* = \delta_{RP}^* = .443$. $\delta_{RG}^* = .25$.[16]

Despite Observation 1, cooperation may be more easily sustained in the RP treatment than in the N treatment thanks to the availability of information on matched partners' IDs in the former treatment. First, a subject's action choice may be conditional on the matched partner's observable actions in previous matches in the RP treatment, as in past research which shows people's conditional cooperation behavior in other games (e.g., Fischbacher and Gächter 2010). The tit-for-tat-like strategy may facilitate cooperation in the RP treatment. Such direct and certain punishment is not possible in the N treatment. Second, IDs could serve as a coordination device among subjects. Subjects in the RP treatment may decide to build cooperative reputations with matched partners through ID disclosure.[17]

In the four Choice treatments, the amount of information available to subjects depends on the other subjects' choices regarding the use of IDs. In each of the Choice treatments, both mutual cooperation and mutual defection hold as equilibrium outcomes. The presence of the cost for hiding does not affect the threshold value of continuation probabilities δ^*. Assuming a grim trigger strategy, we find that the threshold value (δ^*) in the RP-F and RP-C treatments is the same as that in the N and RP treatments.[18] Likewise, we find that the threshold value in the RG-F and RG-C treatments is the same as that in the RG treatment.[19] Therefore, theoretically the

[16] Past research finds that subjects are heterogeneous regarding strategy choices (e.g., Dal Bó and Fréchette forthcoming). There is often a non-negligible fraction of subjects who always choose defection even if mutual cooperation can be sustained as an equilibrium outcome in infinitely repeated games. This strategy is called the "always to defect" strategy. The equilibrium outcome of mutual cooperation may not be obtained in our experiment as well due to the presence of such subjects.
[17] For example, Kamei and Putterman (2017) find that some subjects seek to be matched with specific persons and build cooperative relationships in a finitely repeated regrouping treatment, even if the only available information is subjects' IDs and their own interaction outcomes.
[18] For instance, suppose that each person *s* in subject *i*'s group chooses the following discriminating strategy: "always use ID, and then cooperate in a given period if (a) her partner *j* uses his ID in that period, and (b) *s*'s partner in any period $k \in \{1, 2, \ldots, t\text{-}1\}$ used his/her ID against *s* and selected cooperation; or defect in any other situations." Also assume that subject *i* has also acted on this discriminating strategy so far until period *t*. In this situation, there is no better strategy for subject *i* than using the same strategy, and the threshold value δ^* is calculated as $.443$.
[19] For instance, suppose that the three other members in subject *i*'s group choose the following strategy: "always use ID, and then cooperate in period *t* if (a) her period *t* matched partner uses his ID in that period, and (b) the partner

mutual cooperation would be equally likely to be achieved as an equilibrium outcome in the RP-F and RP-C (RG-F and RG-C) treatments, relative to the RP (RG) treatment.[20]

OBSERVATION 2: (i) $\delta^*_{RP-F} = \delta^*_{RP-C} = .443$. (ii) $\delta^*_{RG-F} = \delta^*_{RG-C} = .25$.

Observations 1 and 2, however, do not necessarily mean that the strength of cooperation norms in the Choice treatments is the same as that in the corresponding No-Choice treatments. According to the literature, there are two opposing possibilities. On the one hand, subjects' cooperation behavior may be stronger if the choice to disclose or hide IDs serves as an opportunity for people to send signals regarding their future action choices (e.g., Tyran and Feld 2006, Cooper *et al.* 1992). It is also possible that endogenous choice itself positively affects people's preferences for cooperation, as has been found in other contexts (e.g., Charness *et al.* 2012, Kube *et al.* 2012, Bartling *et al.* 2014, Dal Bó *et al.* 2010, Kamei 2016, Tyran and Feld 2006). For example, subjects in Kamei (2016) contributed significantly more in a public goods game when they endogenously chose non-deterrent sanctions, whose effect was positive even if selection bias and signaling effects were controlled for.

On the other hand, it is possible that mutual cooperation may be less likely to be realized as an equilibrium outcome in the Choice treatments, compared with the No-Choice treatments, because some subjects may not have enough cognitive ability to anticipate the negative consequences of hiding, as recently shown in Arruñada and Casari (2016).[21] For example, some

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and two other peers in her group have used their IDs and selected cooperation in all the past periods in the given supergame; or, defect in any other situations." Also assume that subject *i* has acted on this discriminating strategy so far until period *t*. In this situation, subject *i* has no incentive to deviate from the strategy, as one instance of hiding or defection triggers all three members' defection, as in the RG treatment.

[20] As explained in footnote 12, the hiding cost is 40% of the deviation gain. Subjects' cooperation rates in infinitely repeated prisoner's dilemma games are known to be affected by stage game payoffs (e.g., Dal Bó *et al.* forthcoming). If subjects use strategies in which they hide their IDs whenever they defect, gains from defection decrease and accordingly the level of cooperation could increase in the costly hiding treatments.

[21] In an indefinitely repeated modified trust game with a judge (third party enforcer) who can intervene the trustee's action choice, Arruñada and Casari (2016) found that judges' enforcement and efficiency are lower when trustees control judges (a treatment condition which requires high cognitive loads) than when trustors control judges or judges' payoffs are determined by the aggregate income of the society (treatment conditions which require low cognitive loads).

subjects may mistakenly believe that when they hide their IDs, their partners may not select defection toward them. However, the partners may protect themselves from non-disclosers by selecting defection, and such defection could trigger a quick decline in cooperation norms as in the logic of the community enforcement (Kandori 1992).

Lastly, we note that subjects' behaviors in the RP-F and RG-F treatments may differ substantially from those in the RP-C and RG-C treatments if the zero cost of hiding has a psychological effect to increase subjects' temptations to hide and to behave uncooperatively. Such a discontinuity of people's behavior between zero and positive cost has been reported in another context (see Shampanier *et al.* 2007 and Kamei and Putterman forthcoming).

4. Results

We will first discuss the subjects' average cooperation rates in Sections 4.1 and 4.2. We then explore the driving forces behind the cooperation behavior in Sections 4.3 to 4.5.

4.1. Average Cooperation Rates

We will compare the average cooperation rates across the treatments in this section (Figure 2(I) and Table 2).[22] First, the results of the No-Choice treatments reveal a significantly positive effect of having a larger quantity of information on subjects' cooperation behavior. The average cooperation rate is higher by 29.2 percentage points when each subject's ID can be seen by their partner (the RP treatment), compared with when it is not (the N treatment). This suggests that simply making people's IDs available to their matched partners can be very effective in encouraging them to achieve high cooperation norms. The average cooperation rate is even higher in the RG treatment (where subjects' IDs and action choices are shown to all group members) than in the RP treatment. This suggests that public monitoring, i.e., the reputation

[22] The average cooperation rates by experiment session can be found in Appendix Table A.1.

mechanism that makes people's decisions open to the public in the RG treatment, is of further help in deterring people's selection of defection.

RESULT 1: *The average cooperation rate is the highest in the RG treatment, followed by the RP treatment and the N treatment, in that order.*

Second, the presence of the *free* ID hiding option significantly alters subjects' cooperation behaviors. The average cooperation rates are 31.9 percentage points and 18.6 percentage points lower in the RP-F and RG-F treatments than in the RP and RG treatments, respectively (Figure 2(I)). These decreases are significant (see variables (iii) and (v) of Table 2).[23] As a result, there is no significant difference in the average cooperation rate between the RP-F and the N treatments. The RG-F treatment still has a significantly higher cooperation rate than the N treatment (Part (A), Appendix Table A.2), showing a clear impact of reputation mechanisms even if hiding is possible. However, the average cooperation rates increase sharply if subjects have to bear a cost each time they hide their IDs. The data shows that the average cooperation rates for the RP-C and RG-C treatments are not significantly different from those in the RP and RG treatments, respectively (Figure 2(I), Table 2, Part (A) of Appendix Table A.2).[24]

RESULT 2: *(a) The average cooperation rates are significantly lower in the RP-F and RG-F treatments than in the RP and RG treatments, respectively. (b) While the average cooperation rate in the RP-F treatment is not significantly different from that in the N treatment, it is still*

[23] Individual random effects linear regressions were used to study the treatment effects. Session clustering is included in the analysis. The reference group is subjects' action choices in the N treatment. As for independent variables, first, we included the RP factor dummy and RG factor dummy in order to measure the impact of these factors. Second, we also added the interaction terms between these dummies and the Choice dummy (= 1 for the four choice treatments) to study the impact of hiding. Third, we further interacted the above interaction terms with the Costly hiding dummy (= 1 for the RP-C and RG-C treatments) and included them as independent variables to study how the cost for hiding affects subjects' cooperation behaviors. We note that in column (2), the length of the previous supergame was added as a control because it can affect subjects' action choices in the subsequent supergame (e.g., Engle-Warnick and Slonim 2006).
[24] We did not find the impact of endogenous choice on boosting cooperation unlike the discussion in Section 3. A likely reason is that the levels of cooperation in the RP and RG treatments were already very high, and thus there was not much room for a further increase in cooperation in the RP-C and RG-C treatments.

significantly higher in the RG-F treatment than in the N treatment. (c) The average cooperation rates are not significantly different between the RP-C (RG-C) and RP (RG) treatments.

The pattern of average payoffs is similar to that of average cooperation rates (Appendix Figure A.1). A regression analysis confirms a qualitatively similar impact of each treatment factor on subjects' per-period payoffs as in Results 1 and 2 (see Appendix Table A.3).

4.2. Trends of Subjects' Cooperation Behaviors over the Supergames

Subjects' learning behavior across the supergames differs according to the quantity of observable information in the No-Choice treatments (Figure 2(II)). The average cooperation rates in the N treatment begin at around 45% and gradually decline from supergame to supergame. In the RG treatment, by contrast, they are much higher from the first supergame, around 65%, and reach above 80% in the last three supergames. When action choices and IDs are known only to matched partners (the RP treatment), the average cooperation rate is similar to that in the N treatment in the first supergame, but the cooperation rates steadily increase from supergame to supergame as in the RG treatment. As shown in Table 2 and Part (B) of Appendix Table A.2, the increases of the average cooperation rates are significantly positive in the RP and RG treatments, but they are significantly negative in the N treatment. In the RP and RG treatments, the trends of period 1 cooperation rates over the supergames are similar to those of the average cooperation rates of each supergame in Figure 2(II) (see Appendix Figure A.2(a)).

The results of the Choice treatments indicate that the level of cooperation is much higher in the RG-F treatment than in the RP-F treatment in each supergame (Figure 2(II)). A larger percentage of subjects choose to cooperate from the onset and learn to cooperate over the supergames in the RG-F treatment (Panel (c)). The average cooperation rates in the RG-F treatment increase significantly faster from supergame to supergame, compared with the RP-F treatment (Table 2, Part (C) of Appendix Table A.2). This again suggests the success of the reputation system in enhancing cooperation, and corresponds to Result 2(b).

Once the hiding cost is introduced, the levels of average cooperation rates increase substantially in the RP environment (Panel (b) in Figure 2(II)). The average cooperation rate is higher by more than 30 percentage points in any supergame when hiding is costly (the RP-C treatment) than when hiding is cost-free (the RP-F treatment). The difference in the level of cooperation is significant (see variable (iv) in Table 2). In the RG environment, the overall level of cooperation is higher in the RG-C treatment than in the RG-F treatment by only a small degree, but subjects in the former treatment learn to cooperate significantly more quickly (see the interaction term between variable (vi) and Supergame Number variable in Table 2). As a result, the average cooperation rates in the RG-C treatment exceed those in the RG-F treatment in the last three supergames. Results of the across-supergame trends of subjects' cooperation behaviors are similar even if we use cooperation rates in the first periods (Panels (b) and (c), Appendix Figure A.2).

4.3. Hiding IDs and Choosing Defection

How can we explain the differences in the average cooperation rate between the free hiding and costly hiding treatments? The frequency of subjects' hiding and non-disclosers' selection of defection is the key. Subjects in the RP-F treatment hide IDs about 39.5% of the time (Figure 3(b)). In the RG-F treatment, subjects hide IDs at a lower rate on average, about 30.0% of the time, although the difference in the frequency of concealing IDs between the two treatments is not significant (Panel (2), Appendix Table A.4).[25] In the costly hiding treatments, by sharp contrast, average ID hiding rates (i.e., the average percentages of cases in which subjects hide IDs) are only 3.3% and 2.9%, both of which are strikingly small, in the RP-C and

[25] Individual random effects linear regressions were used to test the differences in subjects' hiding rate between the treatments.

RG-C treatments, respectively. These two fractions (3.3% and 2.9%) are not significantly different from each other (see again Table A.4). The clear difference between subjects' hiding behaviors with and without the hiding cost is consistent with the idea that a zero cost of hiding significantly triggers subjects' temptation to hide, and is similar to the discontinuity of people's valuation of goods when engaging in purchase decisions (e.g., Shampanier *et al.* 2007).

4.3.1. Subjects' Learning to Disclose IDs

Subjects' learning behavior in the free hiding treatments appears to be sensitive to the amount of information they are given. Subjects in the RP-F treatment learn to disclose IDs over time by only a small degree, and the average ID hiding rate is above 30% even in the last supergame (Appendix Figure A.3(a)). However, in the RG-F treatment, subjects learn to disclose IDs to a larger degree from supergame to supergame (Appendix Figure A.3(b)), and the ID hiding rates drop to a little above 10% in the last two supergames. Although the difference in the hiding rate is not statistically significant in each supergame (Appendix Table A.4), the observed difference in subjects' learning to disclose is parallel to the difference in the cooperation trend between the two treatments.

Subjects' hiding behaviors are clearly different when there is a cost for hiding. When hiding is costly, subjects convey IDs from the very first supergame, and the ID hiding rates decrease further over the supergames (Appendix Figure A.3). The ID hiding rates in the last three supergames are far below 5% in both the RP-C and RG-C treatments. The difference in the hiding rate is significant in each of the five supergames between the RP-F (RG-F) treatment and the RP-C (RG-C) treatment (Panel (1), Appendix Table A.4).

RESULT 3: *(i) While subjects in the RP-F treatment hide IDs more than 30% of the time in each supergame, subjects in the RG-F treatment learn to disclose IDs to a large degree from* *supergame to supergame. (ii) Subjects disclose assigned IDs significantly more often in the RP-C and RG-C treatments than in the RP-F and RG-F treatments, respectively.*

4.3.2. Subjects' Motives to Disclose or Hide IDs

Among others, there are two possibilities why subjects disclose their IDs. First, subjects might want to signal to their peers that they are conditional cooperators, and attempt to encourage non-disclosers or defectors to switch to such conditional cooperative strategies. With this strategy, subjects could select defection even if they disclose IDs, for example when the matched partner is a discloser who selected defection frequently in the past. Second, subjects might reveal their IDs from two possible motives: (a) to build cooperative reputations by conveying signals of future cooperative actions, and (b) to punish members that selected defection in the past while letting the defectors see their IDs.[26,27] With this possibility, subjects switch between motives (a) and (b), dependent on their partners' action choices. Motive (b) is the punishment path with some duration. Regardless of which possibility is valid, subjects' motive to convey their willingness to cooperate can be explored by using subjects' action choices in the first periods of the supergames, because no punitive motives can be present in the first periods (recall that the perfect stranger matching protocol was used across the supergames and thus subjects have never seen defection from their peers in a given supergame). As shown in Figure 4(a), disclosers cooperate much more frequently than non-disclosers in all treatments; and the differences in the average cooperation rate are significant for most comparisons, except the RP-C treatment where we do not have sufficient data because almost all subjects disclosed their IDs in

[26] Non-disclosers were more likely than disclosers to select defection, as will be explained in Section 4.3.3. Thus, motive (b) includes punishment of non-disclosers who disclosers assume would have defected in the past.

[27] As the stage game is repeated with a high probability, some subjects may attempt to establish a reputation as a tough subject by making their retaliatory acts known to previous defectors with their IDs shown.

the first periods.[28] This suggests that revealing the assigned ID in the first periods is a clear sign for a subject to select cooperation.

The significantly higher cooperation rates of disclosers, compared to non-disclosers, remain the same when all data are used (Figure 4(b)). Also, the high likelihood that disclosers select cooperation remains at very high levels from supergame to supergame in each treatment (see Appendix Figure A.4). However, the average cooperation rates of disclosers are higher in the first periods of supergames than in other periods in the RP-F, RP-C and RG-F treatments by about 10 percentage points (Figures 4(a) and (b)). This may mean that some subjects in these treatments are using some sorts of discriminating strategies, as discussed at the beginning of this subsection, after the first rounds.[29] Such discriminating strategies will be explored in details in Section 4.4.

RESULT 4: *(i) Disclosers in period t are significantly more likely than non-disclosers to select cooperation in that period. (ii) The average cooperation rate of disclosers is higher in the first periods than in other periods within supergames.*

In short, Result 3(ii) and Result 4(i) suggest that the high efficiency in the RP-C and RG-C treatments (Result 2(c)) is driven by the presence of a cost for hiding that effectively discourages subjects from hiding and then selecting defection.

4.3.3. Stronger Motives to Build Reputations in the RG-F treatment

We saw that when subjects were provided with the free option to hide IDs, the average cooperation rates dropped significantly, regardless of the amount of information. However, the cooperation rate was still higher in the RG-F than in the N treatments (Result 2(b)), despite the

[28] Two kinds of tests were performed: one is group-level Mann-Whitney tests, and the other is based on linear regressions with standard errors clustered by group id. See Appendix Table A.5 for the details.
[29] We acknowledge that the average cooperation rates of non-disclosers are also higher in the first periods of supergames than in the rest of the periods (Figure 4). This may mean that non-disclosers are also employing some sorts of conditional cooperative strategies.

high overall hiding rate in the RG-F treatment. A stronger cooperation behavior in the RG-F treatment, compared with the RP-F or N treatment, is consistent with Observation 2: with more information, not only subjects are able to cooperate with specific persons more effectively, but also they are able to efficiently select defection in a more targeted manner. Thus, subjects' incentives to select cooperation could rise. In fact, our data suggests that a mechanism which boosts cooperation can be disclosers' stronger motives to build reputations, in addition to the subjects' quick learning curve (Result 3(i)), as shown in this subsection.

