Endogenous Reputation Formation: Cooperation and Identity under the Shadow of the Future

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Abstract:

People are interacting more with strangers thanks to recent technological advancements in online platforms. Recent studies have shown that institutions that make people's decisions known to others may enhance cooperation in such infinitely-repeated situations. But it is still unknown whether people can successfully cooperate with each other by choosing to show their identities and building good reputations when there is an option to hide them. We deal with this question using an experimental laboratory. Our experiment shows that a non-negligible fraction of people conceal their identities and people fail to cooperate with each other if hiding identities is free. However, almost all show their identities and successfully achieve cooperation with their partners if a small explicit cost is charged for act of hiding.

JEL classification: C73, C92, D70, M21
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I. Introduction

How to sustain cooperation or trust among people is one of the most sought-after questions in our society. Reputations play a key role in encouraging people to cooperate. While having a good reputation can benefit people significantly, having a bad reputation can be a disaster for a successful business or personal relationship. One needs to be identified to build a reputation so that people can link his past behavior and his name (or his face or an identification number, if the name is unknown) in the future interactions. Therefore, identity is a crucial element in building a reputation. With the increasing number of e-commerce transactions as well as the emerging businesses built on the idea of sharing economy such as Uber and Airbnb, however, we are interacting more with strangers − people whom we otherwise have no means to find, than we did a decade ago. While the technology has made our life more convenient (e.g., finding a birthday gift for a friend without leaving home or getting a cheaper car ride to an airport), it also means increased anonymity among buyers and sellers (e.g., buying a gift on an online store that doesn't have much information about its true quality or taking a ride with a driver you found online whom you have never met before). Anonymous transactions, especially the ones conducted online, can lead to opportunistic behavior.

Some service providers have developed reputation building mechanisms as a solution to overcome the trust problem between users. For example, eBay and Uber have rating and feedback systems. While some users may still be motivated to engage in opportunistic behavior (e.g., a seller breaking her promise such as warranty or listing a better product that is different from her true product), it is more costly for them to do so with the rating or feedback systems present. For instance, if a seller wants to withhold information on her identity and a product she is selling, without good ratings or positive feedbacks from previous buyers, she may be less likely to find prospective buyers that are willing to deal with her. But in order to build a good reputation, she must go through some due-paying periods to obtain others' trust, which may take some time. She may have to spend even a longer time if she has misbehaved before and received bad ratings or has less history information publicly available with hiding IDs. She could be seen

with suspicion by potential counterparts and it may take time to repair the negative image. In other words, building a reputation can be considered as an implicit cost to users.[1,2]

As the online transactions are becoming a part of our everyday life, however, a large number of online frauds have been reported.[3] Frauds occur often due to the high degree of anonymity in transactions or features that allow users to have multiple accounts in a platform or creating them are easy (e.g., Pinker *et al.* 2003, Trevathan and Read 2006, Chua and Wareham 2002, Kwan *et al.* 2010). Online frauds can also be a consequence of low costs of entry and exit: users with opportunistic intentions can come back to marketplaces under different identities after cheating on their customers. There are several approaches taken by companies with regards to the usage of multiple accounts. Some companies such as eBay permit users to have multiple accounts and entrust users with their moral judgment about the use of the accounts.[4] Allowing multiple accounts can be convenient for users who wish to separate their accounts for some reasons (e.g., managing different product categories). But it also makes it possible for users to hide their identities and to engage in opportunistic behavior. Some online platforms such as Craigslist even allow users to trade each other without having a specific user ID.[5,6]

There are also other companies that attempt to prevent scams by imposing a strict ban on creating multiple accounts. This may help reassure users when using online transaction websites with respects to safety. This approach is chosen by Amazon.[7] The listings on the Amazon marketplace can be cancelled and suspended by Amazon if a seller does not follow the policy imposed by Amazon.

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[1] eBay also has an additional incentive scheme in that they give privileges, such as higher selling limits, to well-established seller accounts (see http://pages.ebay.com/help/sell/sellinglimits.html). Uber has a policy that users can be deactivated if they fail to maintain their ratings above the minimum required score (See http://blog.uber.com/feedback).

[2] Some providers have a system to ensure buyer confidence as well. For example, eBay provides a guarantee that buyers get money back if they don't receive what they ordered. See http://pages.ebay.com/help/policies/money-back-guarantee.html for the details.

[3] See 2013 Internet Crime Report published by Federal Bureau of Investigation.

[4] See http://pages.ebay.com/help/policies/multiple-accounts.html for the policy.

[5] Craigslist encourages its users to deal locally and meet in person for transactions. See http://www.craigslist.org/about/scams for the details.

[6] Regardless of policies on multiple accounts, many providers use some kinds of fraud detection/prevention technologies to protect their users. Research on early fraud detection methods has been actively conducted. The details are omitted to conserve space as they are beyond the scope of the paper.

[7] See http://www.amazon.com/gp/help/customer/display.html?nodeId=200414320 for the policy.

Other countermeasures that may effectively prevent users from misusing online services that are similar to strict rules on multiple accounts are to impose additional costs on users by introducing an entrance fee or a time-consuming registration process for creating a new account (see Dellarocas (2003) for a survey). The presence of such additional costs may give users a sufficient incentive not to deviate from honest and sincere behavior although this may prevent newcomers from joining the service which may hence reduce the efficiency (Friedman and Resnick, 2001). The employment of an upfront cost for creating a new account is simple.[8] Some forms of fixed payment in maintaining accounts are also often observed in real practices.[9] Thus, having multiple accounts is not free for a user. However, to our knowledge, the efficacy of having such additional costs in deterring opportunistic behavior remains as an empirical question due to the lack of the availability of data.

In economics, many transactions on internet can be explained by infinitely-repeated interactions with stranger matching as people's interactions continue without any definite end periods.[10] Under a stranger matching protocol, individuals are randomly matched with each other from round to round. Under a partner matching protocol, by contrast, they are always matched with the same fixed partners. However, neither theoretical nor experimental investigations of people's behavior in infinitely-repeated transactions are straightforward. This is because not only mutual defection but also mutual cooperation holds as an equilibrium under some conditions, even if stranger matching procedures are used (see Dal Bó and Fréchette 2014 for a survey). For instance, with the so-called contagious strategy, mutual cooperation can be theoretically sustained even if people are not informed of their partners' identities nor their partners' past behaviors (Kandori 1992, Ellison 1994). This has been experimentally supported by some studies (Camera and Casari 2009).[11] Literature also suggests that institutions that make peoples'

[8] Most online platforms such as Amazon ask potential users to go through a credit card authorization process for opening an account.
[9] For example, Amazon requires sellers to pay either (a) a fixed monthly fee or (b) a small fixed closing fee for each order instead of paying the monthly fee, in maintaining an account. See http://www.amazon.com/gp/help/customer/display.html/ref=hp_left_cn?ie=UTF8&nodeId=200306550 for the details. Other online marketplaces such as Sears and Rakuten also have similar policies on fixed fee payment.
[10] Imagine that you plan to buy a product and search for it in an online platform such as Craigslist. Your encounter with another user can be described by stranger matching rather than by partner matching. I acknowledge that people's endogenous selection of their partners could be a more realistic description. However, we do not use an endogenous partner choice in our study so as to simplify our study and obtain evidence that is easy to interpret.
[11] This seems to be sensitive to payoff matrices and continuation probabilities, however. In Duffy and Ochs (2009), mutual cooperation did not evolve under a stranger matching protocol although it did evolve under a partner matching protocol.