As explained in Section 4.3.2, disclosers' motives to build cooperative reputations can be explored by using period 1 action choices. Figure 4(a) shows that disclosers' period 1 cooperation rates are much higher in the RG-F treatment than in the RP-F treatment, as is also the case when all data is used (Figure 4(b)). This holds regardless of which supergame we use for analysis (Appendix Figure A.4). In addition, a higher percentage of disclosers chose cooperation in the RG-F treatment than in the RP-F treatment, regardless of the matched partners' action choices. Specifically, while about 64.5% and 36.0% of disclosers in the RP-F treatment selected cooperation when encountering disclosers and non-disclosers, respectively, about 97.5% and 68.5% of disclosers in the RG-F treatment did so when interacting with disclosers and non-disclosers, respectively (Appendix Tables A.6 and A.7). This suggests that the presence of the reputation system, which allows subjects to send signals to all group members, including two other peers in their groups (potential future partners), strengthens disclosers' motives to build cooperative reputations; and this provides a specific mechanism behind the realized high cooperation norm in the RG-F treatment.

RESULT 5: *The period 1 average cooperation rates of disclosers are significantly higher in the RG-F than in the RP-F treatment, whether they encounter disclosers or non-disclosers.*

We note that it is more difficult for a subject to effectively hide their ID in the RG-F than in the RP-F treatment, because there are only two pairs in each group. Despite Result 3(ii), since on average about 70% of subjects disclose IDs in the RG-F treatment, subjects can infer their partners' IDs from publicly available information even if the partners hide their IDs.[30] This feature of small-scale communities may drive Results 2(b), 3(i) and 5.

4.4. Subjects' Reactions to Partners' Disclosure Decisions and Reputational Information

Subjects' strategy choices play an important role in maintaining high cooperation norms. Our data suggests that it is possible that the subjects adopted some discriminating strategies as outlined in Section 4.3.2.

Our method to analyze the subjects' strategy choices is to explore their dynamic action choices by using a regression model. We performed a regression analysis for each of (a) the RP-F and RP-C treatments, and (b) the RG-F and RG-C treatments.[31] The dependent variable is a dummy variable that equals 1 if subject *i* selects cooperation in period *t*, and 0 otherwise, for each dataset. Several variables that explain the partners' disclosure decisions and reputational information are included as independent variables (Table 3).[32,33]

First, consistent with Result 4(i), those who convey IDs select cooperation significantly more often than those who hide them in each of the Choice treatments (variable (i), Table 3). The

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[30] When subject *i* is matched with a non-discloser and the two other subjects in *i*'s group have both disclosed their IDs, *i* can exactly infer the partner's ID. The total numbers of subjects' hiding events were 710 and 104 in the RG-F and RG-C treatments, respectively (Figure 3). Out of these events, 276 cases (38.9%) and 37 cases (35.6%) were the cases in which the partners of non-disclosers could infer the IDs of the non-disclosers.

[31] Fixed effects are added to control for individual effects.

[32] First, the "Observe-ID dummy" was included in order to examine the response of subject *i* to her period *t* partner's current period disclosure decision. Second, an interaction term between the Observe-ID dummy and the "Observe-No-History dummy" was included in order to study the response of subject *i* to her period *t* partner's past disclosure decisions. Third, a variable summarizing the *quality* of reputational information of subject *i*'s partner was included because subject *i* could condition her action choice on the previous actions that her current partner chose with his ID revealed. Specifically, for dataset (a), we added the fraction of cases in which subject *i*'s unmasked interaction partner in period *t* had chosen defection *toward subject i* with his ID revealed before period *t* (variable (iv)). For dataset (b), we added the fraction of cases in which subject *i*'s unmasked partner in period *t* had chosen defection *in their group* with his ID revealed before period *t* (variable (v)). On top of these variables, the "Use-ID dummy" was also included as subjects' ID using/hiding decisions were related to their subsequent action choices (Result 4(i)).

[33] See Fischbacher and Gächter (2010) for the discussion of conditional cooperation in dilemma games.

disclosers' willingness to cooperate is especially strong in the treatments with the RG factor, as consistent with Result 5. The costly hiding institution does not change this result (variable (vii), Table 3). Second, the regression indicates that subjects are more likely to select cooperation when they are able to see their partners' IDs than otherwise, whether the RP or the RG factor is used (variable (ii), Table 3).

RESULT 6: *Regardless of whether the RP or RG factor is used, subjects are more likely to select cooperation in period t if their current period partners reveal their IDs in that period.*

Action choices of subjects in period *t* depend on their matched partners' reputational information accumulated before period *t*. First, subject *i* is reluctant to select cooperation when her current period partner has no history information available for *i* even if he reveals his ID. This tendency is often significant (variable (iii), Table 3). Second, subjects' choice to cooperate is positively correlated with the partners' frequencies of choosing cooperation with IDs revealed in the past (variables (iv), (v), and (xi) in Table 3). This means that by having good recorded history information available to a matched partner, subject *i* is significantly more likely to induce her partner to select cooperation. These findings imply that the low cooperation rate in the free hiding treatments is not only due to the non-cooperative behavior of masked subjects, but also due to the significantly smaller quantity and significantly lower quality of recorded information, which causes subjects to choose defection more frequently based on the discriminating strategies.

We have so far focused on the impact of unmasked partners' reputational information. But the acts of a subject's previous partners who hid their IDs may have also affected her action choice in a given period. In order to explore how experiences of interacting with masked subjects influence subjects' cooperation behaviors, we conducted a supplementary regression while having the percentage of cases in which masked partners selected defection as an additional independent variable. As shown in Appendix Table A.8, this variable turns out to be a negative predictor for a subject's selection of cooperation in the RP-C and RG-C treatments.[34]

In the RG-F and RG-C treatments, each subject is informed of all group members' ID disclosure decisions in each period. Thus, they are aware of the period t partner's hiding rate (the percentage of cases in which the partner did not use the ID up to period $t - 1$). To supplement the analyses in Table 3, we performed a regression by including (a) the interaction term between the Observe-ID dummy and the hiding rate, instead of variable (iii) in Table 3, and (b) the same variables in Table 3 except for the change described in (a). As shown in Appendix Table A.9, the new interaction term obtains a significantly negative coefficient. This again suggests that less recorded information in a community leads to less cooperation in that community.[35]

RESULT 7: *(i) A subject is less likely to choose cooperation if there is no available history information about their partner. (ii) The higher fraction of cooperation her partner has in his recorded information, the more likely a subject is to choose cooperation. (iii) In the RG-F and RG-C treatments, a subject is less likely to cooperate if her counterpart frequently hid his ID in the past periods than otherwise.*

4.5. What Enabled Subjects to Learn to Disclose and Cooperate in the RG-F Treatment?

Despite the clear disadvantage of hiding shown in Results 6 and 7, the overall hiding rates in the free hiding treatments were more than 30%, unlike in the costly hiding treatments (Section 4.3). Hiding rates largely differ by subject, however. About 10% of subjects always hid and about 20% of subjects always disclosed IDs in both the RP-F and RG-F treatments. There are many subjects that do not stick to one option: either disclose or hide (Appendix Figure A.5). The difference in the cumulative distribution of subjects' overall hiding rates between these two

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[34] The same regression model as Table 3 was used. Observations in a given period of those who have never met with non-disclosers in the supergame were excluded in the regression. Due to the omission, the available data diminished 48.4% (73.2%) in the RP-F and RP-C treatments (RG-F and RG-C treatments).

[35] Results on the coefficient estimates on the Use-ID dummy, the Observe-ID dummy and the fraction of defection in the partner's recorded information are similar to those in Table 3.

free hiding treatments is small. Nevertheless, subjects in the RG-F treatment learned to disclose their IDs to a large degree over time and cooperate at high levels, unlike in the RP-F treatment (Section 4.3). As discussed, this can be explained by Observation 2: threshold δ^* is lower in the RG-F than in the RP-F treatment. But how did subjects in the RG-F treatment learn to disclose IDs and cooperate over time? We explore several possibilities in relation to this question.

One potential reason for the difference in the subjects' learning between the RP-F and RG-F treatments is that the advantage of disclosing was larger in the RG-F treatment than in the RP-F treatment. This possibility can be explored in two ways. First, if this is the case, subjects who experimented with disclosing and hiding earlier in the interactions may have learned to disclose more quickly in the RG-F treatment than in the RP-F treatment. However, our data does not support this possibility.[36] This suggests that the subjects' experimentation was not the most important factor that made non-disclosers switch to disclosing in the RG-F treatment. Second, the strength of non-disclosers' responses to partners' intentions to cooperate could be different between the two free hiding treatments. We saw that with the reputation device in the RG-F treatment, disclosers raised their levels of cooperation to build cooperative reputations (Result 5). Responding to the disclosers' signals, non-disclosers may have switched to disclosing and building cooperative relationships more quickly in the RG-F treatment. As shown in Appendix Table A.13, non-disclosers in the RG-F treatment are in fact significantly more likely than non-disclosers in the RP-F treatment to disclose IDs in period t, when the period $t-1$ partners disclosed IDs and selected cooperation. The difference in the non-disclosers' likelihood to select

[36] We sorted subjects based on hiding rates in the first supergame in an ascending order and then split them using quartiles in each treatment; we then studied how subjects in each of the four categories changed behaviors over time. Two clear results were found (Appendix Table A.10). First, while the correlation between the hiding rates in the first supergame and the hiding (cooperation) rates in the last supergame is significantly positive (negative) in the RP-F treatment, the correlations are not significant in the RG-F treatment. Second, those who always hid IDs in the first supergame have lower hiding rates and higher average cooperation rates in the last supergame than those who frequently switched between hiding and disclosing in the RG-F treatment.

cooperation between the two treatments is substantial (about 15 percent).[37] This implies that some subjects' experimentation behavior which had no impact on subjects' learning to disclose was motivated by reasons other than finding a materially beneficial choice.[38]

RESULT 8: *Non-disclosers in the RG-F treatment are significantly more likely than non-disclosers in the RP-F treatment to switch to disclosing IDs, when they encountered disclosers in the last period and the disclosers selected cooperation.*

Another possibility is that subjects in the RG-F treatment were able to imitate successful action choices by others, as they were informed of the outcomes of the other pairs. First, a subject may learn to disclose her ID in the RG-F treatment if two subjects in the other pair in her group disclosed IDs and achieved mutual cooperation. A regression analysis indicated that seeing the other pair achieve mutual cooperation raises a subject's likelihood to disclose her ID by about 3 percent in the following period (see Appendix Table A.11).[39] Second, subjects also have an opportunity to observe negative consequences of hiding in the RG-F treatment. Recall that a discloser encountering a non-discloser was more likely to select defection (Result 6). However, our data shows that seeing a non-discloser defected by a discloser in the other pair had little effect on subjects' disclosure decisions in the following period (Appendix Table A.12).[40]

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[37] We acknowledge that another possible interpretation of this result is due to higher visibility of actions in the RG-F than in the RP-F treatment. As explained in footnote 30, the likelihood to be identified is much higher in the RG-F than in the RP-F treatment, regardless of whether subjects disclose or hide IDs. The higher visibility could have encouraged non-disclosers to learn to disclose IDs in the RG-F treatment.

[38] As an anonymous referee pointed out, those who frequently hide IDs may expect outcomes other than mutual defection. If this is the case, those who frequently switch back and forth between disclosing and hiding may play the game differently, compared with those who stick to one option. An analysis shown in Part (D) of Appendix Table A.10 indicates that regardless of hiding rate, subjects are less likely to select cooperation when they hide than when they disclose IDs. This result and Result 6 suggest that mutual defection is the most likely outcome when a subject hides her ID. This seems to suggest that some subjects may be unsure about the relative advantage between disclosing and hiding IDs, especially in the RP-F treatment, perhaps due to some subjects' insufficient cognitive ability (e.g., Arruñada and Casari 2016).

[39] Individual fixed effects linear regressions were used for this analysis. We note that this result is suggestive evidence only; the increase in subjects' disclosure rate is significant only when session clustering is not added.

[40] Individual fixed effects linear regressions were used in Table A.12.

5. Conclusions

This paper experimentally studied how people formed reputations when they had an option to hide their IDs, using an infinitely repeated prisoner's dilemma game. First, our No-Choice treatments showed that increasing the quantity of information positively affects the community's cooperation rates. Second, we found that having a free option to hide IDs substantially undermines cooperation. Our subjects chose to hide IDs about 30% to 40% of the time, and those who hid their IDs were more likely to select defection than those who disclosed them. In addition, subjects were reluctant to cooperate with partners who hid IDs, and therefore, defection spread within communities. Nevertheless, subjects in the RG-F treatment achieved much higher cooperation rates compared with the RP-F treatment, and learned to disclose IDs to a large degree over time. This suggests a clear impact of the reputation mechanism. By sharp contrast, when subjects incurred a cost for hiding, almost all subjects decided to disclose their IDs. In addition, their average cooperation rates were not significantly different from those in the corresponding No-Choice treatments (where subjects' action choices were automatically conveyed to others). Likely channels for the strong cooperation norms with costly hiding include large quantity and high quality of recorded information, and disclosers' strong cooperation behavior, among others. Lastly, our results suggest the importance of having a good reputation record if a subject wants her partner to select cooperation because subjects' decision to cooperate is dependent on their partners' recorded information.

Our results have a broad implication for studies of infinitely repeated prisoner's dilemma games. While recent experiments have shown that infinite repetition and reputation institutions can encourage people to choose a cooperation equilibrium with community enforcement, to our knowledge, the question of whether they can achieve a high level of cooperation by disclosing their own IDs remained an open question. Our results clearly suggest that the answer to this question may depend on people's ability to hide IDs and also on the cost of hiding. This also has a meaningful implication for studies of reputation mechanisms. With the recent advancement of experimental methodology, infinitely repeated setups are increasingly used in studies of the evolution of cooperation or reputation mechanisms. Our findings suggest that the effectiveness of reputation mechanisms may be affected by how basic rules of games are set (endogenously or exogenously).

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Figure 1: *Payoff Matrix of the Stage Game*

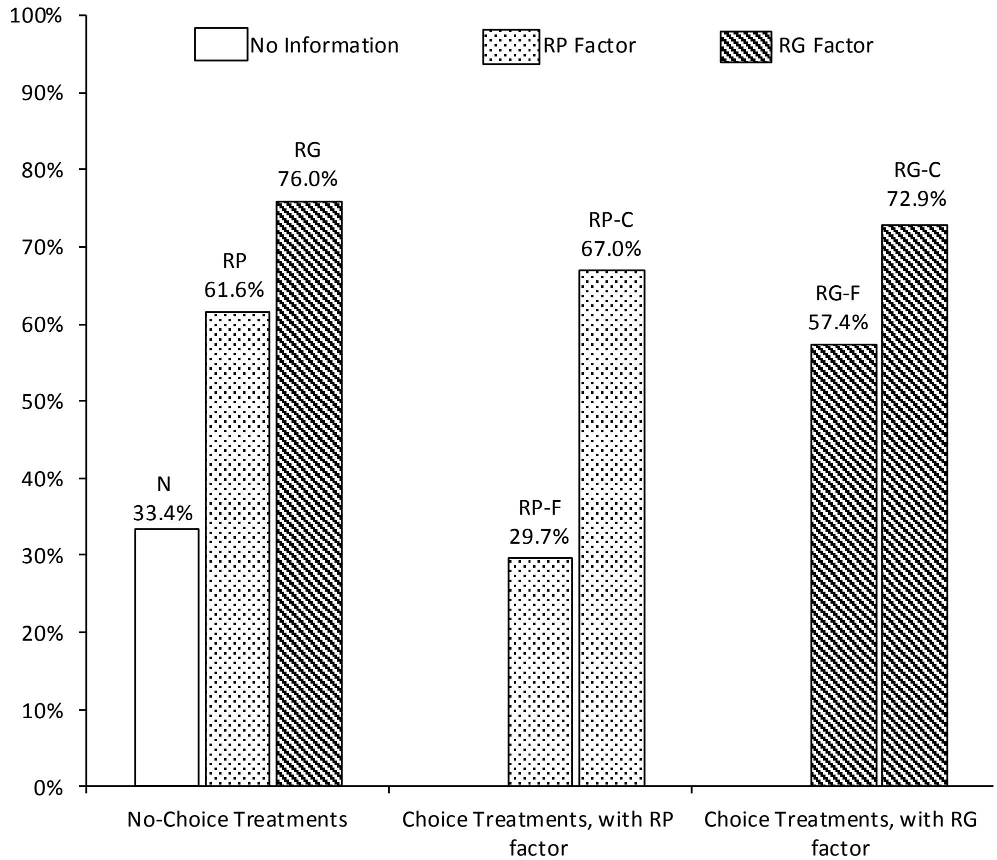
Subject 1 \ Subject 2	C (cooperate)	D (defect)
C	25, 25	5, 30
D	30, 5	10, 10

Note: This payoff matrix is from Camera and Casari (2009).

Table 1: *Summary of Treatments*

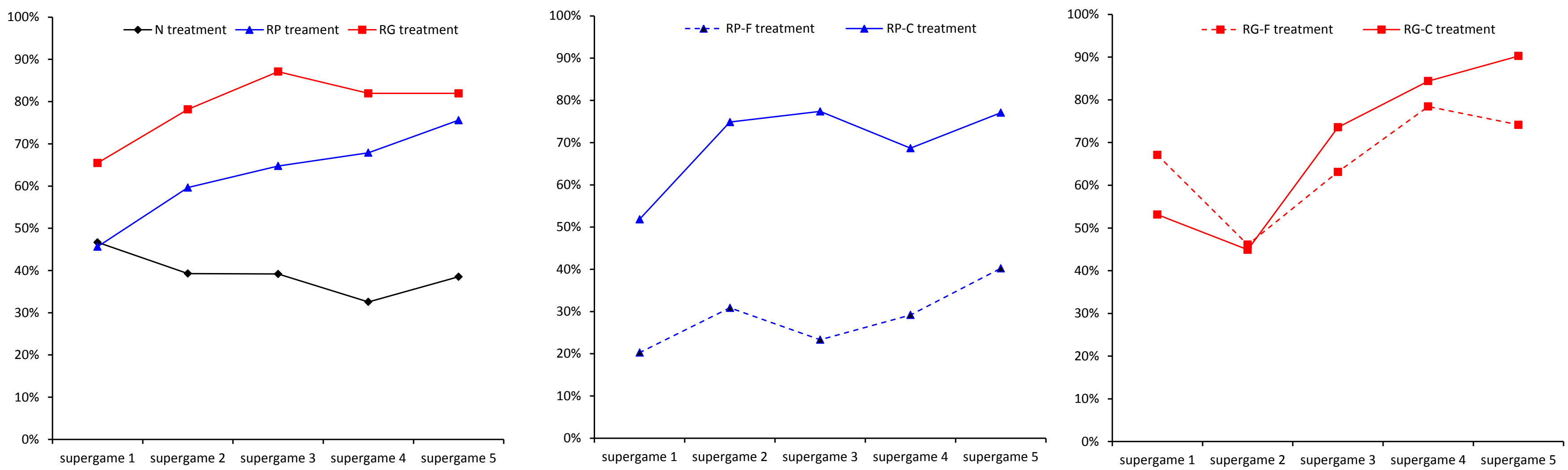
Treatment name	Subject identification numbers in period t interactions	Cost of hiding ID	Available history information on period t partner before subject i chooses an action in period t	Who learns the action choice of subject i in period t at the end of the period	Threshold δ that makes mutual cooperation an equilibrium outcome
I. No-Choice Treatments:					
N (No Information)	Not available	n.a.	n.a.	Period t matched partner learns without i's ID	.443
RP (Reputation with Partner)	A subject's ID is automatically disclosed to period t matched partner	n.a.	Period t partner's action choices in past periods where he was matched with subject i	Period t matched partner learns along with i's ID	.443
RG (Reputation within Group)		n.a.	Period t partner's action choices in all past periods up to period t – 1 in a given supergame	All group members learn along with i's ID	.250
II. Choice Treatments:					
RP-F (Reputation with Partner, Free Hiding)	A subject's ID is disclosed to period t matched partner if the subject chooses to use her ID in period t	0 points	Period t partner's action choices in past periods in which he was matched with subject i and used his ID	Period t matched partner learns along with i's ID (without i's ID) if i uses (hides) her assigned ID in period t	.443
RP-C (Reputation with Partner, Costly Hiding)		2 points			.443
RG-F (Reputation within Group, Free Hiding)		0 points	Period t partner's action choices in past periods in which he used his ID in a given supergame	All three group members learn along with i's ID (Only period t matched partner learns without i's ID) if i uses (hides) her assigned ID in period t	.250
RG-C (Reputation within Group, Costly Hiding)		2 points			.250

Figure 2: *Average Cooperation Rate by Treatment*



(I) Average Cooperation Rates across All Supergames

Notes: In the Choice treatments with the RP factor, when subject *i* uses her ID in period *t*, her partner *j* learns *i*'s previous action choices in periods where *j* was matched with *i* and subject *i* used her ID. In the Choice treatments with the RG factor, when subject *i* uses her ID in period *t* interaction, her partner *j* learns the previous action choices of subject *i* in all periods where *i* used her ID in a given supergame. See Table 2 for the impact of each treatment factor on the average cooperation rate.



(a) No-Choice Treatments

(b) RP-F treatment versus RP-C treatment

(c) RG-F treatment versus RG-C treatment

(II) Average Cooperation Rates by Supergame

Notes: In order to calculate the average cooperation rate (each point in the figures) in a given supergame, we first calculated each subject's average cooperation rate across all periods in that supergame. We then averaged them across all subjects in that treatment. In other words, it is: $\frac{1}{N}\sum_i\left[\frac{1}{T_P}\sum_t c_{ti}^p\right]$, where $c_{ti}^p = 1$ if subject i selected cooperation in period t of supergame p, and 0 if subject i selected defection, N is the number of subjects in a given treatment, p is the supergame number ($\in\{1, 2, 3, 4, 5\}$), T_P is the total number of realized periods in supergame p, and $t \in \{1, 2, \ldots, T_P\}$. As for the statistical tests of the dynamics of the average cooperation rates, see Table 2 of the paper and Table A.2 of the online Appendix.

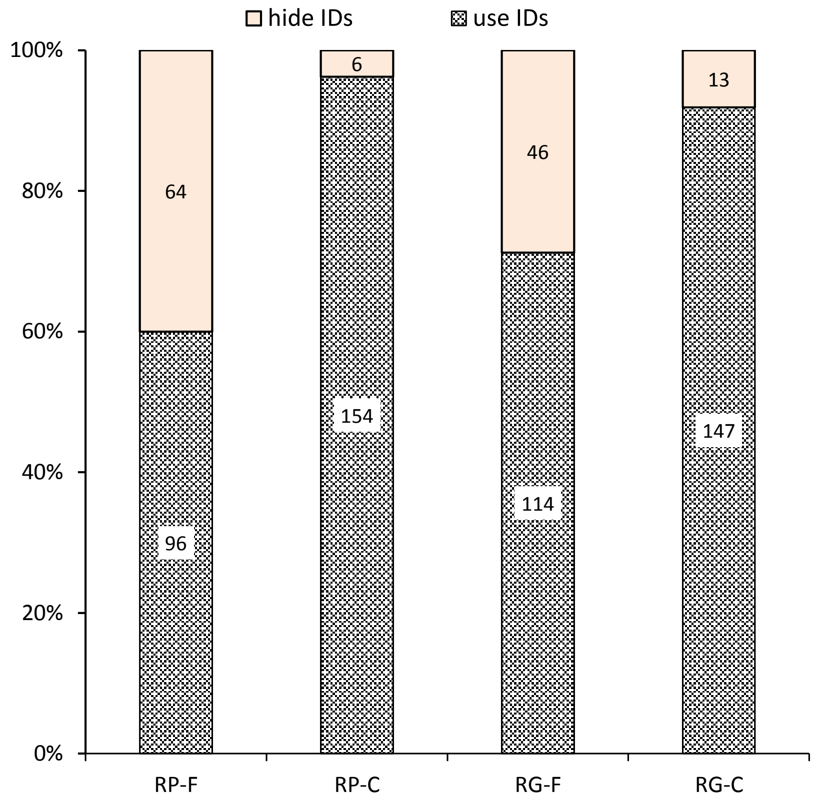
Table 2: *The Effects of Each Treatment Factor on the Average Cooperation Rate*

Dependent Variable: A dummy that equals 1 (0) if a subject chooses to cooperate (defect) in period *t*

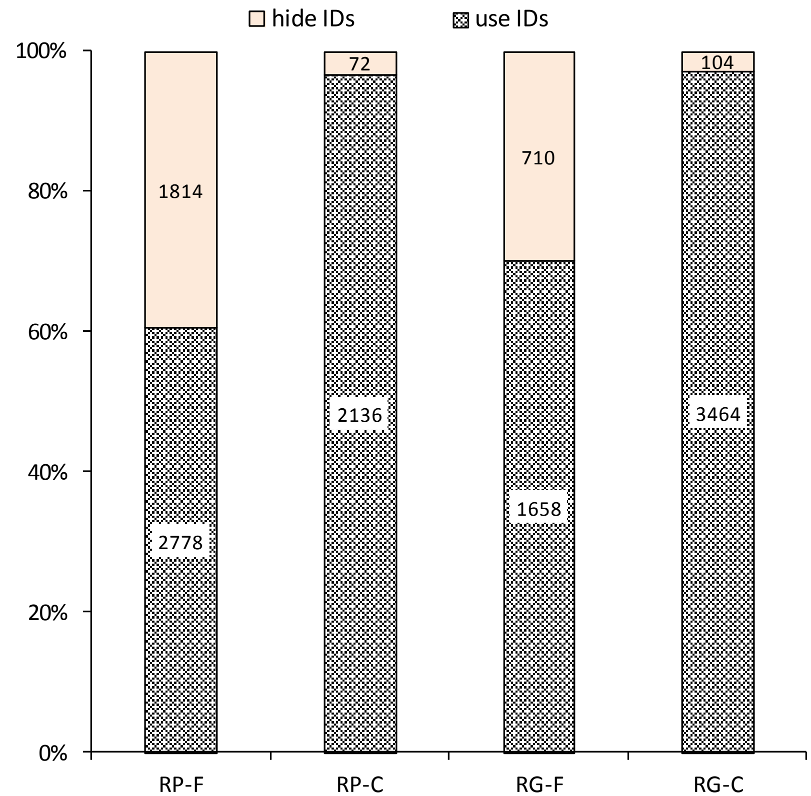
Independent Variable:	(1)	(2)
(i) RP factor dummy {= 1 for the RP, RP-F and RP-C treatments; 0 otherwise}	.280** (.120)	-.117 (.138)
(ii) RG factor dummy {= 1 for the RG, RG-F and RG-C treatments; 0 otherwise}	.426*** (.122)	.102 (.110)
(iii) Variable (i) × Choice dummy {= 1 for the RP-F and RP-C treatments; 0 otherwise}	-.319*** (.056)	-.208** (.087)
(iv) Variable (i) × Choice dummy × Costly hiding dummy {= 1 for the RP-C treatment; 0 otherwise}	.370*** (.070)	.252*** (.097)
(v) Variable (ii) × Choice dummy {= 1 for the RG-F and RG-C treatments; 0 otherwise}	-.187*** (.048)	-.286*** (.104)
(vi) Variable (ii) × Choice dummy × Costly hiding dummy {= 1 for the RG-C treatment; 0 otherwise}	.155** (.076)	-.053 (.123)
Length of previous supergame × the Supergame Number > 1 dummy	----	.002*** (.001)
Supergame Number {= 1, 2, 3, 4, 5}	----	-.046*** (.006)
Variable (i) × Supergame Number	----	.119*** (.015)
Variable (ii) × Supergame Number	----	.113*** (.020)
Variable (iii) × Supergame Number	----	-.046** (.021)
Variable (iv) × Supergame Number	----	.045* (.025)
Variable (v) × Supergame Number	----	.019 (.024)
Variable (vi) × Supergame Number	----	.043** (.017)
Constant	.335*** (.117)	.481*** (.106)
# of Observations	21,756	21,756
R-Squared	.130	.172

Notes: Individual random effects linear regressions with robust standard errors clustered by session id. Random effects are used to control individual effects since dummy variables that measure the effects of treatment factors are included as regressors. The reference group is subjects' action choices in the N treatment. The Choice dummy equals 1 for the RP-F, RP-C, RG-F and RG-C treatments; and 0 otherwise. The Costly hiding dummy equals 1 for the RP-C and RG-C treatments; and 0 otherwise. The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise. See Appendix Table A.2 for tests comparing the coefficient estimates across the independent variables. *, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

Figure 3: *Percentages of Subjects' ID Usages in the Four Choice Treatments*



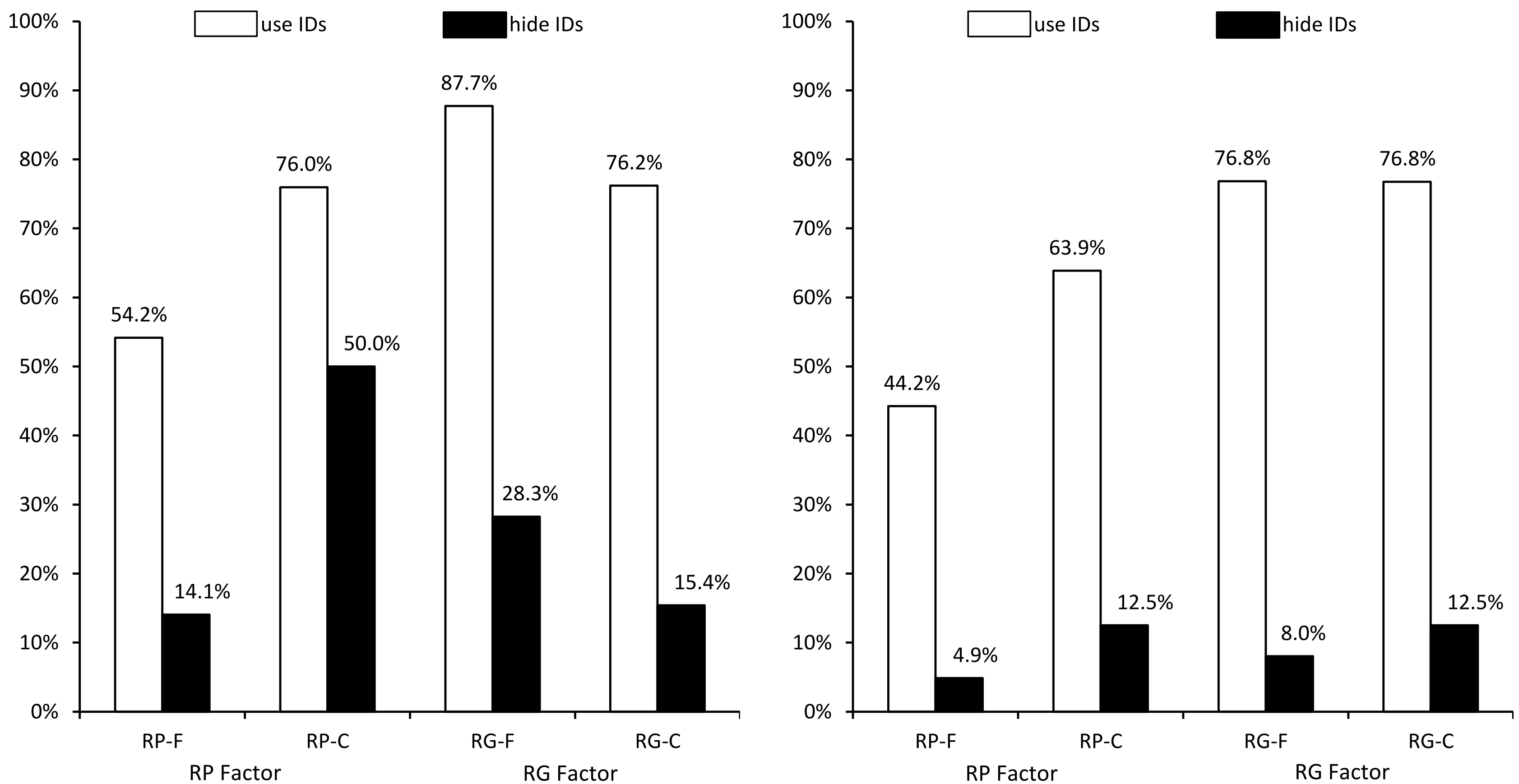
(a) The First Periods of Supergames



(b) All Periods of Supergames

Notes: The numbers in each bar indicate the numbers of subjects' use/hide decisions of IDs in each treatment. In the Choice treatments with the RP factor, when subject *i* uses her ID in period *t*, her partner *j* learns *i*'s previous action choices in periods where *j* was matched with *i* and subject *i* used her ID. In the Choice treatments with the RG factor, when subject *i* uses her ID in period *t* interaction, her partner *j* learns the previous action choices of subject *i* in all periods where *i* used her ID in a given supergame. See Table A.4 in the Appendix for test results comparing the ID hiding rates between the RP-F and RP-C treatments, and between the RG-F and RG-C treatments. See Figure A.3 in the Appendix for the hiding rates by supergame.

Figure 4: *Average Cooperation Rates by ID Usage*



(a) The First Periods of Supergames[#1]

(b) All Periods of Supergames

Note: Each number in a given category was calculated by computing the number of the subjects' choices of cooperation (*C*) divided by the total number of action choices made by the subjects. In the Choice treatments with the RP factor, when subject *i* uses her ID in period *t*, her partner *j* learns *i*'s previous action choices in periods where *j* was matched with *i* and subject *i* used her ID. In the Choice treatments with the RG factor, when subject *i* uses her ID in period *t* interaction, her partner *j* learns the previous action choices of subject *i* in all periods where *i* used her ID in a given supergame. See Figure A.4 in the Appendix for the supergame-by-supergame cooperation rates by ID usage and by treatment. **#1** Only six subjects hid IDs in the RP-C treatment.

Table 3: *History Information and Action Choices in the Choice Treatments*

Dependent Variable: A dummy that equals 1 (0) if subject *i* chooses to cooperate (defect) in period *t*

	No-Choice treatments		The RP-F and RP-C treatments		The RG-F and RG-C treatments	
	RP	RG				
Independent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
(i) Use-ID dummy {= 1 if subject *i* used her ID; 0 otherwise}	----	----	.128** (.023)	.129** (.032)	.350*** (.047)	.426*** (.019)
(ii) Observe-ID dummy {= 1 if matched partner of subject *i* used his ID in period *t*; 0 otherwise}	----	----	.206*** (.046)	.179** (.056)	.281*** (.027)	.329***[#4] (.024)
(iii) Variable (ii) × Observe-No-History dummy {= 1 if subject *i* has no history information of her partner in period *t*; 0 otherwise}[#1]	-.165 (.090)	-.123** (.002)	-.290** (.072)	-.349** (.086)	-.168*** (.024)	-.108** (.023)
(iv) Variable (ii) × (1 − Observe-No-History dummy) × Fraction of cases in which partner of subject *i* has chosen defection to subject *i* using his ID before period *t*	-.665* (.066)	----	-.539*** (.039)	-.521*** (.038)	----	----
(v) Variable (ii) × (1 − Observe-No-History dummy) × Fraction of cases in which partner of subject *i* has chosen defection using his ID before period *t*	----	-.637* (.090)	----	----	-.467** (.083)	-.259*** (.022)
(vi) Supergame variable {= 1, 2, 3, 4, 5}	.041* (.007)	.017 (.005)	.018 (.012)	.007 (.005)	.015* (.006)	.002 (.003)
(vii) Variable (i) × Costly hiding dummy[#2]	----	----	----	.055 (.033)	----	-.192 (.086)
(viii) Variable (ii) × Costly hiding dummy	----	----	----	-.045 (.060)	----	-.183**[#4] (.045)
(ix) Variable (iii) × Costly hiding dummy	----	----	----	.202 (.099)	----	-.038 (.024)
(x) Variable (iv) × Costly hiding dummy	----	----	----	-.098 (.051)	----	----
(xi) Variable (v) × Costly hiding dummy	----	----	----	----	----	-.324*** (.036)
(xii) Variable (vi) × Costly hiding dummy	----	----	----	.026* (.008)	----	.031** (.019)
Length of previous supergame × Supergame Number > 1 dummy[#3]	.000 (.000)	.001 (.001)	.001 (.001)	.001 (.001)	.003*** (.000)	.002** (.001)
Constant	.718** (.017)	.874** (.017)	.352 (.079)	.385** (.071)	.150* (.062)	.252*** (.014)
# of Observations	3,264	2,656	6,800	6,800	5,936	5,936
R-Squared	.455	.297	.455	.480	.455	.405

Notes: Individual fixed effects linear regressions with robust standard errors clustered by session id. [#1] The Observe-No-History dummy equals 0 in period *t* if the partner disclosed his ID at least once to subject *i* before period *t* in the RP-F and RP-C treatments; and if the partner at least once disclosed his ID to a member before period *t* in the RG-F and RG-C treatments; and 1 otherwise. The Observe-No-History dummy equals 1 for any periods greater than 1 within supergames in the RG treatment. [#2] The Costly hiding dummy equals 1 for the RP-C and RG-C treatments; and 0 otherwise. [#3] The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise. [#4] The null hypothesis that the sum of variables (ii) and (viii) is 0 is rejected according to a two-sided F test ($p = .0358$).