identities and behaviors known to their partners or others under stranger matching protocols may be effective in encouraging people to choose a mutual cooperation equilibrium (e.g., Camera and Casari 2009, Kandori 1992, Stahl 2013, Duffy *et al.* 2013, Takahashi 2010).[12,13] However, little is known about how people can endogenously form a reputation by choosing to use their unique identities when there is an option to hide them (for example, by creating another account). In the past infinitely-repeated experimental studies mentioned above, information on the identities and behaviors of other players are exogenously, not endogenously, given.[14]

This paper conducts an infinitely-repeated prisoner's dilemma game experiment, where the subjects themselves decide whether to use or hide their pre-assigned unique identification numbers (IDs) before each interaction. When a subject hides her ID in period *t*, her period *t* partner is just informed that he is interacting with an anonymous player. After that interaction, cooperation decision of the subject will not be recorded; it will not be available in any future periods either. By contrast, when a subject shows her pre-assigned ID in period *t*, her cooperation decision will get recorded and can be referred by her partner(s) in any future periods. We note that in order to simplify our design and also to reduce cognitive load required for subjects, we let subjects choose either to use or hide their IDs in each period, instead of giving them an opportunity to create a new account unknown to others in each period. With this simplification, we can sufficiently explore the strength of people's motives to conceal their IDs and its consequences on cooperation in communities. Following the convention of economic experiments, all terms are neutrally framed in the experiment. In this paper, we address the following three questions: Does having an identity increase cooperation? Does being able to hide an identity hurt cooperation? What happens if there is a cost of hiding an identity?

Predicting subjects' behavior in relation to these research questions involves some considerations. Our experimental setup in which subjects decide whether to use or hide their IDs

[12] Similar effects of reputation mechanisms on raising cooperation or trust/trustworthiness have been widely found also in finitely-repeated setups (e.g., Bolton *et al.* 2004, Bolton *et al.* 2005, Gong and Yang 2010).
[13] Conditions under which cooperation evolves under the partner matching protocols have been actively studied (e.g., Aoyagi and Fréchette 2009, Blonski *et al.* 2011, Dal Bó 2005, Dal Bó and Fréchette 2011, Murnighan and Roth 1983). Mechanisms behind the evolution of cooperation for each matching protocol have been also actively studied by biologists and political scientists (e.g., Axelrod 2006).
[14] Duffy *et al.* (2013) studied the effects of history information in sustaining cooperation. They let subjects play infinitely-repeated trust games. The subjects were provided their partners' past decisions for free or were given opportunities to purchase such information at a small cost. They find that regardless of whether the provision of reputational information was free or costly, trust and reciprocity were both enhanced, compared with a treatment with no history information available.

somewhat resembles the identifier commitment proposed by Friedman and Resnick (2001). In Friedman and Resnick, each user chooses between a once-in-a-lifetime identifier (unique ID that can be obtained only once for each platform) and regular identifiers (which the users can obtain any time freely) in each period in an infinitely-repeated environment. They theoretically propose that no players would use the regular identifiers in equilibrium as those who do not use once-in-a-lifetime identifiers are treated poorly by others. In our context, no subjects would hide their IDs in equilibrium. This theoretical prediction may not hold, however. Many past infinitely-repeated game experiments find that people are heterogeneous and not all subjects choose cooperation even though mutual cooperation can be sustained as an equilibrium. Similarly, in our study, a non-negligible percentage of the subjects may hide their IDs and attempt to trick others, by which they may be trapped in the mutual defection equilibrium. If people's motives to hide their identities and decisions are sufficiently strong and detrimental to the harmony in communities, then we may need some institutions that can effectively deter such opportunistic behavior. Our paper examines the efficacy of a costly-hiding institution (a scheme in which a subject incurs a small cost in case she attempts to hide her ID), whose investigation would also contribute to the advancement of emerging research on institutions, including those that may encourage cooperation.

Our experiment consists of seven treatments, with three no-choice treatments and four choice treatments. Our design is a between-subjects design. The subjects in each treatment play multiple infinitely-repeated prisoner's dilemma games that have a random continuation rule in sequence. In each infinitely-repeated game, subjects are randomly assigned to groups of four and interact with a randomly selected member in their groups in every period. The matching protocol across the different infinitely-repeated games is a perfect stranger matching protocol. Each subject never interacts with a specific subject in more than one infinitely-repeated prisoner's dilemma game.

The three no-choice treatments serve as control treatments in this study. They differ by the quantity of information available to subjects. In one treatment, subjects are informed of neither their matched partners' IDs nor their past decisions. In the second treatment, subjects are informed of their matched partners' IDs in each interaction. Thus they can keep track of their partners' IDs and decisions. However, the subjects are not informed of the decisions and specific IDs of the two members with whom they were not matched. In the third treatment, in addition to

the information provided in the second treatment, subjects are also informed of the decisions made by the two group members that were not their partners along with the members' specific IDs.

In the four choice treatments, unlike the no-choice treatments, subjects themselves decide whether to show or hide their IDs for each interaction. When a subject decides to use (hide) her ID in a period, her matched partner is (is not) informed of her ID before making his cooperation decision in that period. In addition, as mentioned earlier, the partner can refer to the subject's decision at any time after that period if she uses her ID. The four choice treatments differ by two dimensions. The first dimension is whether only a matched partner or all three group members learn the decisions of a group member who has revealed her ID. The second dimension is whether concealing an ID is free or costly. The cost charged for hiding is small enough that the stage game is still a prisoner's dilemma game. Thus, this part of our design is a 2×2 design.

Our data of the no-choice treatments indicates that increasing the quantity of information has positive effects on the subjects' cooperation rates. This result is consistent with the finding from previous studies in that reputation institutions making people's decisions known to others (e.g., rating systems) raise the cooperation rate or the degree of trust. However, our data of the choice treatments shows that having a free option to hide their IDs significantly undermines cooperation behavior. This negative effect is especially strong when the subjects' IDs and cooperation decisions can be observed only by their matched partners. A closer look at the data finds that substantial fractions of the subjects decide to conceal their IDs when given a choice to hide them. It also shows that those who hide their IDs are more likely to select defection in the stage games than those who show their IDs. An exploration of the trend of the subjects' decisions finds that the hiding rates (the fractions of cases where the subjects hide their IDs out of all decisions) decrease to some degree from infinitely-repeated game to infinitely-repeated game. However, the overall hiding rates stay at a high level, even though their matched partners are more likely to choose defection when the subjects hide their IDs than when they show them.

By sharp contrast, when hiding IDs is *costly* with a small explicit fee automatically charged for hiding, almost all subjects decide to reveal their IDs. The average cooperation rates in the costly-hiding treatments are significantly higher than those in the free-hiding treatments. In addition, the former rates are statistically similar to the high cooperation rates of the

corresponding no-choice treatments where their cooperation decisions are automatically revealed to the members.

Our study also shows that subjects' cooperation decisions are affected by their partners' previous cooperation decisions made with their IDs shown. A detailed analysis finds that a subject's partners react conditionally cooperatively on the frequency of cooperation in her recorded history information. Moreover, the subjects are less likely to select cooperation if they are faced with someone whose ID they have never encountered before or someone who has less history information (i.e., a history of frequent hiding). These suggest a possible mechanism where cooperation can be sustained by making sufficient information available as well as a potentially high efficacy of having a costly-hiding institution in online platforms.

The rest of the paper proceeds as follows: Section II describes our experimental design. Section III provides theoretical considerations and specific questions. Section IV reports results, and Section V concludes.

II. Experimental Design

The design frame of our study is an infinitely-repeated prisoner's dilemma game. Our design 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 pre-assigned unique identification number involves subjects' decisions, (b) which member in a group learns the cooperation decisions of those who have decided to show their assigned IDs, and (c) whether a subject owes a fee if she hides her assigned ID. Our design is based on the framework employed by Camera and Casari (2009) – as explained in the first subsection in Section II (Common Features in All Treatments). Two of the three no-choice treatments are from the treatments used in Camera and Casari (2009). We add one new treatment as the third no-choice treatment. We then set up four new choice treatments.

Common Features in All Treatments.— Subjects play five infinitely-repeated prisoner's dilemma games in each treatment. We call an "infinitely-repeated prisoner's dilemma game" also a super-game or a phase in this paper. Subjects are randomly assigned to a group of four at the beginning of each super-game. The list of four members' IDs is common knowledge in a group. Group assignment across the super-games follows the standard perfect stranger matching

protocol. That is, once a super-game is over, subjects are randomly assigned to another group of four, and no one has the same person as a group member in more than one super-game. Any information in a given super-game is not carried over to a future super-game. Within a super-game, each subject is randomly paired with another member in their group in every period. Since group size is four, the probability that a subject interacts with a specific group member in a period is 1/3. They do not interact with subjects outside their groups within a super-game. Neither their decisions nor their interaction outcomes in the past affect the matching process. The duration of each super-game is not pre-determined. Their interactions will be over with a probability of 95%.[15] Thus, the expected length of each super-game is 20 (= 1/(1−.95)). The payoff matrix of the prisoner's dilemma game is shown in Figure 1.

Three No-Choice Treatments.— The "No Information" treatment, dubbed as the N treatment, is the "Private Information" treatment in Camera and Casari (2009). The identification numbers of subjects are not disclosed to their matched persons in groups in each period. Subjects just know that they are randomly matched with one of the three individuals in their groups when they make cooperation decisions. They learn their own pairs' interaction results (the cooperation decisions of their matched persons and their payoffs) at the end of each period without learning the partners' IDs. This corresponds to highly anonymous transactions between individuals in the real world (e.g., classified ads on newspapers or online).[16]

The "Reputation within Group" treatment, dubbed as the RG treatment, is the "Public Monitoring (non-anonymous)" treatment in Camera and Casari (2009). Each subject is informed of their matched counterpart's ID when making a cooperation decision in every period. At the same time, they are informed of all the past decisions made by each of the three other members in their group in a given super-game. At the end of each period, they learn the cooperation decisions of the other three members, including those who are not matched with them. Therefore, subjects in the RG treatment can build cooperative reputations within their groups. This treatment corresponds to online platforms where users can use only one ID and there are post-transaction feedback mechanisms that allow users to see other users' past behavior through ratings.

[15] An integer between 1 and 100 is randomly drawn in each period. If it is less than 96 (greater than or equal to 96), subjects have (do not have) the next period. This setup can be interpreted that the discounting factor within a super-game is .95.
[16] Examples include Craigslist.

The last no-choice treatment is called the "Reputation with Partner" treatment and dubbed as the RP treatment. In the RP treatment, as in the RG treatment, each subject is informed of their matched counterpart's ID in every period when making a cooperation decision. Subjects are also given the records of cooperation decisions by the past partners of theirs at the cooperation decision stage as in the RG treatment. However, subjects are not informed of any cooperation decisions by those who have not been matched with them, unlike the RG treatment. In other words, once a subject interacts with a member in period *t*, the member's record will become available only to the period *t* subject in the future periods. Therefore, each subject can build a reputation with a specific member in their group through her decisions to that member, not to the other two group members. This treatment is set in order to examine how the use of single IDs (that can be seen by their transaction partners) alone, without feedback systems, affects the evolution of cooperation norms in the market. In other words, the difference in the subjects' behavior between the RP and RG treatments can be attributed to the effects of feedback systems that make people's decisions known to others.

Four Choice Treatments.— We design two sets of two choice treatments. In these four treatments, before engaging in a transaction, each subject can choose either to use her assigned ID, for example in order to build a reputation, or to hide it so that her matched partner will not know whom he is interacting with. This endogenous aspect contrasts with the RP and RG treatments as the disclosure of the subjects' IDs and past decisions in the no-choice treatments do not involve the subjects' decisions. The two sets of the choice treatments are exactly the same except the presence of a fee that a subject owes in a period if she decides to hide her assigned ID in the transaction.

In the "Reputation with Partner, Free Hiding" treatment, dubbed as the RP-F treatment, subjects decide whether to use their assigned IDs or to hide them without any costs in each period. If a subject *i* decides to use his assigned ID in a period, then his ID is informed to his matched person *j* before *j* makes her cooperation decision. In addition, the cooperation decision of subject *i* in that period will be shown on the computer screen of subject *j* in any future periods of the super-game as in the RP treatment. By contrast, if subject *i* decides not to use his assigned ID, his matched person *j* only knows that she will be playing with one of the three members in her group. Thus, the quantity of information that subject *j* has about the decisions of her matched

person *i* in a given super-game is less than that in the RP treatment unless subject *i* always reveals his assigned ID when interacting with subject *j*. The "Reputation with Partner, Costly Hiding" treatment, dubbed as the RP-C treatment, is exactly the same as the RP-F treatment except that a subject has to pay a fee of two points when she decides to conceal her assigned identification number.

In the "Reputation within Group, Free Hiding" treatment (dubbed as the RG-F treatment) and the "Reputation within Group, Costly Hiding" treatment (dubbed as the RG-C treatment), subjects make decisions regarding the use of their assigned IDs at the onset of each period as in the RP-F and RP-C treatments. While a subject can disguise his ID without any fees in the RG-F treatment, a subject needs to pay a fee of two points each time she chooses not to use her assigned ID in the RG-C treatment. The consequence of a subject's using her assigned ID is the same as that in the RG treatment. Suppose that subject *i* decides to use her assigned ID in period *t* of a super-game. In this circumstance, the ID of subject *i* will be informed to her matched partner *j* in that period. In addition, after the interaction between subject *i* and partner *j* ends, all three members in her group will learn the cooperation decision of subject *i* in that period. Furthermore, her cooperation decision in period *t* will be always available to the three group members in any future rounds after period *t* in the super-game.

Experimental Procedure.— This experiment is a computerized experiment, programmed using ztree (Fischbacher 2007). All instructions are neutrally framed. No subjects participate in more than one session in the experiment. No communication among the subjects is allowed after entering the laboratory and before the experiment ends. Subjects are asked to answer a couple of control questions to check their understanding of the experiment at the start of each session. At the end of the fifth super-game, subjects are asked to answer open-ended questions regarding the reasoning of their cooperation decisions, along with questions on demographics such as gender.

III. Theoretical Considerations and Specific Questions

The standard economic theory does not provide a sharp prediction in our environment as we use an infinitely-repeated prisoner's dilemma game as a framework. Both mutual cooperation and mutual defection are equilibria even in the N treatment. Our continuation probability is .95, and the threshold value of continuation probabilities so that mutual cooperation can be sustained as

an equilibrium is .443 (page 986 in Camera and Casari 2009). As discussed in Camera and Casari, mutual cooperation is more easily attained in the RG treatment than in the N treatment if the grim trigger strategy is used. The grim trigger strategy also predicts that the threshold value of continuation probability δ^* in the RP treatment — a new no-choice treatment, is the same as that in the N treatment. This is because each subject in the RP treatment learns their matched partner's cooperation decisions only.[17] Nevertheless, the availability of the information on randomly matched partners' IDs may facilitate cooperation with specific players in the RP treatment, compared with the N treatment.[18] Therefore, we can expect that increasing the quantity of information has positive effects on the average cooperation rates in our three no-choice treatments. These considerations lead to the first set of questions:

Question 1: (a) Is the average cooperation rate higher in the RG treatment than in the RP treatment? (b) Is the average cooperation rate higher in the RP treatment than in the N treatment?