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

Not for Publication

Supplementary Online Appendix for Kamei, 2017,

"Endogenous Reputation Formation

under the Shadow of the Future"

Kenju Kamei

Department of Economics and Finance, Durham University, Durham, UK.

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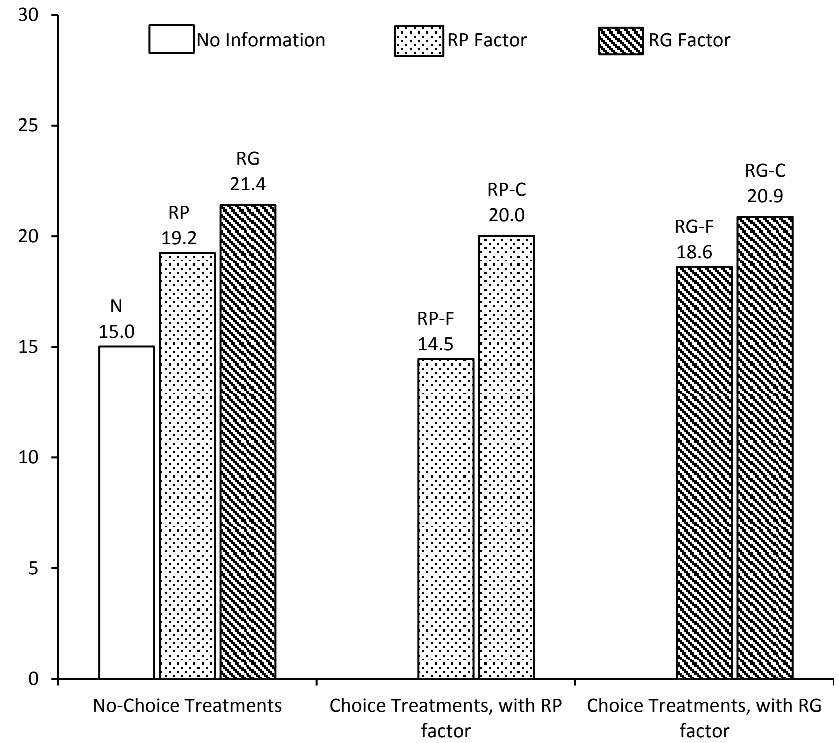
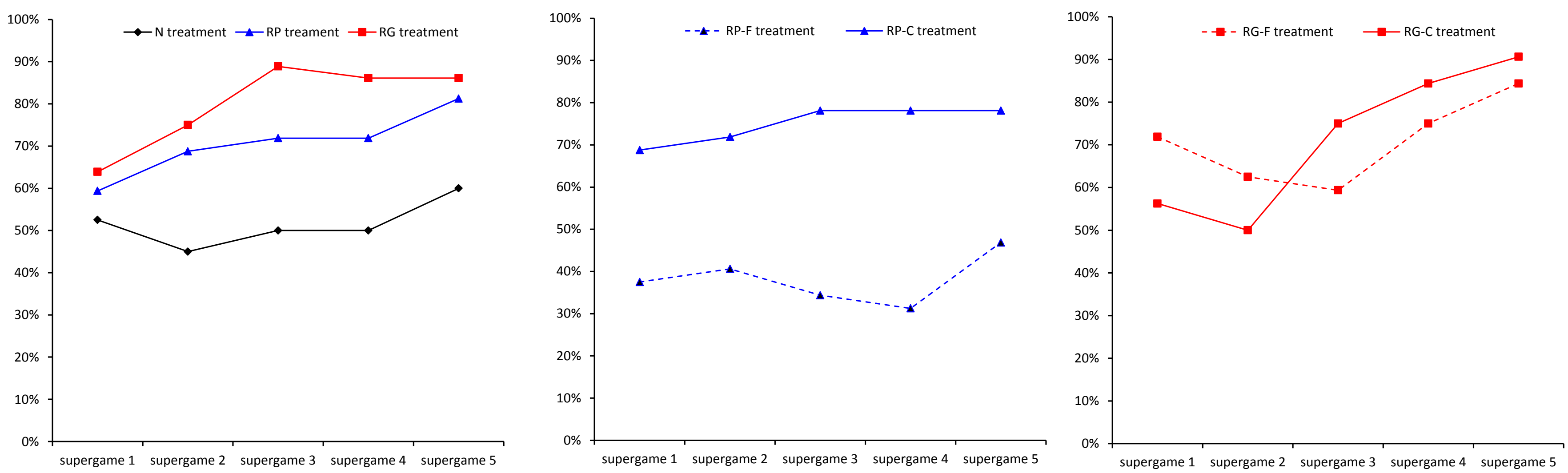
Appendix A: Additional Tables and Figures

Figure A.1: *Average Per-period Payoff by Treatment*



Notes: The unit in the vertical axis is points (experimental currency units). In the treatments with the RP factor, when subject *i* uses her ID in period *t*, her partner *j* learns *i*'s previous action choices in periods where *j* was matched with *i* and subject *i* used her ID. In the treatments with the RG factor, when subject *i* uses her ID in period *t* interaction, her partner *j* learns the previous action choices of subject *i* in all periods where *i* used her ID in a given supergame. See Appendix Table A.3 for the impact of each treatment factor on the average per-period payoffs.

Figure A.2: *Average Period 1 Cooperation Rates by Supergame and Treatment*



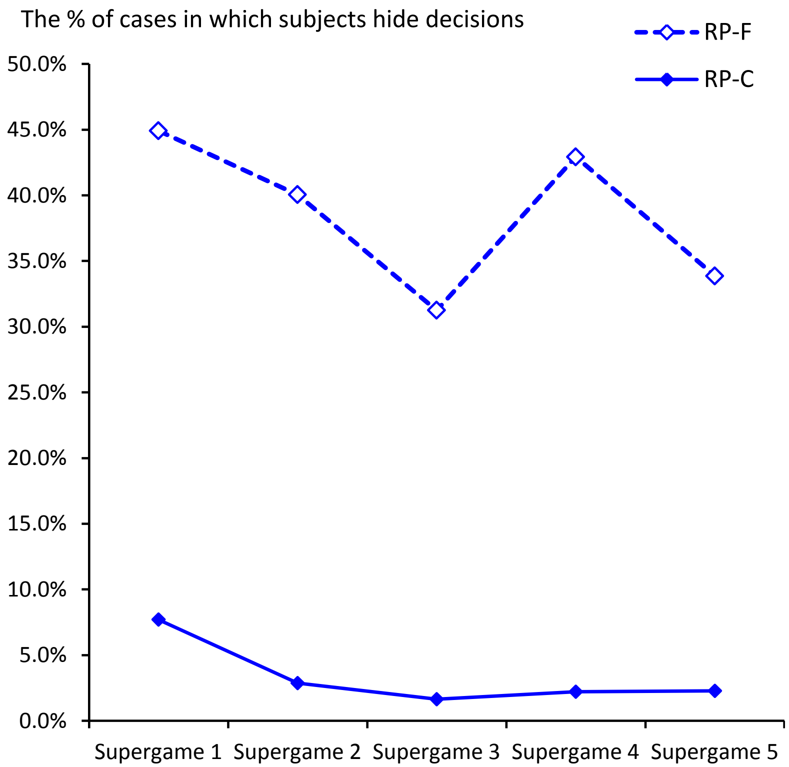
(a) No-Choice Treatments

(b) RP-F treatment versus RP-C treatment

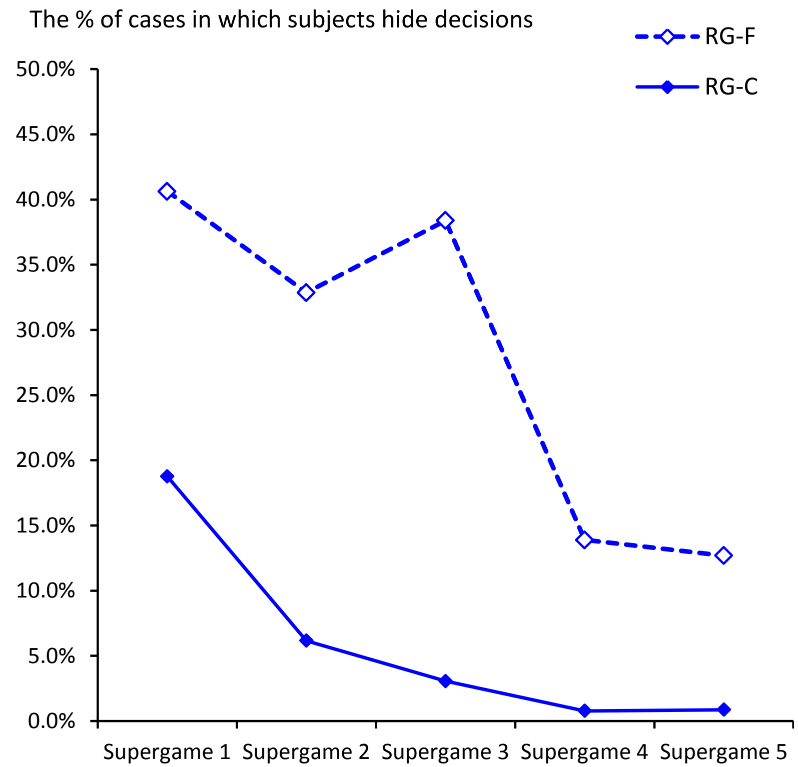
(c) RG-F treatment versus RG-C treatment

Note: Each point indicates the average cooperation rate in period 1 of a given supergame in a given treatment.

Figure A.3: *ID Hiding Rates by Supergame and Treatment (supplementing Figure 3 of the paper)*



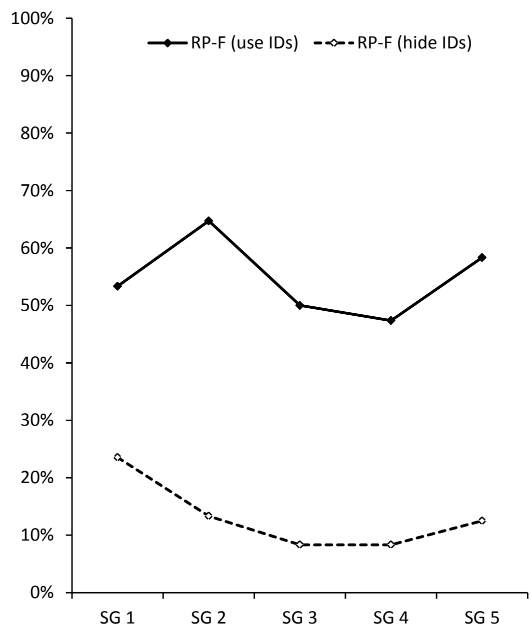
(a) The RP Factor: When subject *i* discloses her ID in period *t*, her partner *j* learns *i*'s previous action choices in periods where *j* was matched with *i* and subject *i* used her ID.



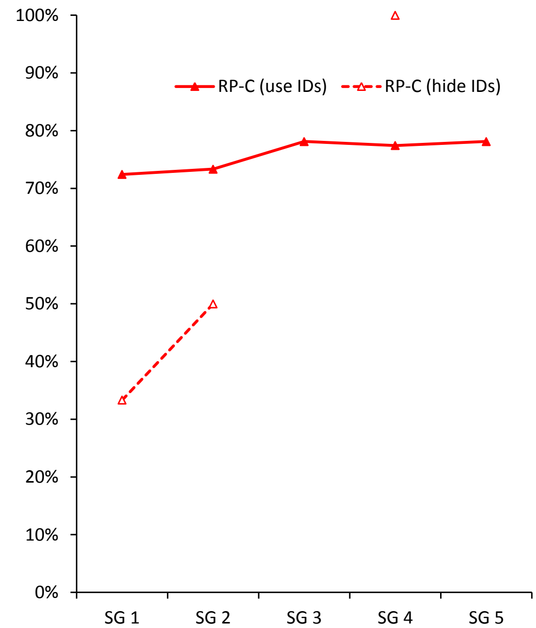
(b) The RG Factor: When subject *i* discloses her ID in period *t*, her partner *j* learns the previous action choices of subject *i* in all periods where subject *i* used her ID in a given supergame.

Notes: The ID hiding rates in a given supergame [%] are calculated by: (the total number of subjects' hiding events in a given supergame)/(the total number of the ID hiding/using opportunities in a given supergame)×100. A supergame-by-supergame comparison of the hiding rates between the choice treatments can be found in Appendix Table A.4.

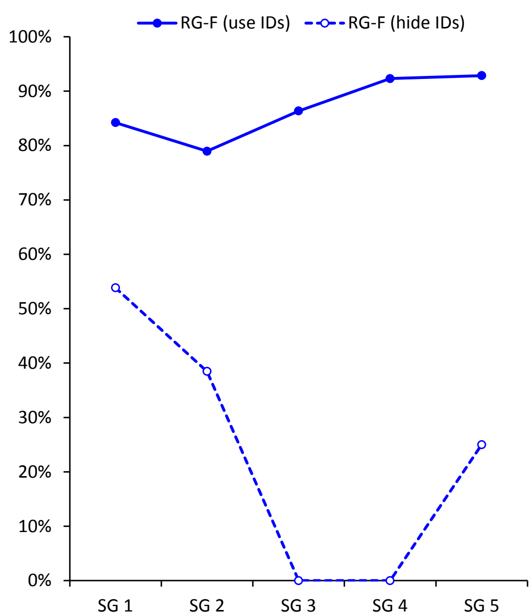
Figure A.4: *Supergame-by-Supergame Average Cooperation Rates by Treatment and by Disclosure Decision (supplementing Figure 4 of the paper)*



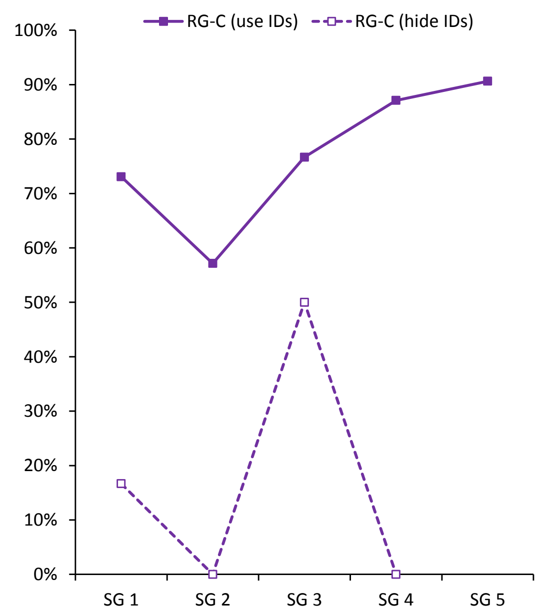
(i) RP-F treatment



(ii) RP-C treatment[#1]



(iii) RG-F treatment

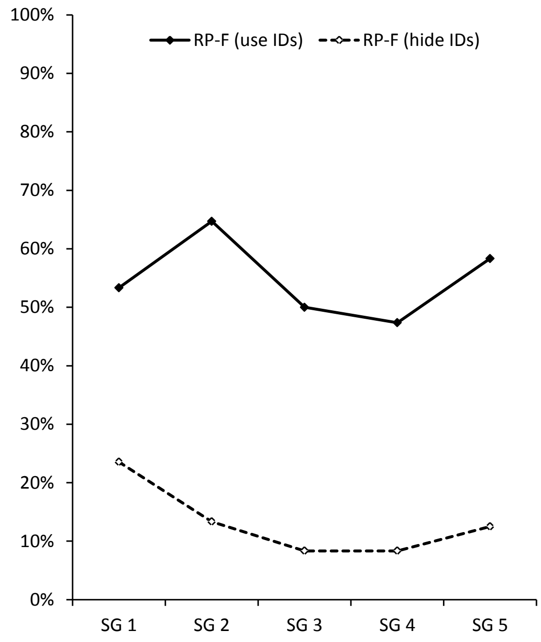


(iv) RG-C treatment[#2]

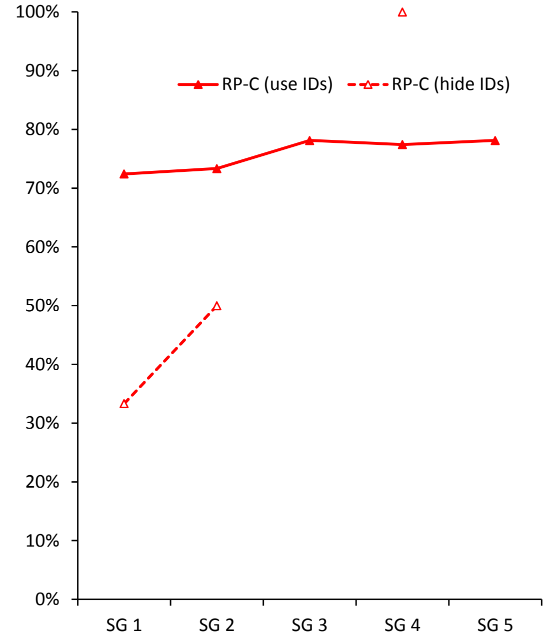
(I) Average Cooperation Rates in the First Periods of Supergames

Notes: [#1] Very few subjects hid IDs in the first period of each supergame in the RP-C treatment (see Panel (a) of Figure A.3). Specifically, only one subject hid his or her ID and selected to cooperate in the first period of the fourth supergame; no subjects hid IDs in the first period of the third and fifth supergames.

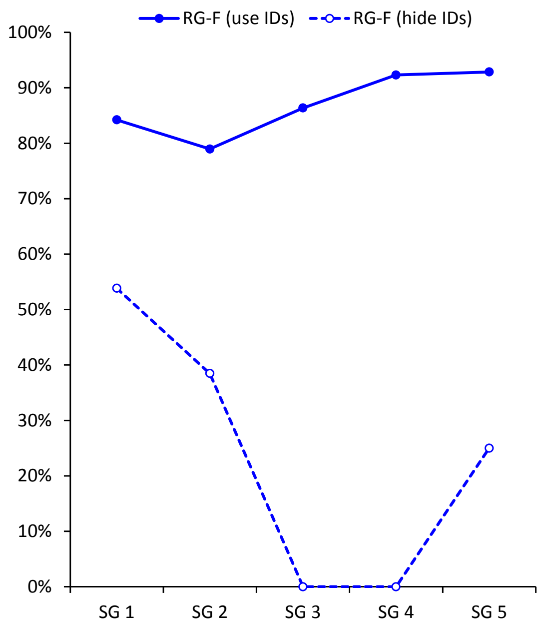
[#2] Very few subjects hid IDs in the first period of each supergame in the RG-C treatment (see Panel (b) of Figure A.3). No subjects hid IDs in the first period of the fifth supergame.



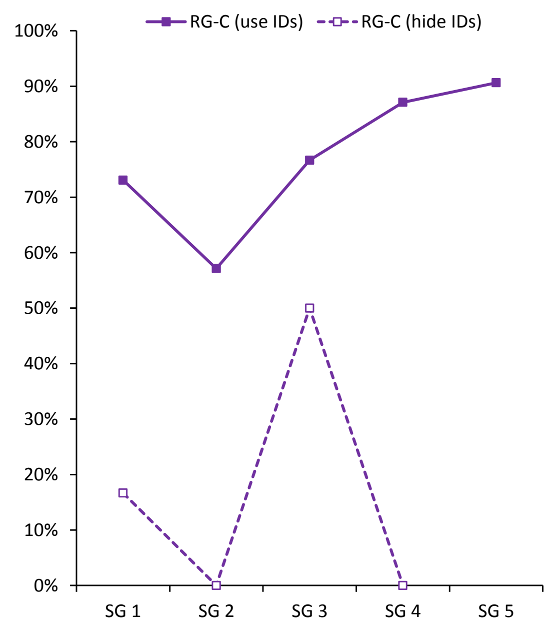
(i) RP-F treatment



(ii) RP-C treatment



(iii) RG-F treatment

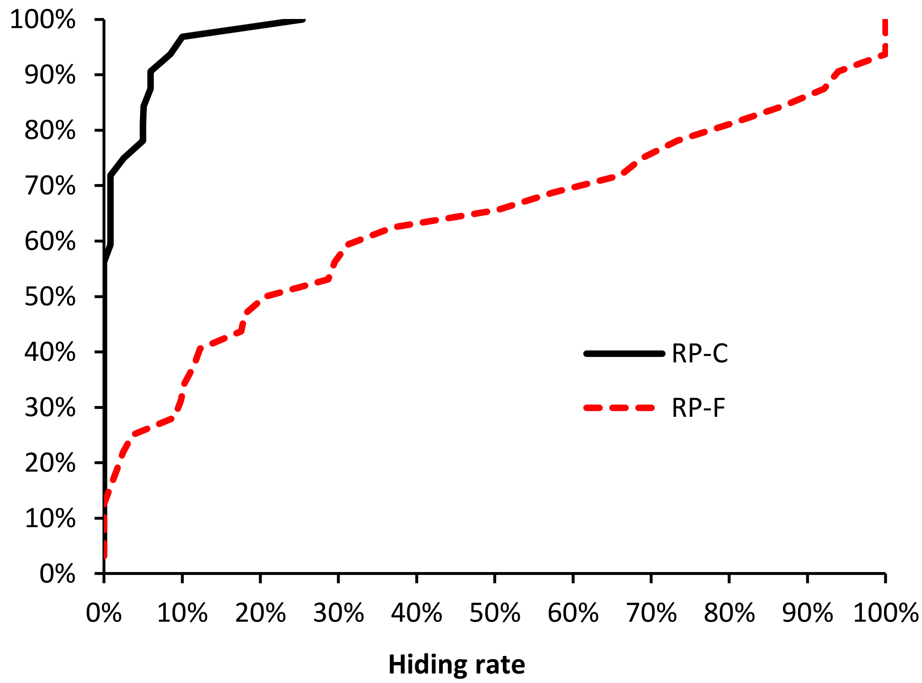


(iv) RG-C treatment

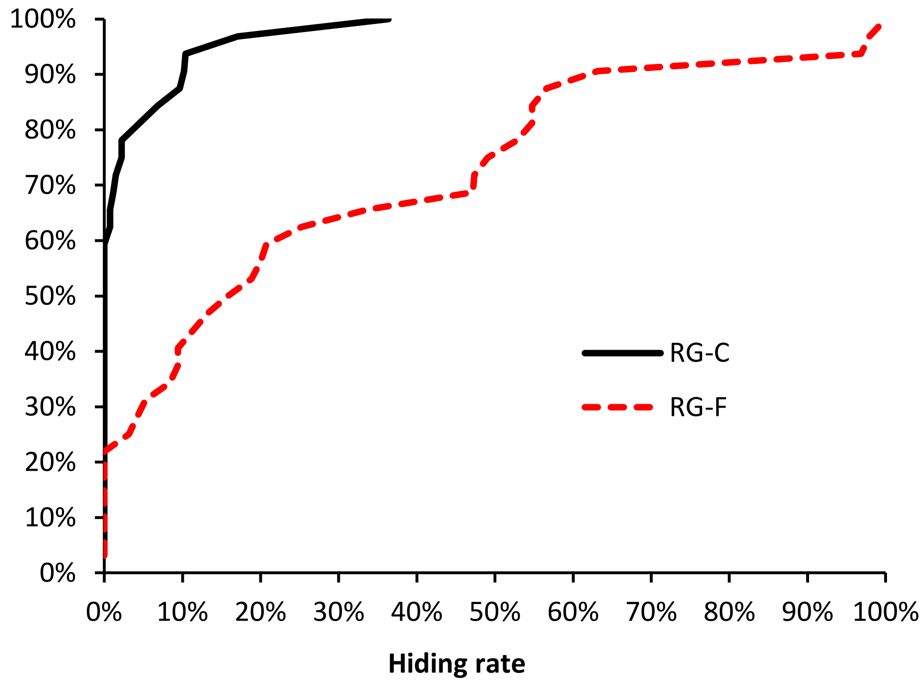
(II) Average Cooperation Rates when All Periods' Data is Used

REMARK: See Appendix Table A.5 for test results that compare average cooperation rates between when subjects used IDs and when subjects hid IDs.

Figure A.5: *Cumulative Distribution of Subjects' Overall Hiding Rates by Treatment*



(i) Choice Treatments with RP factor



(ii) Choice Treatments with RG factor

Table A.1: *Average Cooperation Rates by Session*

The following table includes average cooperation rates by experimental session. See Figure 2 of the paper for the overall average cooperation rates. See Table 2 of the paper for the test results of the difference in average cooperation rate across the treatments.

Each session contains four or five groups. In Table A.1, we omit to report data of average cooperation rates by group to conserve space since subjects' behaviors could be correlated with each other within sessions. As mentioned in the paper, we included session-level clustering in each regression analysis of this study.

Treatment	1st Supergame		2nd Supergame		3rd Supergame		4th Supergame		5th Supergame	
	Period 1	Overall	Period 1	Overall	Period 1	Overall	Period 1	Overall	Period 1	Overall
N treatment										
Avg. cooperation rate	0.525	0.467	0.450	0.393	0.500	0.392	0.500	0.326	0.600	0.385
[breakdown by session]										
a. Session 1	0.500	0.325 (6)	0.250	0.300 (2)	0.250	0.206 (9)	0.350	0.108 (33)	0.400	0.330 (5)
b. Session 2	0.550	0.608 (6)	0.650	0.486 (14)	0.750	0.578 (9)	0.650	0.544 (24)	0.800	0.440 (47)
RP treatment										
Avg. cooperation rate	0.594	0.456	0.688	0.596	0.719	0.648	0.719	0.679	0.813	0.756
[breakdown by session]										
c. Session 1	0.563	0.343 (29)	0.563	0.474 (24)	0.688	0.688 (2)	0.688	0.639 (80)	0.813	0.790 (22)
d. Session 2	0.625	0.570 (8)	0.813	0.719 (8)	0.750	0.608 (18)	0.750	0.719 (4)	0.813	0.722 (9)
RG treatment										
Avg. cooperation rate	0.639	0.655	0.750	0.782	0.889	0.871	0.861	0.819	0.861	0.819
[breakdown by session]										
e. Session 1	0.600	0.625 (34)	0.800	0.832 (33)	0.950	0.918 (20)	0.900	0.875 (10)	1.000	1.000 (11)
f. Session 2	0.688	0.692 (15)	0.688	0.719 (8)	0.813	0.813 (1)	0.813	0.750 (5)	0.688	0.594 (2)
RP-F treatment										
Avg. cooperation rate	0.375	0.203	0.406	0.309	0.344	0.233	0.313	0.292	0.469	0.402
[breakdown by session]										
g. Session 1	0.375	0.223 (7)	0.375	0.121 (17)	0.250	0.125 (7)	0.125	0.209 (79)	0.438	0.305 (55)
h. Session 2	0.375	0.182 (36)	0.438	0.496 (32)	0.438	0.342 (15)	0.500	0.375 (20)	0.500	0.500 (19)

Treatment	1st Supergame		2nd Supergame		3rd Supergame		4th Supergame		5th Supergame	
	Period 1	Overall	Period 1	Overall	Period 1	Overall	Period 1	Overall	Period 1	Overall
RP-C treatment										
Avg. cooperation rate	0.688	0.518	0.719	0.749	0.781	0.774	0.781	0.687	0.781	0.771
[breakdown by session]										
i. Session 1	0.750	0.719 (2)	0.875	0.875 (1)	0.813	0.813 (2)	0.750	0.715 (9)	0.750	0.729 (6)
j. Session 2	0.625	0.318 (24)	0.563	0.622 (23)	0.750	0.735 (21)	0.813	0.658 (45)	0.813	0.813 (5)
RG-F treatment										
Avg. cooperation rate	0.719	0.671	0.625	0.461	0.594	0.631	0.750	0.784	0.844	0.741
[breakdown by session]										
k. Session 1	0.563	0.488 (5)	0.500	0.422 (4)	0.375	0.438 (58)	0.688	0.788 (5)	0.813	0.739 (23)
l. Session 2	0.875	0.854 (3)	0.750	0.500 (31)	0.813	0.825 (5)	0.813	0.781 (4)	0.875	0.744 (10)
RG-C treatment										
Avg. cooperation rate	0.563	0.531	0.500	0.449	0.750	0.736	0.844	0.844	0.906	0.903
[breakdown by session]										
m. Session 1	0.438	0.375 (2)	0.500	0.388 (14)	0.625	0.551 (16)	0.750	0.714 (49)	0.813	0.839 (7)
n. Session 2	0.688	0.688 (1)	0.500	0.510 (39)	0.875	0.920 (33)	0.938	0.973 (40)	1.000	0.966 (22)

Note: The figures in parentheses are the numbers of periods realized in supergames.

Table A.2: *Test Results concerning Table 2 of the Paper (supplementing Table 2 of the paper)*

(A) Wald Chi-Squared Tests for the coefficient estimates in column (1)

- H_0: Variable (i) = Variable (ii)
  Chi-squared = 11.01
  p-value (two-sided) = .001***

  Result: The average cooperation rate in the RG treatment is significantly higher than that in the RP treatment.

- H_0: Variable (i) + Variable (iii) = 0
  Chi-squared = .09
  p-value (two-sided) = .762

  Result: The average cooperation rate in the RP-F treatment is not significantly different from that in the N treatment.

- H_0: Variable (ii) + Variable (v) = 0
  Chi-squared = 3.85
  p-value (two-sided) = .050**

  Result: The average cooperation rate in the RG-F treatment is significantly higher than that in the N treatment.

- H_0: Variable (iii) + Variable (iv) = 0
  Chi-squared = .85
  p-value (two-sided) = .357

  Result: The average cooperation rate in the RP-C treatment is not significantly different from that in the RP treatment.

- H_0: Variable (v) + Variable (vi) = 0
  Chi-squared = .17
  p-value (two-sided) = .682

  Result: The average cooperation rate in the RG-C treatment is not significantly different from that in the RG treatment.

(B) Wald Chi-Squared Tests for the trends of average cooperation rates over the supergames in the RP and RG treatments using the coefficient estimates in column (2)

- H_0: The Supergame Number variable + The interaction term between variable (i) and the Supergame number variable = 0
  Chi-squared = 17.49

p-value (two-sided) = .000***

Result: The average cooperation rates increase significantly from supergame to supergame in the RP treatment.

- H_0: The Supergame Number variable + The interaction term between variable (ii) and the Supergame number variable = 0
  Chi-squared = 12.50
  p-value (two-sided) = .000***

Result: The average cooperation rates increase significantly from supergame to supergame in the RG treatment.

(C) Wald Chi-Squared Tests for the differences in the increase rate of average cooperation rates between the RP-F versus RG-F treatments, and also between the RP-C versus RG-C treatments

The RP-F treatment versus the RG-F treatment:

- H_0: The coefficient estimate of the supergame number variable in the RP-F treatment (The Supergame Number variable + the "Variable (i) × Supergame Number" variable + the "Variable (iii) × Supergame Number" variable) = The coefficient estimate of the supergame number variable in the RG-F treatment (The Supergame Number variable + the "Variable (ii) × Supergame Number" variable + the "Variable (v) × Supergame Number" variable)

Using the coefficient estimates in column (2):

The coefficient estimate of the supergame number variable in the RP-F treatment is .027. By contrast, the coefficient estimate of the supergame number variable in the RG-F treatment is .086. These two numbers are significantly different as shown below.

Chi-squared = 7.36
p-value (two-sided) = .007***

This suggests that subjects' learning across the supergames is stronger in the RG-F treatment than in the RP-F treatment.

The RP-C treatment versus the RG-C treatment:

- H_0: The coefficient estimate of the supergame number variable in the RP-C treatment (The Supergame Number variable + the "Variable (i) × Supergame Number" variable + the "Variable (iii) × Supergame Number" variable + the "Variable (iv) × Supergame Number" variable) = The coefficient estimate of the supergame number variable in the RG-C treatment (The Supergame Number variable + the "Variable (ii) × Supergame Number" variable + the "Variable (v) × Supergame Number" variable + the "Variable (vi) × Supergame Number" variable)

Using the coefficient estimates in column (2):

> The coefficient estimate of the supergame number variable in the RP-C treatment is .072. By contrast, the coefficient estimate of the supergame number variable in the RG-C treatment is 1.29. These two numbers are significantly different as shown below.
>
> Chi-squared = 9.97
> *p*-value (two-sided) = .002***

This suggests that the subjects' learning across the supergames is stronger in the RG-C treatment than in the RP-C treatment.

Table A.3: *The Effects of Each Treatment Factor on the Average Payoff (supplementing Appendix Figure A.1 of the Appendix)*

Dependent Variable: The payoff of subject *i* in a given period

Independent Variable	(1)	(2)	(3)	(4)
(i) RP factor dummy {= 1 for the RP, RP-F and RP-C treatments; 0 otherwise}	4.122** (1.799)	4.137** (1.727)	-1.688 (2.177)	-1.745 (2.092)
(ii) RG factor dummy {= 1 for the RG, RG-F and RG-C treatments; 0 otherwise}	6.373*** (1.832)	6.311*** (1.629)	2.121 (1.707)	1.579 (1.679)
(iii) Variable (i) × Choice dummy {= 1 for the RP-F and RP-C treatments; 0 otherwise}	-4.765*** (.846)	-5.517*** (1.083)	-3.123* (1.647)	-2.987** (1.304)
(iv) Variable (i) × Choice dummy × Costly hiding dummy {= 1 for the RP-C treatment; 0 otherwise}	5.404*** (1.06)	6.148*** (1.337)	3.600** (1.509)	3.375** (1.373)
(v) Variable (ii) × Choice dummy {= 1 for the RG-F and RG-C treatments; 0 otherwise}	-2.867*** (.706)	-2.458*** (.560)	-4.457*** (1.576)	-4.267*** (1.557)
(vi) Variable (ii) × Choice dummy × Costly hiding dummy {= 1 for the RG-C treatment; 0 otherwise}	2.299** (1.161)	1.452 (.948)	-1.676 (1.920)	-1.034 (1.899)
The length of the previous supergame × the Supergame Number > 1 dummy	----	.058*** (.020)	----	.034*** (.012)
Supergame Number {= 1, 2, 3, 4, 5}	----	----	-.471*** (.038)	-.669*** (.084)
Variable (i) × Supergame Number	----	----	1.761*** (.274)	1.743 (.223)
Variable (ii) × Supergame Number	----	----	1.580*** (.306)	1.673*** (.290)
Variable (iii) × Supergame Number	----	----	-.565** (.279)	-.729** (.322)
Variable (iv) × Supergame Number	----	----	.557** (.284)	.753** (.360)
Variable (v) × Supergame Number	----	----	.208 (.392)	.254 (.365)
Variable (vi) × Supergame Number	----	----	1.04*** (.250)	.711*** (.262)
Constant	15.090*** (1.756)	14.373*** (1.657)	16.865*** (1.683)	17.179*** (1.627)
# of Observations	21,756	21,756	21,756	21,756
R-Squared	.098	.113	.125	.131

Notes: Individual random effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors. The reference group is subjects' payoffs in the N treatment. The Choice dummy equals 1 for the RP-F, RP-C, RG-F and RG-C treatments; and 0 otherwise. The Costly hiding dummy equals 1 for the RP-C and RG-C treatments; and 0 otherwise. The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

Table A.4: *Subjects' Decisions about Whether to Use or Hide IDs (supplementing Panel (b), Figure 3 of the paper and Figure A.3 of the online Appendix)*

(1) Testing for the Differences in the Subjects' Hiding Rate between With versus Without Cost for Hiding, Supergame by Supergame

Dependent Variable: A dummy that equals 1 (0) if a subject chooses to (not to) use her ID