In the four choice treatments, the amount of information available to subjects in a given period depends on other subjects' decisions regarding whether or not to use their assigned IDs before that period. One potential reason that some subjects do not use their assigned IDs is to choose defection to their matched partners and at the same time attempt to avoid having records as defectors. Due to this signaling aspect, however, theoretically those who hide their pre-assigned IDs would be treated poorly by others. As a result, regardless of the presence of the cost for hiding, no subjects would hide their assigned IDs in equilibrium (Friedman and Resnick 2001).

This theoretical prediction may not hold in our experiment, however. Many past experimental studies find that subjects are heterogeneous with regards to strategy choices. That is, regardless of matching protocols, in most cases there is a non-negligible fraction of subjects who choose defection even if cooperation can be sustained as an equilibrium in infinitely-repeated prisoner's dilemma games. In our context, some subjects may hide their identities and attempt to

[17] 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.

[18] For example, Kamei and Putterman (2014) find that some subjects seek to be matched with a specific person and build a trustful relationship with her in a finitely-repeated regrouping treatment although the only available information is subjects' IDs and their own interaction outcomes in their paper (see the LR-LG treatment and the LR-HG treatment in Kamei and Putterman).

exploit their partners if they can do so for free. If this happens, cooperation norms may not evolve in the RP-F and RG-F treatments.[19] Nevertheless, even if hiding is cost-free and some subjects may commit opportunistic behavior, the majority of subjects may not hide their identities. Going through the due-paying periods to build trustful relationships with their cooperative peers while letting partners see their IDs could result in a higher payoff (which can be sustained as an equilibrium), compared with obtaining a one-time increased payoff from defection (after which they may be trapped in a mutual defection equilibrium). Concealing an ID implies that it takes more periods for a subject to build such a cooperative reputation. It might be *more* costly for a subject as having less history information may be seen with suspicion by others and thus it may take time to repair the negative image. The presence of this extra implicit cost could motivate subjects to show their IDs more. Given these considerations, we ask the following questions in our paper:

Question 2: (a) Are there a non-negligible fraction of subjects in the RP-F and RG-F treatments who hide their IDs in their interactions? (b) Is the cooperation rate in the RP-F treatment lower than that in the RP treatment? (c) Is the cooperation rate in the RG-F treatment lower than that in the RG treatment?

An explicit cost for disguising IDs is present in the RP-C and RG-C treatments. The small fee for hiding their true IDs may substantially prevent subjects from engaging in opportunistic behavior at least for two reasons. First, it may reduce the temptation to hide IDs and defect to some degree. The gain a subject could obtain when hiding her ID to defect decreases by 2 points from the 30 points while she could obtain the same 25 points of the mutual cooperation payoff if she does not hide her ID. Second, not building a cooperative record using her assigned ID may serve as a strong signal that she may behave opportunistically in her future interactions in a given super-game. This signaling aspect could be stronger when hiding identities is costly, compared with when it is cost-free. If a subject decides to conceal her ID even though she has to pay to do it, her matched counterpart may contemplate the subject's intentions to hide her ID more deeply and may be more likely to choose defection. Subjects in the RP-C and RG-C treatments may therefore show their IDs more frequently than those in the

[19] Although the structure of experiments are different, in finitely-repeated (as opposed to infinitely-repeated) trust games where the trust-trustworthy relationship is not an equilibrium, Wibral (forthcoming) recently finds that with an option of identity changes both the degree of trust and that of trustworthiness decrease significantly.

RP-F and RG-F treatments. If the small fee constrains act of concealing IDs and thus increases the quantity of records available to others due to these two reasons, subjects' cooperation rates may rise. Based on these considerations, we ask the following third specific questions in our experiment:

Question 3: (a) Are subjects in the RP-C and RG-C treatments more likely to use their IDs than those in the RP-F and RG-F treatments? (b) Is the average cooperation rate higher in the RP-C treatment than in the RP-F treatment? (c) Is the average cooperation rate higher in the RG-C treatment than in the RG-F treatment?

IV. Results

We conducted 14 sessions, with two sessions per treatment, at the University of Michigan in Ann Arbor from July to October, 2014.[20] The average duration of the experiment (including the payment to subjects) was around two hours.

Average Cooperation Rates.— We will first compare the average cooperation rates across the treatments (Figure 2 and Table 2). First, the data of the three no-choice treatments reveals a significantly positive effect of having larger quantity of information on the average cooperation rates. The average cooperation rate is substantially higher when each subject's assigned IDs can be seen by their matched partner (the RP treatment), compared with when they are not (the N treatment). It is a large increase of 29.2 percentage points. This suggests that simply making people's IDs available to their matched interaction persons can be very effective in encouraging them to achieve mutual cooperation with specific partners. The average cooperation rate is even higher when the subjects' IDs and decisions are shown to all group members. This suggests reputation mechanisms (e.g., ratings) that make people's decisions open to the public in the RG treatment are furthermore helpful in deterring their opportunistic behavior, compared with the RP treatment.

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

[20] All subjects were recruited using solicitation emails on the University of Michigan online recruiting system based on the Online Recruitment System for Economic Experiments (ORSEE). The number of female subjects was 134 (56.8% of the subjects). The average earnings (excluding the participation fee) were $21.80.

Second, the presence of the ID-hiding option significantly alters the subjects' subsequent cooperation behavior if hiding IDs is not associated with payment of a fee. 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). These decreases are statistically significant (see coefficient estimates of variables (iii) and (v) of Table 2).[21] The average cooperation rate in the RP-F treatment is statistically similar to that in the N treatment while the RG-F treatment still has significantly higher average cooperation rate than in the N treatment. However, the average cooperation rates jump with the scheme in which subjects have to pay two points each time they hide their IDs. The average cooperation rates in the RP-C and RG-C treatments record statistically similar levels to those in the RP and RG treatments, respectively (see Table 2 and Appendix Table A.1).

Result 2: The average cooperation rates in the choice treatments are significantly lower than the corresponding no-choice treatments in which subjects' ID are known to others, if hiding IDs is cost-free. However, they are not statistically different if hiding IDs is associated with payment of fees.

An analysis of the trend of the average cooperation rates by treatment shows that the subjects learn to cooperate over the phases when history information is available (Appendix Figure A.1(a)). The average cooperation rate in the N treatment begins at around 45% and gradually declines over the five phases. By sharp contrast, in the RG treatment, it is much higher from the very first phase, around 65%, and reaches above 80% in the last three phases. When cooperation decisions are known only to matched partners (the RP treatment), the average cooperation rate is at the similar level to that in the N treatment in Phase 1, but it steadily increases over the phases. A regression analysis finds that the increase rates of average cooperation rates are statistically significant in the RP and RG treatments (Table 2 and Appendix Table A.1). Moreover, the trend of the average period 1 cooperation rates is similar to that of the phase-average cooperation rates in each of the no-choice treatments (Appendix Figure A.2(a)). These results suggest that having an identity helps subjects learn to cooperate over the super-games.

[21] Standard errors are clustered by session id in the analysis as the subjects' decisions could be correlated within the sessions.

Letting subjects decide whether to show or hide IDs to their matched persons, we find that they learn to cooperate over the phases even if their cooperation decisions are revealed only to their matched partners (Appendix Figure A.1(b)). However, the level of average cooperation rates substantially differs by whether or not hiding is free. The average cooperation rate is much higher in any given phase when hiding is costly (the RP-C treatment) than when hiding is cost-free (the RP-F treatment). The very low level of cooperation in the RP-F treatment, around 40% even in the last phase, is somewhat surprising. By contrast, with cooperation decisions revealed also to the two group members with whom they are not paired, the subjects cooperate highly from the onset and learn to cooperate over the phases even if hiding is cost-free (Appendix Figure A.1(c)). This shows some success of the reputation system in enhancing cooperation. But when hiding is costly, the subjects learn to cooperation more quickly. We see that the average cooperation rate in the RG-C treatment exceeds that in the RG-F treatment in each of the last three phases. Results on the trends are similar even if we use period 1 average cooperation rates instead of the phase-average cooperation rates (see Appendix Figure A.2(b) and (c)).

Hiding IDs and Choosing Defection.— The difference in the cooperation rate by the presence of the cost for hiding can be partly explained by the subjects' frequencies of using their assigned IDs. As shown in Figure 3, the subjects in the RP-F treatment hide their assigned IDs around 39.5% of the time. When cooperation choices along with their IDs are also shown to their two members that are not their partners, the subjects on average disguise their IDs at a slightly lower rate, around 30.0% of the entire periods. However, the decrease in the frequency of concealing IDs in the RG-F treatment is not statistically significant (Appendix Table A.2). By sharp contrast, in the treatments with the explicit-fee scheme, the average fractions of cases in which the subjects hide their IDs are only 3.3% and 2.9% in the RP-C and RG-C treatments, respectively. These two fractions (3.3% and 2.9%) are not significantly different between each other.

A phase-by-phase examination of their ID disclosure decisions finds that the subjects in the RP-F treatment do learn to reveal their assigned IDs to some degree over the phases.[22] However, the average ID-hiding rate stays higher than 30% across the five phases in that

[22] The average ID-hiding rate significantly decreases over the phases in each treatment. However, the level of the ID-hiding rate and the speed to learn to show IDs differ by treatment. See Panel (2) of Appendix Table A.2 for the details.

treatment (Appendix Figure A.3). With cooperation choices along with their IDs revealed also to the two other group members, the subjects appear to learn to use their IDs to a large degree. But the ID-hiding rates in the RG-F treatment are still above 10% even in the last two phases. By contrast, with the presence of the fee payment for hiding, the subjects convey their assigned IDs to others from the very first phase, and the ID-hiding rates decrease further over the phases. The fractions of cases where the subjects hide their IDs in the last three phases 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 phases between the RP-F (RG-F) treatment and the RP-C (RG-C) treatment (see Panel (1) of Appendix Table A.2).

Result 3: The subjects in the RP-C and RG-C treatments show their assigned IDs in their interactions significantly more often than those in the RP-F and RG-F treatments, respectively. The differences in the ID-hiding rate are significant in each phase.

A closer look at the subjects' cooperation choices by use of IDs shows that not using her assigned ID is a clear sign for a subject to defect in the on-going interaction (see Appendix Figure A.4). The average cooperation rate when the subjects hide their IDs ranges from 4.9% in the RP-F treatment to 12.5% in the RP-C and RG-C treatments. The opportunistic behavior of those who hide IDs stays at a low level over the phases in each treatment (Appendix Figure A.4 Panel (b)). By contrast, the average cooperation rate when the subjects convey their assigned IDs in transactions is substantially higher in each treatment.[23] The average cooperation rate is the highest in the RG-F treatment (76.84%), followed by the RG-C treatment (76.76%), the RP-C treatment (63.9%) and the RP-F treatment (44.2%) in this order.

Result 4: The subjects who show their IDs in period t are more likely to cooperate in that period than those who conceal their IDs.

Results 3 and 4 suggest that the presence of a small cost for hiding effectively prevents the subjects' opportunistic behavior in the experiment.

Reactions to Partners' Disclosure Decisions and Reputational Information.— In order to examine the subjects' cooperation decisions in more details, we conduct a regression analysis separately for (a) the RP-F and RP-C treatments and (b) the RG-F and RG-C treatments. The

[23] See also Appendix Table A.3. This is also confirmed by a regression analysis as discussed with Table 3.

dependent variable is a dummy variable that equals 1 if a subject *i* selects cooperation in period *t*; 0 otherwise, for each dataset. As for independent variables, first, we include the "Use-ID dummy" variable (which equals 1 if subject *i* reveals her ID in period *t*; 0 if she hides it) as use/hide decisions are closely related to the subjects' subsequent cooperation choices as mentioned above. Second, we add the "Observe-ID dummy" variable (which equals 1 if the matched person of subject *i* reveals his ID in period *t*; 0 if he hides it) in order to examine the response of subject *i* to her period *t* partner's disclosure decision. Third, we further include an interaction term between the Observe-ID dummy and the "Observe-No-History dummy" variable (which equals 1 if the matched person has no recorded history available to subject *i* in period *t*; 0 otherwise) in order to see the response of subject *i* to her period *t* partner's past ID revelation decisions (variable (iii) in Table 3). Moreover, we include a variable summarizing the level of reputational information of subject *i*'s partner to supplement the third variable. This variable is added as subject *i* could condition her decision on the previous cooperation decisions that her current partner made with his ID shown. For dataset (a), we add the fraction of cases in which subject *i*'s unmasked interaction partner in period *t* has chosen defection *to subject i* using his assigned ID before period *t* (variable (iv) in Table 3).[24] For dataset (b), we add the fraction of cases in which subject *i*'s unmasked partner in period *t* has chosen defection *in their group* using his assigned ID before period *t* (variable (v) in Table 3).[25] Finally, in columns (4) and (6), we include the interaction terms between all variables and the Costly hiding dummy (which equals 1 for the RP-C and RG-C treatments; 0 otherwise), as the impact of each variable may differ by the presence of the fee-payment scheme. In each specification, standard errors are clustered by session level as the subjects' behavior could be correlated with each other within the sessions.

As shown in Table 3, we confirm Result 4. That is, those who convey their IDs decide to choose cooperation significantly more often than those who hide their IDs do in each choice treatment (see variable (i) of Table 3). This result is not much affected by the presence of the costly-hiding institution (see variable (vii) of Table 3). Moreover, we find that the subjects respond differently to their current-period partners depending on the partners' decisions to use or

[24] Suppose that it is in period 12 and subject *i*'s current-period partner revealed his ID to subject *i* twice out of their three past encounters in this super-game. Also suppose that the partner chose cooperation once out of these two interactions where he showed his ID. In this circumstance, variable (iv) is calculated as .50 (= 1/2).

[25] Suppose that it is in period 12 and subject *i*'s current-period partner revealed his ID eight times out of the past 11 periods in this super-game. Also suppose that the partner chose cooperation five times out of these eight periods in which he showed his ID. In this circumstance, variable (v) is calculated as .625 (= 5/8).

hide IDs. The subjects are more likely to select cooperation when they interact with those who have revealed their IDs. This result is not much affected by the experimental factor of the RP or the RG (see variable (ii) of Table 3).

Result 5: The subjects are more likely to cooperate in period t if their current-period partners show their IDs in that period.