Independent Variable:	1st SG (2)	2nd SG (3)	3rd SG (4)	4th SG (5)	5th SG (5)
(i) The RG-F dummy {= 1 for the RG-F treatment; and 0 otherwise}	.139 (.111)	.0574 (.120)	.100 (.160)	.198 (.121)	.133 (.119)
(ii) The RP-C dummy {= 1 for the RP-C treatment; and 0 otherwise}	.470*** (.097)	.401*** (.105)	.349*** (.104)	.320*** (.121)	.239** (.119)
(iii) The RG-C dummy {= 1 for the RG-C treatment; and 0 otherwise}	.352*** (.102)	.356*** (.109)	.316*** (.107)	.328*** (.120)	.245** (.120)
Constant	.471*** (.095)	.559*** (.104)	.641*** (.104)	.664*** (.120)	.737*** (.119)
# of Observations	1,280	2,576	2,512	4,016	2,352
Wald Chi-squared	54.74	45.91	16.55	195.62	119.63
Prob > Wald Chi-squared	.000***	.000***	.001***	.000***	.000***
R-Squared	.135	.150	.151	.272	.126
Wald test results					
H_0: (i) = (iii)					
Chi-squared	10.24	19.31	3.04	187.21	58.44
Prob > Chi-squared	.001***	.000***	.081*	.000***	.000***
H_0: (ii) = (iii)					
Chi-squared	8.91	1.68	1.37	1.55	.14
Prob > Chi-squared	.003***	.195	.241	.213	.711

Notes: Individual random effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors. The reference group is subjects' ID hiding/using decisions in the RP-F treatment. *, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

(2) The Trends of the Subjects' Disclosure Decisions over the Supergames

Dependent Variable: A dummy that equals 1 (0) if a subject chooses to (not to) use her ID

Independent Variable:	(1)	(2)
(i) The RG-F dummy {= 1 for the RG-F treatment; and 0 otherwise}	.106 (.117)	.023 (.144)
(ii) The RP-C dummy {= 1 for the RP-C treatment; and 0 otherwise}	.356*** (.109)	.529*** (.082)
(iii) The RG-C dummy {= 1 for the RG-C treatment; and 0 otherwise}	.342*** (.109)	.474*** (.097)
(iv) Supergame Number{= 1, 2, 3, 4, 5}	.050*** (.014)	.062*** (.0094)
(v) Variable (i) × Supergame Number	-----	.029 (.023)
(vi) Variable (ii) × Supergame Number	-----	-.052*** (.010)
(vii) Variable (iii) × Supergame Number	-----	-.039*** (.016)
The length of the previous supergame × the Supergame Number > 1 dummy	.000 (.000)	.000 (.000)
Constant	.451*** (.101)	.408*** (.082)
# of Observations	12,736	12,736
R-Squared	.172	.172
Wald test results		
H_0: (i) = (iii)		
Chi-squared	23.87	11.84
Prob > Chi-squared	.000***	.001***
H_0: (ii) = (iii)		
Chi-squared	.74	.99
Prob > Chi-squared	.390	.319
H_0: (iv) + (v) = 0		
Chi-squared	-----	19.69
Prob > Chi-squared	-----	.000***
H_0: (iv) + (vi) = 0		
Chi-squared	-----	42.58
Prob > Chi-squared	-----	.000***
H_0: (iv) + (vii) = 0		
Chi-squared	-----	2.96
Prob > Chi-squared	-----	.085*

Notes: Individual random effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors. The reference group is subjects' ID hiding/using decisions in the RP-F treatment. The Supergame Number > 1 dummy equals 1 for the 2^{nd} to 5^{th} supergame; and 0 otherwise. *, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

Table A.5: *Supergame-by-Supergame Tests for the Differences in the Average Cooperation Rate between Those Who Used the Assigned IDs versus Those Who Hid Them (supplementing Appendix Figure A.4)*

[Tests by means of regressions:]

(1) For the First Periods within Supergames (supplementing Figure A.4(I) of the Appendix)

	The RP-F treatment	The RP-C treatment[#1]	The RG-F treatment	The RG-C treatment
1st supergame	.064*	.288	.082*	.067*
2nd supergame	.010***	.520	.031**	.000***
3rd supergame	.069*	n.a.	.000***	.517
4th supergame	.072*	.019**	.000***	.000***
5th supergame	.009***	n.a.	.036**	n.a.

Notes: The numbers in this table are *p*-values (two-sided). To test the statistical difference in subjects' cooperation rate between when they show their IDs and hide them in a given supergame, we conducted a linear regression with standard errors clustered by group id. The dependent variable is a subject's action choice (which equals 1 if s/he chose to cooperate; and 0 otherwise). The independent variable is the Use-ID dummy variable (which equals 1 if subject *i* disclosed her assigned ID; and 0 otherwise). Only period 1 action choices are used for the analyses. *p*-values are ones for the coefficient estimates of the Use-ID dummy variable.

[#1] As reported in Figure A.4(I), very few subjects hid IDs in each supergame in the RP-C treatment; which makes each test almost not meaningful.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

(2) All Periods within Supergames (supplementing Figure A.4(II) of the Appendix)

	The RP-F treatment	The RP-C treatment	The RG-F treatment	The RG-C treatment
1st supergame	.026**	.001***	.004***	.070*
2nd supergame	.018**	.013**	.000***	.001***
3rd supergame	.010***	.022**	.000***	.000***
4th supergame	.000***	.005***	.000***	.042**
5th supergame	.000***	.000***	.000***	.000***

Notes: The numbers in this table are *p*-values (two-sided). To test the statistical difference in subjects' cooperation rate between when they show their IDs and hide them in a given supergame, we conducted a linear regression with standard errors clustered by group id. The dependent variable is a subject's action choice (which equals 1 if s/he chose to cooperate; and 0 otherwise). The independent variable is the Use-ID dummy variable (which equals 1 if subject *i* disclosed her assigned ID; and 0 otherwise). *p*-values are ones for the coefficient estimates of the Use-ID dummy variable.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

[Tests by means of non-parametric tests:]

To supplement the regression analysis on the previous two pages, we also performed non-parametric tests to compare average cooperation rates between disclosers and non-disclosers.

(1) The First Periods within Supergames (supplementing Figure A.4(I) of the Appendix)

Procedure to compare average cooperation rates in the first periods between (a) subjects who used assigned IDs and (b) subjects who hid them:

Step 1: For each group, we computed the average cooperation rate of disclosers and the average cooperation rate of non-disclosers.

Step 2: We performed a group-level Mann-Whitney test to compare period 1 cooperation behaviors between disclosers and non-disclosers in each supergame by treatment.

	The RP-F treatment	The RP-C treatment	The RG-F treatment	The RG-C treatment
1st supergame	.105	.784	.184	.024**
2nd supergame	.016**	.682	.109	.005***
3rd supergame	.132	n.a.#1	.002***	.681
4th supergame	.058*	.301#2	.002***	.088*
5th supergame	.004***	n.a.#1	.035**	n.a.#1

Notes: The numbers are *p*-values (two-sided) for Mann-Whitney tests.

#1 No subjects hid IDs. #2 Only one subject hid his or her ID.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

(2) All Periods within Supergames (supplementing Figure A.4(II) of the Appendix)

Procedure to compare average cooperation rates between (a) the cases in which subjects used assigned IDs and (b) the cases in which subjects hid them:

Step 1: For each subject, we computed (i) the average cooperation rate when he or she used the assigned ID and (ii) the average cooperation rate when he or she hid it.

Step 2: Using the calculation results in Step 1, we computed (i) group-average cooperation rates when subjects used their assigned IDs and (ii) group-average cooperation rates when they hid them.

Step 3: In each supergame, we performed group-level Wilcoxon Signed Ranks tests to compare average cooperation rates between when they used IDs and when they hid IDs.

	The RP-F treatment	The RP-C treatment	The RG-F treatment	The RG-C treatment
1st supergame	.036**	.174	.019**	.171
2nd supergame	.401	.166	.012**	.017**
3rd supergame	.043**	.655	.043**	.095*
4th supergame	.028**	.782	.042**	.715
5th supergame	.028**	.180	.092*	.180

Notes: The numbers are *p*-values (two-sided) for Wilcoxon signed ranks tests.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

Table A.6: *Percentages of Disclosers or Non-Disclosers in the First Periods of Supergames in the Free Hiding Treatments*

a. The RP-F treatment

	Raw Players' Matched Partners are Disclosers			Raw Players' Matched Partners are Non-disclosers			Total
		Raw players' action:			Raw players' action:		
		cooperate	defect		cooperate	defect	
Disclosers	37.5%			22.5%			60.0%
		24.4%	13.1%		8.1%	14.4%	
Non-disclosers	22.5%			17.5%			40.0%
		3.8%	18.8%		1.9%	15.6%	
Total	60.0%			40.0%			100.0%

b. The RG-F treatment

	Raw players' Matched Partners are Disclosers			Raw Players' Matched Partners are Non-disclosers			Total
		Raw players' action:			Raw players' action:		
		cooperate	defect		cooperate	defect	
Disclosers	47.5%			23.8%			71.3%
		46.3%	1.3%		16.3%	7.5%	
Non-disclosers	5.0%			23.8%			28.8%
		2.5%	2.5%		5.6%	18.1%	
Total	52.5%			47.5%			100.0%

Table A.7: *Were Disclosers in the RG-F Treatment More Likely to Choose to Cooperate in the First Periods of Supergames, Compared with Disclosers in the RP-F Treatment?*

(I) When Disclosers Encounter Disclosers

Dependent Variable: A dummy that equals 1 (0) if discloser *i* chooses cooperation (defection) to her matched discloser

Independent Variable	(1)	(2)
The RG-F treatment dummy {= 1 for the RG-F treatment; = 0 for the RP-F treatment}	.335*** (.038)	.351*** (.055)
Supergame Number {= 1, 2, 3, 4, 5}	---	-.010 (.024)
The length of the previous supergame × the Supergame Number > 1 dummy	---	.001 (.002)
Constant	.643*** (.035)	.648*** (.122)
# of Observations	136	136
R-Squared	.184	.192

Notes: Individual random effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors. Observations in the first rounds of supergames in the RP-F and RG-F treatments where disclosers were matched with disclosers are used for the analysis. The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

(II) When Disclosers Encounter Non-Disclosers

Dependent Variable: A dummy that equals 1 (0) if discloser *i* chooses cooperation (defection) to her matched <u>non-discloser</u>

Independent Variable	(1)	(2)
The RG-F treatment dummy {= 1 for the RG-F treatment; = 0 for the RP-F treatment}	.336*** (.029)	.342*** (.018)
Supergame Number {= 1, 2, 3, 4, 5}	---	-.074 (.045)
The length of the previous supergame × the Supergame Number > 1 dummy	---	.002 (.001)
Constant	.353 (.029)	.526*** (.119)
# of Observations	74	74
R-Squared	.105	.129

Notes: Individual random effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors. Observations in the first rounds of supergames in the RP-F and RG-F treatments where disclosers were matched with non-disclosers are used for the analysis. The Supergame Number > 1 dummy equals 1 for the 2^{nd} to 5^{th} supergame; and 0 otherwise.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

RESULT: *Regardless of whether they encounter disclosers or non-disclosers, disclosers in the RG-F treatment are more likely to select cooperation in the first periods of supergames, compared with those in the RP-F treatment.*

Table A.8: *History Information and Action Choices in the Choice Treatments* (supplementing Table 3 of the paper)

Table 3 of the paper reports what kinds of conditions may affect subjects' decision to cooperate. Another possible factor that makes a subject select defection is his or her experiences about the defection by masked subjects. In the following table, the fraction of masked partners' defection before a given period (see variable (vi) in the following table) was added as an independent variable, in addition to the independent variables included in Table 3.[1] The number of available observations diminished 48.4% (73.2%) in the RP-F and RP-C treatments (RG-F and RG-C treatments) because observations where subjects had never interacted with non-disclosers before a given period cannot be used in the regressions. The table below shows that with a greater likelihood masked subjects selected defection, the less likely the counterpart is to select cooperation in the RP-C and RG-C treatments (see the coefficient estimates of variable (xiii)).

Observations in a period of those who have met with non-disclosers at least once before the given period were used for this analysis.

Dependent Variable: A dummy that equals 1 (0) if subject *i* chooses to cooperate (defect) in period *t*

	The RP-F and RP-C treatments		The RG-F and RG-C treatments	
Independent Variable:	(3')	(4')	(5')	(6')
(i) Use-ID dummy {= 1 if subject *i* used her assigned ID; and 0 otherwise}	.069** (.008)	.071** (.009)	.343*** (.038)	.359*** (.034)
(ii) Observe-ID dummy {= 1 if the matched partner of subject *i* used his assigned ID in period *t*; and 0 otherwise}	.151** (.031)	.154** (.034)	.307*** (.012)	.318*** (.000)
(iii) Variable (ii) × Observe-No-History dummy {= 1 if subject *i* has no history information of her matched partner in period *t*; and 0 otherwise}#1	-.448** (.082)	-.446** (.088)	-.300* (.104)	-.250*** (.015)
(iv) Variable (ii) × (1 − Observe-No-History dummy) × The fraction of cases in which the matched partner of subject *i* has chosen defection to subject *i* using his ID before period *t*	-.569** (.066)	-.567*** (.073)	----	----
(v) Variable (ii) × (1 − Observe-No-History dummy) × The fraction of cases in which the matched partner of subject *i* has chosen defection using his ID before period *t*	----	----	-.350* (.125)	-.243** (.072)
(vi) The fraction of subject *i*'s masked partners' defection up to period *t* -1 within a given supergame	-.067 (.136)	-.045 (.126)	.011 (.069)	.035 (.045)
(vii) Supergame variable {= 1, 2, 3, 4, 5}	.016 (.054)	.017* (.006)	-.014 (.015)	-.018 (.012)
(viii) Variable (i) × Costly hiding dummy#2	----	-.19*** (.010)	----	-.153* (.051)
(ix) Variable (ii) × Costly hiding dummy	----	-.127* (.034)	----	-.095* (.033)
(x) Variable (iii) × Costly hiding dummy	----	.081 (.088)	----	-.179 (.242)
(xi) Variable (iv) × Costly hiding dummy	----	-.026	----	----

[1] Suppose that subject *i* has interacted with non-disclosers three times until period 11 in a supergame. Also suppose that two non-disclosers chose defection out of these three encounters. In this circumstance, variable (vi) is calculated as .667 (= 2/3) for subject *i* in period 12.

		(.073)		
(xii) Variable (v) × Costly hiding dummy	----	----	----	-.378 (.345)
(xiii) Variable (vi) × Costly hiding dummy	----	-.614** (.13)	----	-.950*** (.116)
(xiv) Variable (vii) × Costly hiding dummy	----	.021*** (.001)	----	.299* (.118)
The length of the previous Supergame × the Supergame Number > 1 dummy[#3]	.001 (.001)	.001 (.001)	.003* (.001)	.003* (.001)
Constant	.496 (.066)	.526** (.038)	.195* (.113)	.214* (.090)
# of Observations	3,510	3,510	1,590	1,590
R-Squared	.458	.289	.4342	.364

Notes: Individual fixed effects linear regressions with robust standard errors clustered by session id. [#1] The Observe-No-History dummy equals 0 in period *t* if the partner disclosed his ID at least once to subject *i* before period *t* in the RP-F and RP-C treatments; and if the partner at least once disclosed his ID to a member before period *t* in the RG-F and RG-C treatments; and 1 otherwise. The Observe-No-History dummy equals 1 for any periods greater than 1 within supergames in the RG treatment. [#2] The Costly hiding dummy equals 1 for the RP-C and RG-C treatments; and 0 otherwise. [#3] The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

Table A.9: *History Information and Action Choices in the RG-F and RG-C Treatments (supplementing Table 3 of the paper)*

Dependent Variable: A dummy that equals 1 (0) if subject *i* chooses to cooperate (defect) in period *t*

Data:	Action choices in periods when period number within supergames is equal to 1		Action choices in periods when period number within supergames is greater than 1	
Independent Variable	(1)	(2)	(3)	(4)
(i) Use-ID dummy {= 1 if subject *i* used her assigned ID in period *t*; and 0 otherwise}	.467** (.146)	.464** (.146)	.339*** (.041)	.406*** (.024)
(ii) Observe-ID dummy {= 1 if the matched partner of subject *i* used his assigned ID in period *t*; and 0 otherwise}	.138** (.042)	.136** (.040)	.572*** (.017)	.525*** (.029)
(iii) Variable (ii) × The hiding rate of the matched partner of subject *i* (fraction of cases in which the partner did not use his assigned ID before period *t*)	----	----	-.213*** (.031)	-.268*** (.013)
(iv) Variable (ii) × (1 − Observe-No-History dummy) × The fraction of cases in which the matched partner of subject *i* has chosen defection using his ID before period *t* [#1]	----	----	-.520*** (.084)	-.266** (.073)
(v) Supergame Number variable {= 1, 2, 3, 4, 5}	.032 (.035)	.016 (.020)	.004 (.005)	-.009* (.004)
(vi) The length of the previous supergame × the Supergame Number > 1 dummy[#3]	----	.002 (.002)	.003** (.000)	.002** (.001)
(vii) Variable (i) × Costly hiding dummy[#2]	----	----	----	-.170 (.079)
(viii) Variable (ii) × Costly hiding dummy	----	----	----	.004 (.030)
(ix) Variable (iii) × Costly hiding dummy	----	----	----	.006 (.035)
(x) Variable (iv) × Costly hiding dummy	----	----	----	-.346** (.076)
(xi) Variable (v) × Costly hiding dummy	----	----	----	.032 (.015)
Constant	.118 (.077)	.138 (.087)	-.069** (.028)	.011 (.021)
# of Observations	320	320	5,616	5,616
R-Squared	.241	.240	.483	.510

Notes: Individual fixed effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors. Observations in the RG-F and RG-C treatments were used in this analysis.

[#1] The Observe-No-History dummy variable equals 0 in period *t* if the partner disclosed his ID to a member in the group at least once before period *t*; and 1 otherwise.

[#2] The Costly hiding dummy equals 1 for the RG-C treatment; and 0 otherwise.

[#3] The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

Table A.10: *Subjects' Hiding Rates in the First Supergame and Their Behaviors in the Later Supergames in the Free Hiding Treatments*

A. Correlations between hiding rates in the 1st supergame and average cooperation rates in the last supergame:

(1) The RP-F treatment

- Pearson's correlation coefficient = -.474
- *p*-value (two-sided) = .006***

(2) The RG-F treatment

- Pearson's correlation coefficient = -.240
- *p*-value (two-sided) = .186

B. Correlations between hiding rates in the 1st supergame and hiding rates in the last supergame:

(1) The RP-F treatment

- Pearson's correlation coefficient = .406
- *p*-value (two-sided) = .021**

(2) The RG-F treatment

- Pearson's correlation coefficient = .292
- *p*-value (two-sided) = .106

C. Analysis by using quartiles:

We first sorted subjects based on their hiding rates in the first supergame in an ascending order; and then classified subjects into four categories based on quartiles (25th percentile, 50th percentile, 75th percentile). The tables on the next page include the subjects' learning for each category.