The regression analysis also finds that the cooperation decisions of the subjects in period *t* depend on their matched persons' reputational information accumulated before period *t* in a given super-game. First, subject *i* is reluctant to select cooperation when her current-period matched partner has no history information available for subject *i* even if he shows his ID to subject *i*. This effect is often significant (see variable (iii) of Table 3). Second, the cooperation decisions of the subjects and their partners' frequencies of choosing cooperation with IDs shown in the past are positively correlated. Specifically, the higher variable (iv) in period *t*, the less likely subject *i* is to choose cooperation in that period in the RP-F and RP-C treatments. Likewise, the higher variable (v) (also variable (xi)) in period *t*, the less likely subject *i* is to choose cooperation in that period in the RG-F and RG-C treatments. These results suggest that by having good recorded history information available to a matched partner, subject *i* is significantly more likely to have her matched partner select cooperation. Our findings also suggest that the low average cooperation rate when hiding is cost-free is not only due to the opportunistic behavior of masked subjects, but also due to the significantly smaller quantity of recorded history information, which causes the subjects to choose defection more.

Result 6: A subject is less likely to cooperate if her matched partner has no history information available to her. The higher the fraction of cooperation her matched partner has in his recorded history information, the more likely a subject is to choose cooperation to the partner.

In the RG-F and RG-C treatments, all subjects are informed of each of their group members' ID disclosure decisions in each period. We can therefore measure the quantity of a subject's history information in period *t* by using the hiding rate (the fraction of cases in which the subject did not use her assigned ID before period *t*). To supplement the analyses of the RG-F and RG-C treatments in Table 3, we perform a regression by using (a) the interaction term between the Observe-ID dummy and the hiding rate variable, instead of variable (iii) in Table 3, and (b) the same variables in Table 3 except the change as described in (a). As shown in

Appendix Table A.4, we find that the new interaction term obtains a significantly negative coefficient. This result also supports Result 6 in that a smaller amount of recorded history information in a community leads to less cooperation in that community.[26]

V. Conclusions

This paper experimentally studies how people form reputations when they have an option to hide their IDs that is either for free or costly in an infinitely-repeated setting. First, our no-choice treatments without such a hiding option find that increasing the quantity of information positively affects the subjects' cooperation rates. Specifically, the average cooperation rate is significantly higher when the subjects' decisions are revealed to their matched persons. In addition, the average cooperation rate is even higher when the subjects' decisions are revealed also to two others with whom they are not paired in their groups. Second, we find that having a free option to hide their IDs substantially undermines cooperation. Our subjects choose to hide their IDs around 30% to 40% of the time, and those who hide their IDs are more likely to select defection than those who show their IDs. In addition, faced with a partner that hides her ID, a subject is reluctant to cooperate with him. This is in a sharp contrast with the subjects' decisions where hiding is costly. When subjects are charged a small fee for hiding, almost all subjects decide to use their assigned IDs. In addition, their average cooperation rates are statistically similar to those in the corresponding no-choice treatments where their decisions are automatically conveyed to others. Third, our study suggests the importance of having a good reputation record if a subject wants her partner to cooperate with her. The larger amount of records a subject has without much hiding and the higher cooperation rate her partner sees in her recorded history information, the more likely her partner is to decide to cooperate with her.

Opportunistic behavior is observed more frequently when hiding is cost-free. Our results suggest that having an additional cost for hiding may be highly effective in encouraging users to behave in an honest and sincere manner. The high efficacy of the costly-hiding institution may partially account for what we see in our society in that some online service providers make users pay some kind of cost for enjoying their services. For instance, many providers impose some

[26] Results on the coefficient estimates on the Use-ID dummy, the Observe-ID dummy and the fraction of defection in the partner's recorded history information are similar to those in Table 3, which suggests Results 5 and 6 are robust.

additional costs, such as a time-consuming registration process with credit card authorization for opening an account and periodic fees for maintaining it, to users (e.g., the Amazon marketplace). Thus, attempting to hide their identities by creating more than one account is costly there.

Our results have a significant implication for recent studies on infinitely-repeated prisoner's dilemma games and on reputation mechanisms. While recent experiments have shown that reputation institutions can encourage people to choose a cooperation equilibrium, the question of whether they can achieve mutual cooperation by their own by choosing to show their IDs remains, to our knowledge, as an open question. Our results in the RP-F and RG-F treatments appear to suggest a negative answer to the above question. Even though mutual cooperation was an equilibrium, a substantial fraction of subjects did not use their IDs in their interactions and selected defection. The subjects in the RG-F treatment, however, gradually learned to show their assigned IDs and to cooperate over the phases, but the average cooperation rate was still lower than the corresponding no-choice treatment. Nevertheless, our data does not completely reject the possibility of people's endogenous formation of cooperative norms. We find that almost all subjects decided to reveal their IDs to their partners when only a small cost was imposed for act of hiding, and a substantially high percentage of the subjects selected cooperation afterwards. Further investigation to check the robustness of our findings could be useful as recent studies show that subjects' behavior and strategy choices might be sensitive to payoff matrices and continuation probabilities in infinitely-repeated settings (e.g., Dal Bó and Fréchette, 2011, Dal Bó and Fréchette, 2014).[27]

Lastly, we note that one possible side effect of having an additional cost in using the services is that it may discourage some potential users from joining the service as mentioned in Section I. This side effect might be large enough to cancel out its positive effect of preventing opportunistic behavior by those who are already in the market. But, the presence of such costs may discipline new entrants as well. Our study is definitely the initial step with regards to people's endogenous formation of reputations. Experimental investigation of the same question with opt-in or opt-out options or with alternative institutions could be useful and remain for future research.

[27] Also see Duffy *et al.* (2009). In their paper, unlike other papers, mutual cooperation did not evolve in an infinitely-repeated prisoner's dilemma experiment with a random matching protocol even when history information was exogenously provided.

Acknowledgement: I thank Yan Chen for her hospitality in letting me conduct the experiment at the University of Michigan. I thank Pedro Dal Bó and the seminar audience at the Behavioural and Experimental Northeast Cluster seminar held at Newcastle University for helpful comments. This project was supported by a grant-in-aid from the Telecommunications Advancement Foundation.

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Figure 1: Payoff Matrix of the Stage Game