(1) The RP-F treatment

	Average hiding rate					Average cooperation rate				
Classification based on hiding rates in the 1st supergame (SG)	1st SG	2nd SG	3rd SG	4th SG	5th SG	1st SG	2nd SG	3rd SG	4th SG	5th SG
Top 25%	0.003[#1]	0.183	0.231	0.117	0.001	0.477	0.359	0.475	0.326	0.478
25th percentile to 50th percentile	0.348	0.258	0.232	0.247	0.261	0.365	0.188	0.341	0.260	0.395
50th percentile to 75th percentile	0.756	0.595	0.475	0.522	0.337	0.149	0.220	0.151	0.143	0.103
Bottom 25%	1.000[#2]	0.719	0.508	0.460	0.434	0.192	0.063	0.254	0.198	0.182

(2) The RG-F treatment

	Average hiding rate					Average cooperation rate				
Classification based on hiding rates in the 1st supergame (SG)	1st SG	2nd SG	3rd SG	4th SG	5th SG	1st SG	2nd SG	3rd SG	4th SG	5th SG
Top 50%[#3]	0.000	0.137	0.063	0.031	0.050	0.672	0.804	0.591	0.817	0.828
50th percentile to 75th percentile	0.550	0.570	0.373	0.313	0.282	0.531	0.700	0.436	0.561	0.681
Bottom 25%	1.000[#4]	0.715	0.496	0.175	0.138	0.422	0.375	0.226	0.331	0.800

Notes: [#1] The 25th percentile of supergame 1 hiding rates in the RP-F treatment is 0.0278. [#2] 28% of subjects in the RP-F treatment have a hiding rate of 100% in the first supergame in the RP-F treatment. Results are similar, regardless of which subjects among those subjects are included in the bottom 25% category. The numbers shown in this row are calculation results in one case. [#3] Exactly 50% of subjects in the RG-F treatment have a hiding rate of 0% in the 1st supergame in the RG-F treatment. [#4] Exactly 25% of subjects in the RG-F treatment have a hiding rate of 100% in the first supergame in the RG-F treatment.

D. Subjects' average cooperation rates by disclosure decision

(1) The RP-F treatment

- Subjects whose hiding rate is 0%:

  Average cooperation rate is 52.0%.

- Subjects whose hiding rate is 100%:

  Average cooperation rate is 1.4%.

- Subjects whose hiding rates are between 10% and 90%:

  Average hiding rate of those subjects: 41.2%.

  Average cooperation rate when disclosing IDs: 41.2%.

  Average cooperation rate when hiding IDs: 8.3%.

- Subjects whose hiding rates are between 25% and 75%:

  Average hiding rate of those subjects: 49.1%.

  Average cooperation rate when disclosing IDs: 31.4%.

  Average cooperation rate when hiding IDs: 6.4%.

(2) The RG-F treatment

- Subjects whose hiding rate is 0%:

  Average cooperation rate is 77.8%.

- Subjects whose hiding rate is 100%:

  Average cooperation rate is 7.5%.

- Subjects whose hiding rates are between 10% and 90%:

  Average hiding rate of those subjects: 36.5%.

  Average cooperation rate when disclosing IDs: 72.8%.

  Average cooperation rate when hiding IDs: 8.9%.

- Subjects whose hiding rates are between 25% and 75%:

  Average hiding rate of those subjects: 48.5%.

  Average cooperation rate when disclosing IDs: 68.7%.

  Average cooperation rate when hiding IDs: 8.3%.

Table A.11: *The Impact of Observing Mutual Cooperation in the Other Pair on Subjects' Decision to Disclose in the RG-F treatment*

Dependent Variable: A dummy that equals 1 (0) if a subject *i* chooses to (not to) disclose her ID in period *t*

Observations used in this analysis: *i*'s disclosure decision when two individuals in the other pair of *i*'s group both disclosed IDs in period $t-1$ in the RG-F treatment

Independent Variable	When session clustering is not added (1)	(2)	When session clustering is added (3)	(4)
Observe-mutual-cooperation dummy[#1]	.033** (.015)	.025* (.015)	.033 (.037)	.025 (.035)
Subject *i*'s period $t-1$ disclosure decision {= 1 if *i* disclosed ID; and = 0 if *i* hid ID in period $t-1$}	.574*** (.024)	.561*** (.024)	.574 (.108)	.561 (.103)
Supergame Number {= 1, 2, 3, 4, 5}	----	.011 (.006)	----	.011 (.005)
The length of the previous supergame × the Supergame Number > 1 dummy[#2]	----	.001*** (.000)	----	.001 (.000)
Constant	.327*** (.023)	.295*** (.027)	.327 (.119)	.295 (.129)
# of Observations	1,144	1,144	1,144	1,144
R-squared	.727	.724	.727	.724

Notes: Individual fixed effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors.

[#1] The Observe-mutual-cooperation dummy variable equals 1 if among the two players with which subject *i* was not matched in period $t-1$, both of the two players selected cooperation in that period; and 0 otherwise.

[#2] The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

RESULT: *Seeing two subjects in the other pair achieve mutual cooperation increases subjects' likelihood to disclose in the following period by around three percent. However, this result is suggestive only because the effect is not significant once session clustering is added in the regressions.*

Table A.12: *The Impact of Observing Defection Targeted at a Non-discloser in the Other Pair on Subjects' Decisions to Disclose in the RG-F treatment*

Dependent Variable: A dummy that equals 1 (0) if a subject *i* chooses to (not to) disclose her ID in period *t*

Observations that satisfy the following conditions were used in this analysis: (a) Among two individuals *k* and *s* in the other pair in *i*'s group, one hid his/her ID, and the other disclosed ID in the last period (period $t-1$); and (b) *i* and *i*'s interaction partner had an interaction outcome other than the one in which one subject hid his/her ID and the other subject disclosed but selected defection in period $t-1$.

Independent Variable	(1)	(2)
Observe-nondisclosers-defected dummy[#1]	-.046 (.024)	-.054 (.020)
Subject *i*'s period $t-1$ disclosure decision {= 1 if *i* disclosed ID; and = 0 if *i* hid ID in period $t-1$}	.751** (.018)	.732** (.024)
Supergame Number {= 1, 2, 3, 4, 5}	----	.020 (.005)
The length of the previous supergame × the Supergame Number > 1 dummy[#2]	----	.001 (.000)
Constant	.204** (.005)	.158 (.011)
# of Observations	570	570
R-squared	.730	.730

Notes: Individual fixed effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors.

[#1] The Observe-nondisclosers-defected dummy variable equals 1 if among the two players with which subject *i* was not matched in period $t-1$, one person hid his/her ID while the other person disclosed his/her ID and selected defection in that period; and 0 otherwise.

[#2] The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

RESULT: *Seeing a non-discloser defected by his or her matched discloser in the other pair little affects subjects' decisions to disclose in the following period.*

Table A.13: *The Difference in Non-disclosers' Response to the Disclosers' Intentions to Cooperate between the RP-F and RG-F Treatments*

Dependent Variable: A dummy that equals 1 (0) if a period t – 1 non-discloser i chooses to (not to) disclose her ID in period t

Observations used in the regression: when subject i hid his/her ID but the matched partner disclosed and selected cooperation in period t – 1 (the previous period).

Independent Variable	(1)	(2)
The RG-F treatment dummy {= 1 for the RG-F treatment; and = 0 otherwise}	.145** (.067)	.161** (.074)
Supergame Number {= 1, 2, 3, 4, 5}	----	.037 (.040)
The length of the previous supergame × the Supergame Number > 1 dummy	----	.001 (.003)
Constant	.157** (.067)	.048 (.086)
# of Observations	265	265
R-squared	.013	.005

Notes: Individual random effects linear regressions with robust standard errors clustered by session id. The numbers in parentheses are standard errors. The Supergame Number > 1 dummy equals 1 for the 2nd to 5th supergame; and 0 otherwise.

*, **, and *** indicate significance at the 10 percent level, at the 5 percent level and at the 1 percent level, respectively.

Appendix B: Instructions

B.1: The RP treatment (no-choice treatment)

The following are the instructions for the RP treatment.[1]

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 $5 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. If you have a question, raise your hand. One of us will come to answer your question. In the experiment, you are given a fixed identification number. Your identification number stays the same during the entire experiment. You are not allowed to reveal it to any other participants in the experiment.

During the experiment, your earnings will be calculated in points. At the end of the experiment, points will be converted to U.S. dollars at the following rate:

10 points = 13 cents.

At the end of the experiment, your total earnings (including the $5 for participation) will be paid out to you in cash.

There are 5 phases in the experiment. In each phase, all participants are randomly divided into **groups of 4 individuals**. This means that you are in a group with 3 other participants and play with them in that phase. **You will be part of the same group in 1 phase only**. Once a phase is over, you will be randomly assigned to another group with 3 other new participants. You will never interact with the same set of 3 participants in the following phases. Each phase consists of multiple periods. You will interact with your 3 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 first explain the details of each period in a phase. We then explain the duration of each phase.

[1] The ztree files in our study were programmed by amending the program files used in Casari and Camera (https://www.aeaweb.org/articles.php?doi=10.1257/aer.99.3.979).

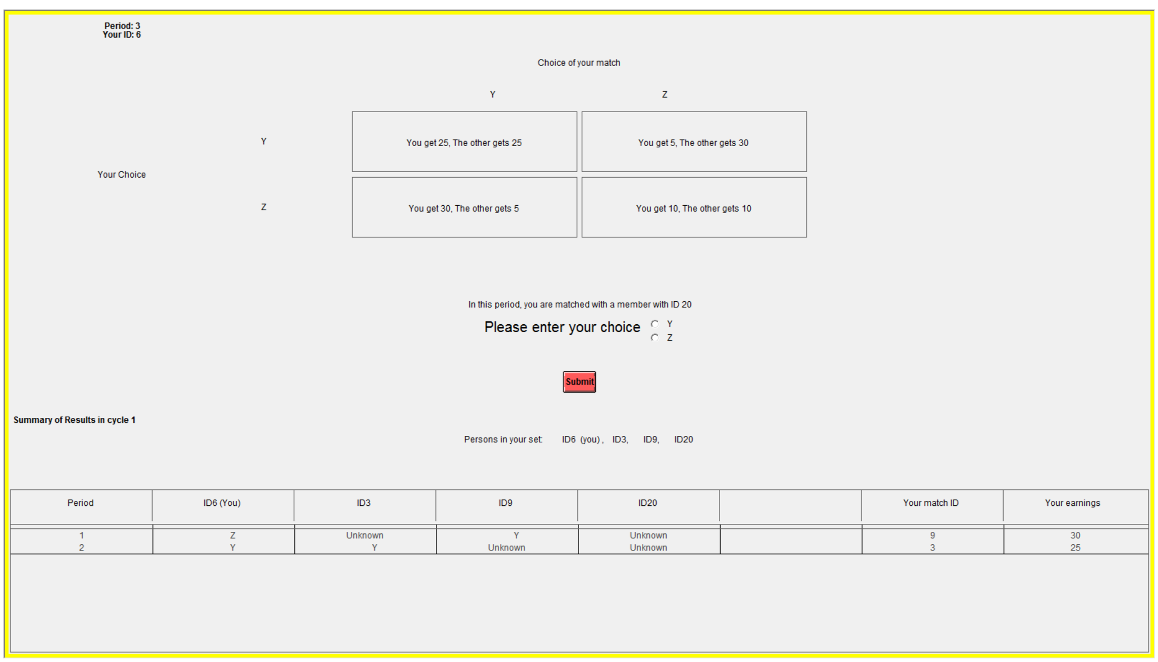
Your decision in each phase:

In each period, you will be randomly paired with an individual in your group. You will be informed of the identification number of your partner. Your partner will also be informed of the identification number of you. The pairing is completely random. Neither your decisions in previous periods in this phase nor your decisions in previous phases affect the pairing process. Since there are 4 individuals in your group, the probability that you will be matched with the same individual in 2 consecutive periods of a given phase is 1/3. In each period, you and your partner simultaneously choose Y or Z. There are 4 possible interaction outcomes:

(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.

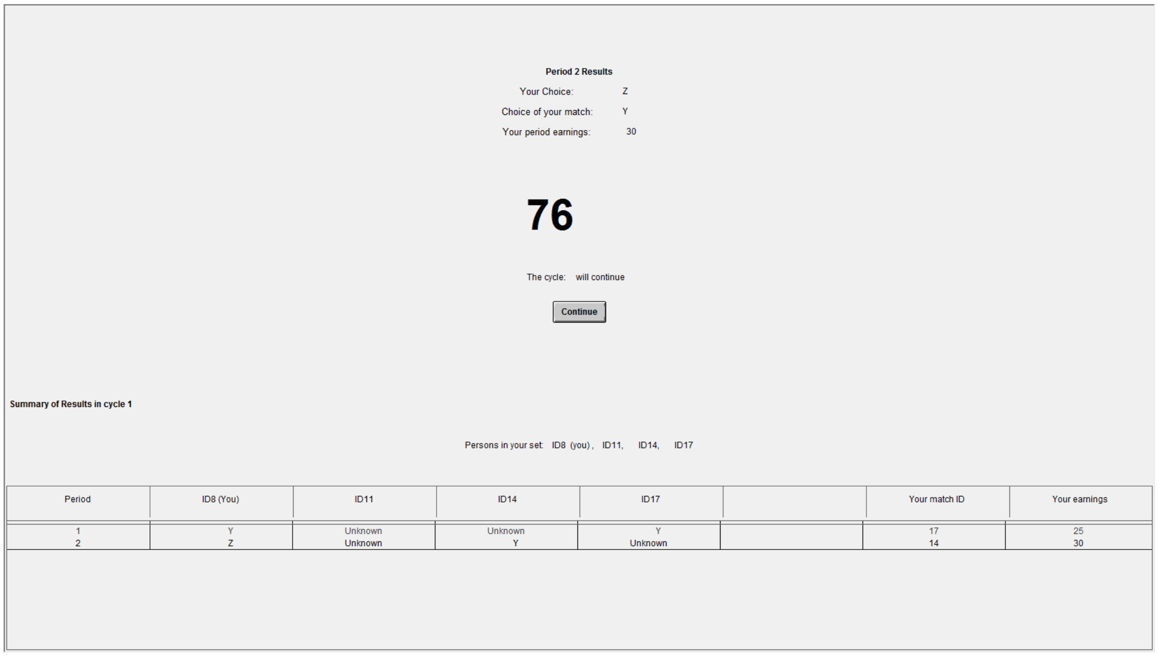
Your partner has the same earnings consequences as you. Once all participants in a session make decisions and click the "Submit" button, you are informed of the outcome of your interaction. Specifically, you will be informed of (1) your partner's choice and (2) your earnings in this period.

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



Note: Period 3. Decisions here are for illustration only.

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



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

Your past decisions and interaction outcomes are displayed along with your partners' identification numbers in a table (named "Summary of Results") at the bottom of your computer screen as shown in the screen image (see Computer screen 2 above). As in the screen shots, you will not be informed of the decisions of the two participants that are not paired with you in each period. Your decisions in any periods are also known to your matched partners. By contrast, your decisions are not observed by the two other participants that are not paired with you in those periods.

The Number of Periods in Each Phase:

The number of periods is not predetermined. The probability that you will have another period is 95%. Operationally, at the end of each period, the computer randomly draws an integer between 1 and 100 for this session. The drawn integer will be displayed on the computer screen along with your interaction outcome of the present period (see Computer Screen 2 above). If the drawn integer is less than or equal to 95, you will move on to the next round, and you will randomly be paired with an individual in your group. If it is greater than 95, then the present phase is over. You will move on to the next phase and will interact with 3 different, randomly selected individuals from today's participants. The nature of interactions in the next phase is exactly the same as the present one. Note that your newly assigned 3 group members are those who have never interacted with you in previous phases. You will never interact with a participant for more than 1 phase.

Since the probability that you have the next period is 95%, the expected length of a phase is 20 periods. However, since the decision to discontinue is randomly exerted by the computer, you may have a phase with periods that are much longer than 20. Likewise, you might have a phase with periods that are much shorter than 20.

Your Earnings:

At the end of the experiment, you will be paid in cash, based on your accumulated earnings across the five phases. The conversion rate is 10 points = 13 cents.

The structure of each phase is identical. If you have any questions at this time, please raise your hand. When 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? What are your partner's earnings?

a) How much do you earn? ____________________

b) How much does your partner earn? ____________________

c) Who are informed of your choice of Y in this phase?

i. Your current period partner only

ii. All three other persons in your group

iii. All participants in today’s experiment

B.2: The RP-C treatment (choice treatment)

The following are the instructions for the RP-C treatment.

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 $5 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. If you have a question, raise your hand. One of us will come to answer your question. In the experiment, you are given a fixed identification number. Your identification number stays the same during the entire experiment.

During the experiment, your earnings will be calculated in points. At the end of the experiment, points will be converted to U.S. dollars at the following rate:

10 points = 13 cents.

At the end of the experiment, your total earnings (including the $5 for participation) will be paid out to you in cash.

There are 5 phases in the experiment. In each phase, all participants are randomly divided into **groups of 4 individuals**. This means that you are in a group with 3 other participants and play with them in that phase. **You will be part of the same group in 1 phase only**. Once a phase is over, you will be randomly assigned to another group with 3 other new participants. You will never interact with the same set of 3 participants in the following phases. Each phase consists of multiple periods. You will interact with your 3 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 first explain the details of each period in a phase. We then explain the duration of each phase.

Your decision in each phase:

In each period, you will be randomly paired with an individual in your group. The pairing is completely random. Neither your decisions in previous periods in this phase nor your decisions in previous phases affect the pairing process. Since there are 4 individuals in your group, the probability that you will be matched with the same individual in 2 consecutive periods of a given phase is 1/3. Your first decision in each period is **whether to use your identification number in your interaction with your matched**

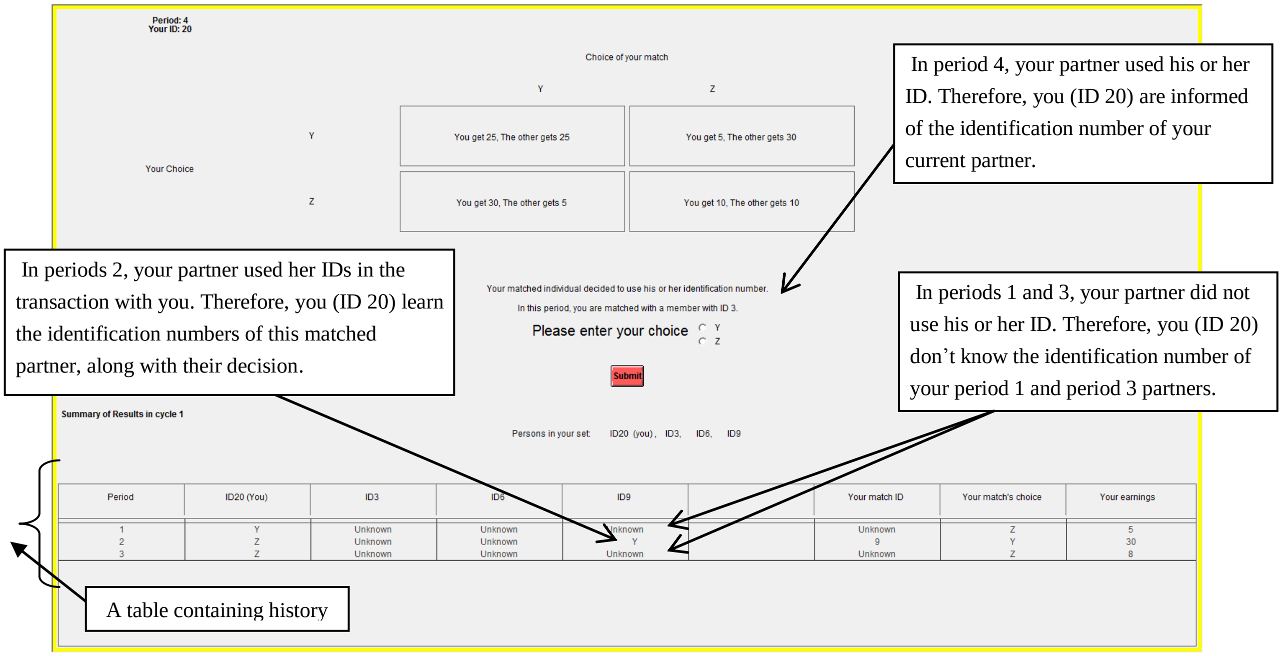
partner, or to hide it which costs you 2 points. If you decide to use your assigned identification number, your matched partner will be informed of your identification number before your interaction with him or her. By contrast, if you decide to hide it, your earnings will be deducted by 2 points, but your matched partner will not know your identification number; he or she only knows that he or she is matched with 1 of the 3 individuals in the group. Likewise, your partner makes the same decision regarding his or her identification number as you do. You will be informed of the identification number of your partner if your partner decides to use and show his or her identification number to you. If your partner decides not to use (decides to hide) his or her identification number by paying 2 points, then you will only know that you are randomly matched with 1 of the 3 individuals in your group.

Once both you and your partner make decisions concerning the use of identification numbers, you and your partner simultaneously make choices of either Y or Z. There are 4 possible interaction outcomes:

(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.

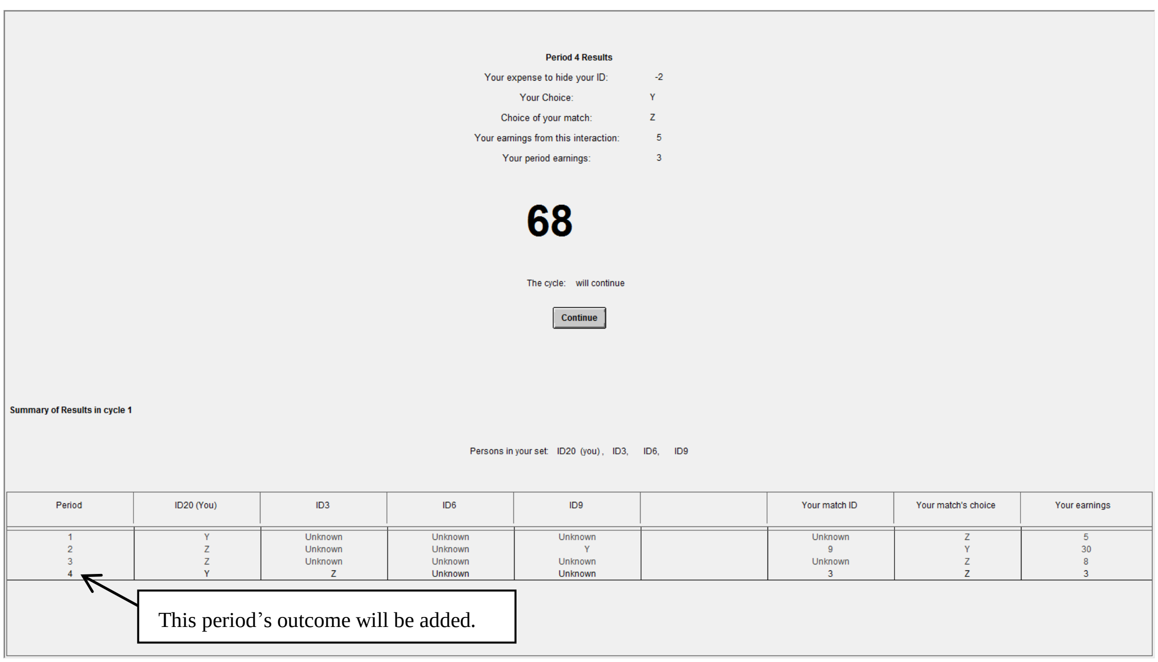
Your partner has the same earnings consequences as you. Once all participants in a session make decisions and click the “Submit” button, you are informed of the outcome of your interaction. Specifically, you will be informed of (1) your partner’s choice and (2) your earnings in this period, along with your partner’s identification number in case your partner has chosen to use and show his or her assigned identification number in this interaction. If you have chosen to use your identification number, your partner will also be informed of your identification number along with the outcome.

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



Note: Period 4. Decisions here are for illustration only.

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



Note: Period 4. Decisions here are for illustration only.

Your past decisions and interaction outcomes are displayed along with your partners' identification numbers (if used) in a table (named "Summary of Results") at the bottom of your computer screen as shown in the screen image (see Computer screen 2 above). As in the screen shots, you will not be informed of the decisions of the 2 participants that are not paired with you in each period. Likewise, your decisions are not known by the 2 other participants that are not paired with you in those periods. But, your decision in a period is known to your matched partner, along with your identification number, if you decided to use your identification number in that period. By contrast, your decision in a period is not revealed to your matched partner if you decided to hide your identification number in that period by expending 2 points.

The Number of Periods in Each Phase:

The number of periods is not predetermined. The probability that you will have another period is 95%. Operationally, at the end of each period, the computer randomly draws an integer between 1 and 100 for this session. The drawn integer will be displayed on the computer screen along with your interaction outcome of the present period (see Computer Screen 2 above). If the drawn integer is less than or equal to 95, you will move on to the next round, and you will randomly be paired with an individual in your group. If it is greater than 95, then the present phase is over. You will move on to the next phase and will interact with 3 different, randomly selected individuals from today's participants. The nature of interactions in the next phase is exactly the same as the present one. Note that your newly assigned 3 group members are those who have never interacted with you in previous phases. You will never interact with a participant for more than 1 phase.

Since the probability that you have the next period is 95%, the expected length of a phase is 20 periods. However, since the decision to discontinue is randomly exerted by the computer, you may have a phase with periods that are much longer than 20. Likewise, you might have a phase with periods that are much shorter than 20.

Your Earnings:

At the end of the experiment, you will be paid in cash, based on your accumulated earnings across the five phases. The conversion rate is 10 points = 13 cents.

The structure of each phase is identical. If you have any questions at this time, please raise your hand. When 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. How much does it cost you to hide your identification number in a period?

____

4. Suppose that you have decided to show your identification number while your partner has decided to hide his or her identification number to you. Suppose that you choose Y and your partner chooses Z in a period of a given phase. What are your earnings? What are your partner's earnings?

a) How much do you earn? ____________________

b) How much does your partner earn? ____________________

B.3: The RG-F treatment (choice treatment)

The following are the instructions for the RG-F treatment.

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 $5 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. If you have a question, raise your hand. One of us will come to answer your question. In the experiment, you are given a fixed identification number. Your identification number stays the same during the entire experiment.

During the experiment, your earnings will be calculated in points. At the end of the experiment, points will be converted to U.S. dollars at the following rate:

10 points = 13 cents.

At the end of the experiment, your total earnings (including the $5 for participation) will be paid out to you in cash.

There are 5 phases in the experiment. In each phase, all participants are randomly divided into **groups of 4 individuals**. This means that you are in a group with 3 other participants and play with them in that phase. **You will be part of the same group in 1 phase only**. Once a phase is over, you will be randomly assigned to another group with 3 other new participants. You will never interact with the same set of 3 participants in the following phases. Each phase consists of multiple periods. You will interact with your 3 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 first explain the details of each period in a phase. We then explain the duration of each phase.

Your decision in each phase:

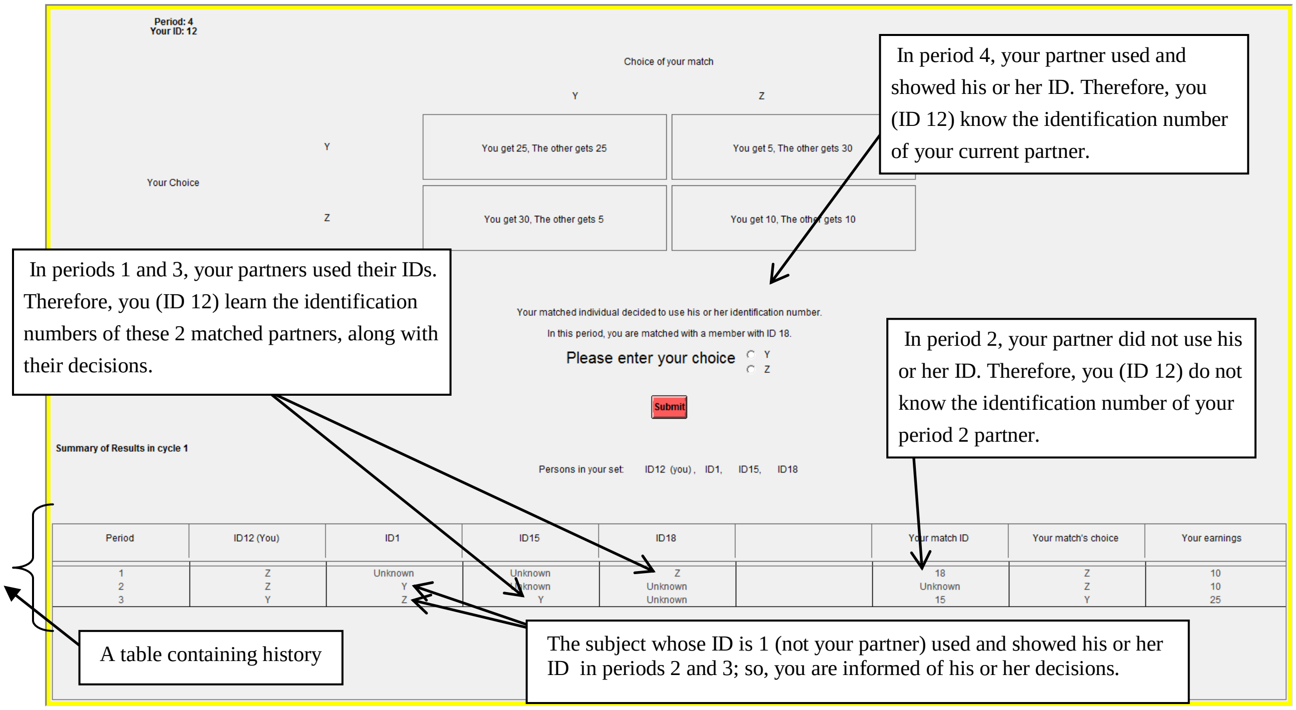
In each period, you will be randomly paired with an individual in your group. The pairing is completely random. Neither your decisions in previous periods in this phase nor your decisions in previous phases affect the pairing process. Since there are 4 individuals in your group, the probability that you will be matched with the same individual in 2 consecutive periods of a given phase is 1/3. Your first decision in each period is **whether to use your identification number in your transaction with your matched partner and the 2 other individuals in your group or hide it**. The cost of hiding it is free of charge. If you decide **to use** your identification number, your matched partner **will be informed of** the identification number of you. By contrast, if you decide **to hide** it, your matched partner **will not know** your identification number; he or she will only know that he or she is matched with 1 of the 3 individuals in the group. Likewise, your partner makes the same decision regarding his or her identification number as you do. You will be informed of the identification number of your partner if your partner decides to use his or her identification number to you. If your partner decides not to use (decides to hide) his or her identification number, then you will only know that you are randomly matched with 1 of the 3 individuals in your group.

Once both you and your partner make decisions concerning the use of identification numbers, you and your partner simultaneously make choices of either Y or Z. There are 4 possible interaction outcomes:

(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.

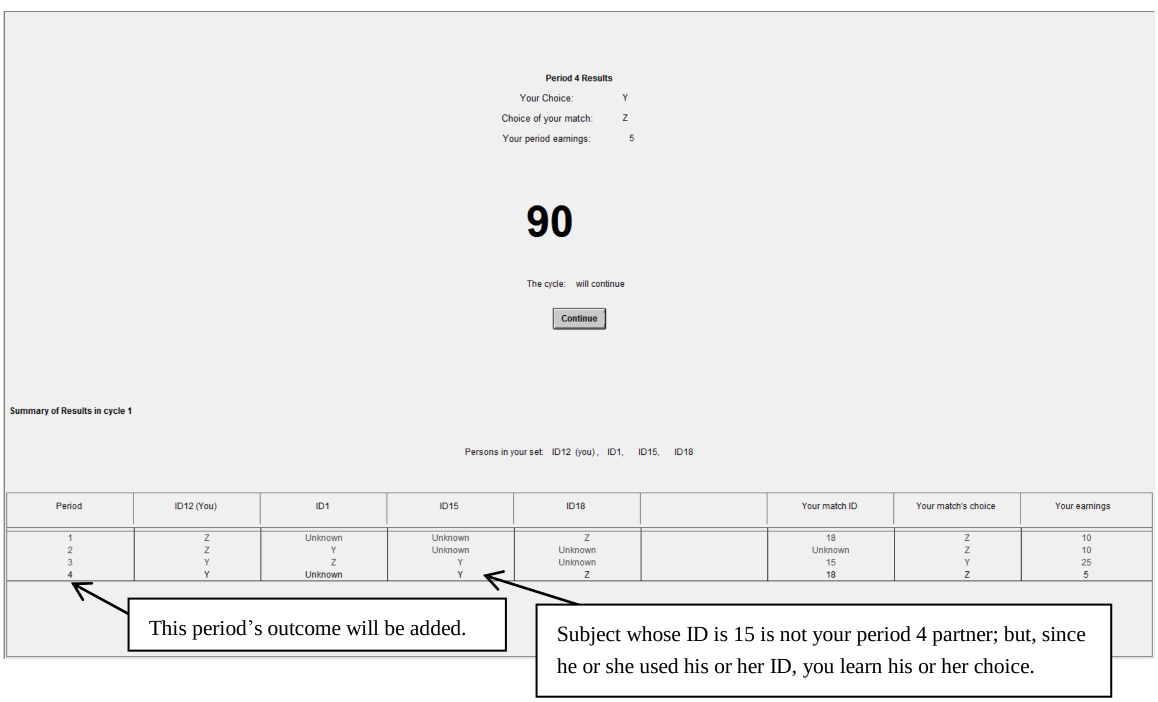
Your partner has the same earnings consequences as you. Once all participants in a session make decisions and click the "Submit" button, you are informed of the outcome of your interaction. Specifically, you will be informed of (1) your partner's choice and (2) your earnings in this period, along with your partner's identification number in case your partner has chosen to use and show his or her assigned identification number in this interaction. You will also be informed of (3) the choice of other individual(s) in your group and (4) their identification number(s) if they have decided to use and show their identification number(s) to your group. If you have chosen to use your identification number, your partner will also be informed of your identification number; also, the 2 individuals that are not matched with you learn your choice and your identification number.

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



Note: Period 4. Decisions here are for illustration only.

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



Note: Period 4. Decisions here are for illustration only.

Your past decisions and interaction outcomes are displayed along with your partners' identification numbers (if used) in a table (named "Summary of Results") at the bottom of your computer screen as shown in the screen image (see Computer screen 2 above). As in the screen shots, you will also be informed of the decisions of a participant that is not paired in a period with you if he or she has decided to use and show his or her ID in that period. Likewise, your decision in a period is known to your matched partner and the 2 other group members, along with your identification number, if you have chosen to use and show your identification number in that period. By contrast, your decision in a period is not shown to your matched partner or the 2 other participants that are not paired with you if you decided not to use your identification number in that period.

The Number of Periods in Each Phase:

The number of periods is not predetermined. The probability that you will have another period is 95%. Operationally, at the end of each period, the computer randomly draws an integer between 1 and 100 for this session. The drawn integer will be displayed on the computer screen along with your interaction outcome of the present period (see Computer Screen 2 above). If the drawn integer is less than or equal to 95, you will move on to the next round, and you will randomly be paired with an individual in your group. If it is greater than 95, then the present phase is over. You will move on to the next phase and will interact with 3 different, randomly selected individuals from today's participants. The nature of interactions in the next phase is exactly the same as the present one. Note that your newly assigned 3 group members are those who have never interacted with you in previous phases. You will never interact with a participant for more than 1 phase.

Since the probability that you have the next period is 95%, the expected length of a phase is 20 periods. However, since the decision to discontinue is randomly exerted by the computer, you may have a phase with periods that are much longer than 20. Likewise, you might have a phase with periods that are much shorter than 20.

Your Earnings:

At the end of the experiment, you will be paid in cash, based on your accumulated earnings across the five phases. The conversion rate is 10 points = 13 cents.

The structure of each phase is identical. If you have any questions at this time, please raise your hand. When 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. How much does it cost you to hide your identification number to your partner in a period?

____

4. Suppose that you decide to use and show your identification number in a period. Who learns your choice (either Y or Z) along with your identification number?

i. Nobody

ii. Your current period partner only

iii. All 3 other persons in your group

iv. All participants in today's experiment

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

a) How much do you earn? ___________________

b) How much does your partner earn? ___________________