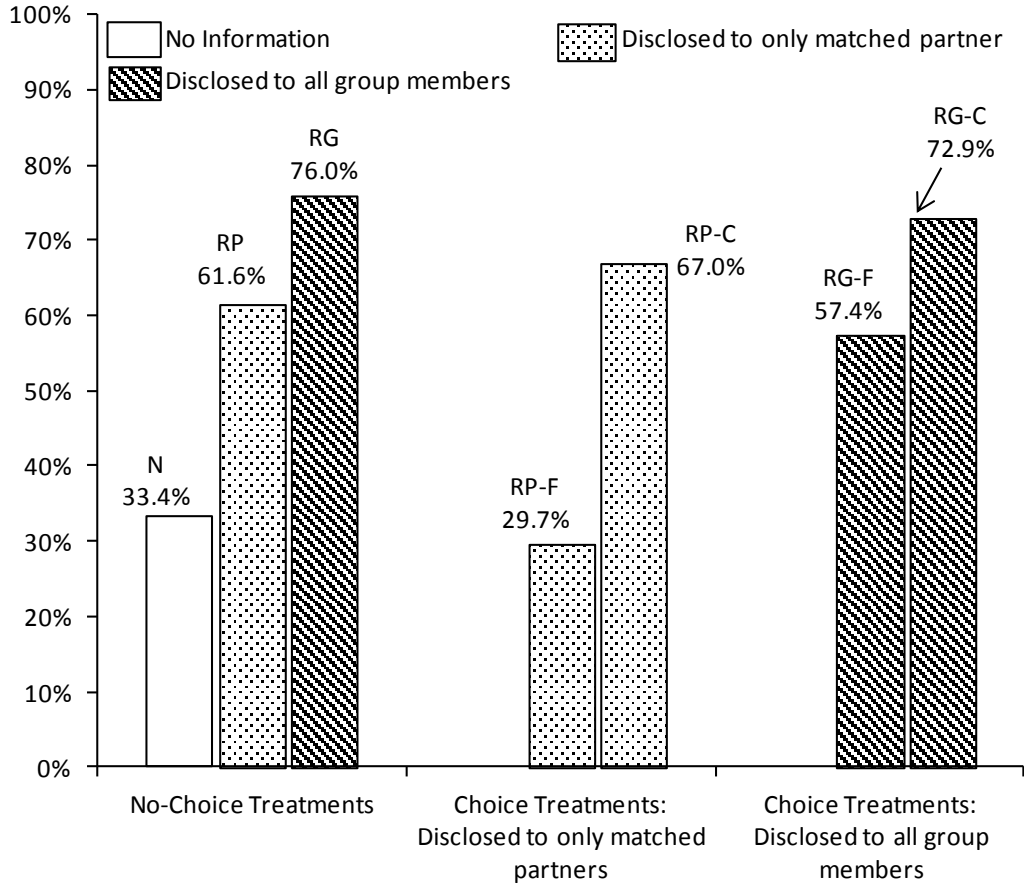
		subject 2	
subject 1		C (cooperate)	D (defect)
	C (cooperate)	25, 25	5, 30
	D (defect)	30, 5	10, 10

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

Table 1: Summary of Treatments

Treatment Name	Subject Identification Numbers	The Cost of Hiding ID	Transaction Results in Period *t*
I. No-Choice Treatments:			
N (No Information)	Not Available	n.a.	Not Available
RP (Reputation with Partner)	Disclosed to matched partner	n.a.	Disclosed to period *t* matched partner
RG (Reputation within Group)	Disclosed to all group members	n.a.	Disclosed to all group members
II. Choice Treatments:			
RP-F (Reputation with Partner, Free Hiding)	Disclosed to matched partner if a subject chooses to use her ID	0 points	Disclosed to period *t* matched partner if she uses her assigned ID in period *t*
RG-F (Reputation within Group, Free Hiding)	Disclosed to all group members if a subject chooses to use her ID	0 points	Disclosed to all group members if she uses her assigned ID in period *t*
RP-C (Reputation with Partner, Costly Hiding)	Disclosed to matched partner if a subject chooses to use her ID	2 points	Disclosed to period *t* matched partner if she uses her assigned ID in period *t*
RG-C (Reputation within Group, Costly Hiding)	Disclosed to all group members if a subject chooses to use her ID	2 points	Disclosed to all group members if she uses her assigned ID in period *t*

Figure 2: Average Cooperation Rate by Treatment



Notes: In order to calculate each bar, we first calculated average cooperation rates by subject. We then averaged the average cooperation rates by treatment. Appendix Figure A.1 reports a trend of phase-average cooperation rates by treatment. Appendix Figure A.2 reports a phase-by-phase trend of average period 1 cooperation rates by treatment.

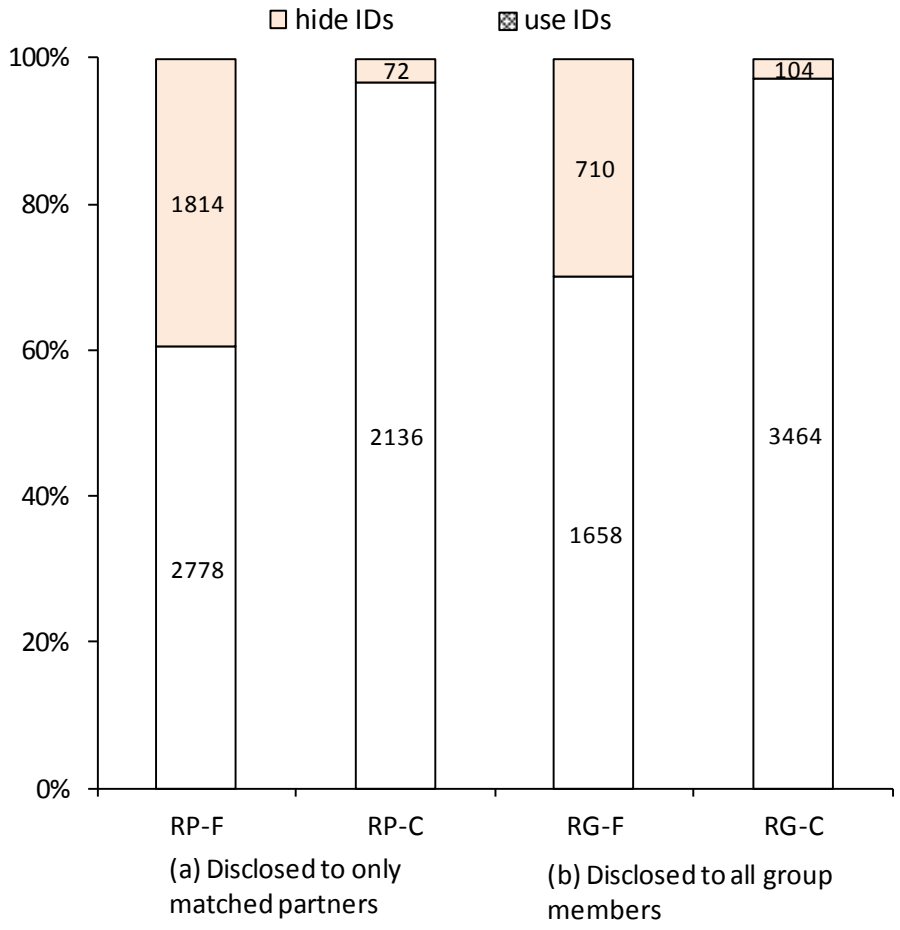
Table 2: The Effects of Each Treatment Factor on the Average Cooperation Rate

Dependent Variable: A dummy variable that equals 1 (0) if a subject chooses to cooperate (defect) with her matched partner

Independent Variable	(1)	(2)
(i) Disclosed-to-matched-partner dummy {= 1 for the RP, RP-F and RP-C treatments; 0 otherwise}	.28** (.12)	-.11 (.14)
(ii) Disclosed-to-all-group-members dummy {= 1 for the RG, RG-F and RG-C treatments; 0 otherwise}	.43*** (.12)	.14 (.11)
(iii) Variable (i) × Endo. dummy {= 1 for the RP-F and RP-C treatments; 0 otherwise}	-.32*** (.056)	-.22** (.11)
(iv) Variable (i) × Endo. dummy × Costly hiding dummy {= 1 for the RP-C treatments; 0 otherwise}	.37*** (.070)	.26** (.10)
(v) Variable (ii) × Endo. dummy {= 1 for the RG-F and RG-C treatments; 0 otherwise}	-.19*** (.048)	-.30*** (.11)
(vi) Variable (ii) × Endo. dummy × Costly hiding dummy {= 1 for the RG-C treatments; 0 otherwise}	.16** (.076)	-.096 (.12)
Phase Number {= 1, 2, 3, 4, 5}	----	-.034*** (.0033)
Variable (i) × Phase Number	----	.12*** (.018)
Variable (ii) × Phase Number	----	.11*** (.021)
Variable (iii) × Phase Number	----	-.035* (.018)
Variable (iv) × Phase Number	----	.032* (.020)
Variable (v) × Phase Number	----	.016 (.026)
Variable (vi) × Phase Number	----	.065*** (.017)
Constant	.34*** (.12)	.46*** (.11)
# of Observations	21756	21756
R-Squared	.1296	.1640

Notes: Random effects linear regressions with robust standard errors clustered by session id. Random effects are used to control individual effects as dummy variables that measure the effects of treatment factors are included as regressors. The reference group is cooperation decisions in the N treatment. The Endo. dummy equals 1 for the RP-F, RP-C, RG-F and RG-C treatments; 0 otherwise. The Costly hiding dummy equals 1 for the RP-C and RG-C treatments; 0 otherwise. See Appendix Table A.1 for tests comparing the coefficient estimates across independent variables. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

Figure 3: Percentages of ID Usages in the Choice Treatments



Notes: The numbers in each bar indicate the number of use/hide decisions of their IDs in each treatment. See Appendix Table A.2 for test results comparing the average fractions of the cases where the subjects use their assigned IDs between the RP-F and RP-C treatments, and between the RG-F and RG-C treatments. See Appendix Table A.2 also for the fractions of using their assigned IDs by phase.

Table 3: History Information and Cooperation Decisions in the Choice Treatments

Dependent Variable: A dummy variable that equals 1 (0) if subject *i* chooses cooperation (defection) to her matched partner 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 assigned ID; 0 otherwise}	----	----	.12** (.024)	.12** (.031)	.36*** (.047)	.44*** (.018)
(ii) Observe-ID dummy {= 1 if the matched partner of subject *i* revealed his assigned ID in period *t*; 0 otherwise}	----	----	.58*** (.013)	.59*** (.016)	.53*** (.012)	.47*** (.019)
(iii) Variable (ii) × Observe-No-History dummy {= 1 if subject *i* has no history information of her matched partner in period *t*; 0 otherwise}[#1]	-.17 (.091)	-.13**	-.23** (.066)	-.31* (.11)	-.13** (.033)	-.074 (.067)
(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*	-.67* (.065)	----	-.62*** (.029)	-.62*** (.030)	----	----
(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*	----	-.65* (.086)	----	----	-.59*** (.076)	-.35*** (.059)
(vi) Phase variable {= 1, 2, 3, 4, 5}	.041* (.0054)	.019 (.0042)	.020 (.0091)	.013** (.0026)	.027 (.012)	-.00042 (.0017)
(vii) Variable (i) × Costly hiding dummy[#2]	----	----	----	.057 (.031)	----	-.19 (.087)
(viii) Variable (ii) × Costly hiding dummy	----	----	----	-.040 (.047)	----	.014 (.028)
(ix) Variable (iii) × Costly hiding dummy	----	----	----	.17 (.11)	----	-.065 (.068)
(x) Variable (iv) × Costly hiding dummy	----	----	----	-.029 (.050)	----	----
(xi) Variable (v) × Costly hiding dummy	----	----	----	----	----	-.30** (.070)
(xii) Variable (vi) × Costly hiding dummy	----	----	----	.021* (.0071)	----	.048** (.013)
Constant	.72** (.018)	.88*** (.0078)	.021 (.030)	.012 (.019)	-.066** (.017)	.0017 (.030)
# of Observations	3264	2656	6800	6800	5936	5936
R-Squared	.4551	.2957	.4814	.4905	.4724	.4878

Notes: Fixed effects linear regressions with robust standard errors clustered by session id. [#1] The Observe-No-History dummy variable equals 0 in period *t* if the partner at least once revealed his ID to subject *i* before period *t* in the RP-F and RP-C treatments; and if the partner at least once revealed his ID to some member before period *t* in the RG-F and RG-C treatments; 1 otherwise. This variable equals 1 for any periods greater than 1 within phases in the RG treatment. [#2] The Costly hiding dummy equals 1 for the RP-C and RG-C treatments; 0 otherwise. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

Not for Publication

Supplementary Online Appendix for Kamei, 2015,

"Endogenous Reputation Formation: Cooperation and Identity

under the Shadow of the Future"

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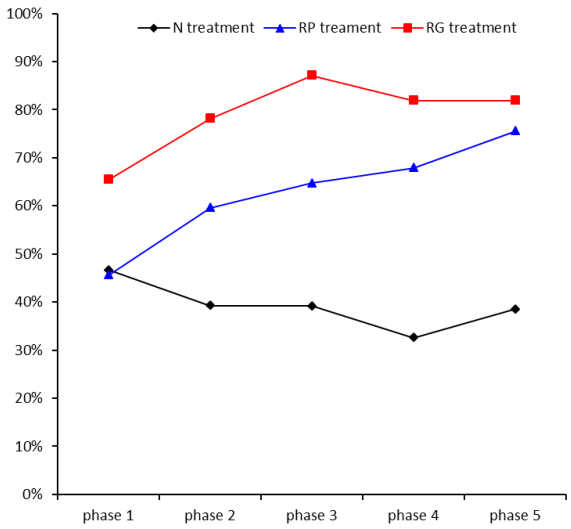
Table of Contents

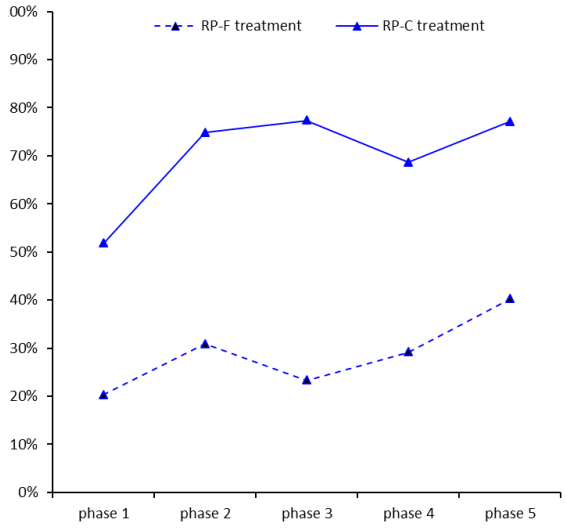
Appendix A: Additional Tables and Figures . . . . . p. 2

Appendix A: Additional Tables and Figures

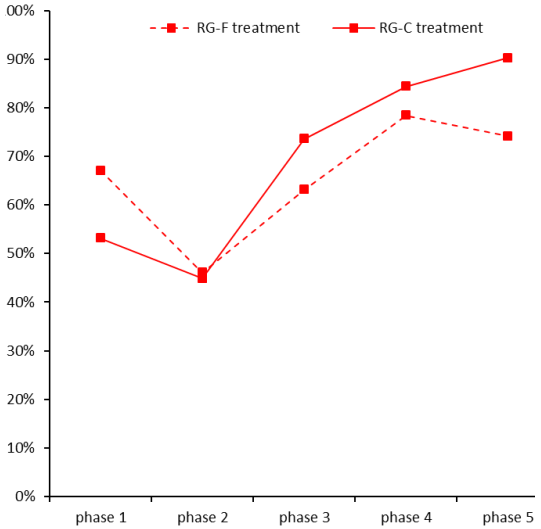
Figure A.1: Phase-by-Phase Average Cooperation Rates by Treatment



(a) No-Choice Treatments



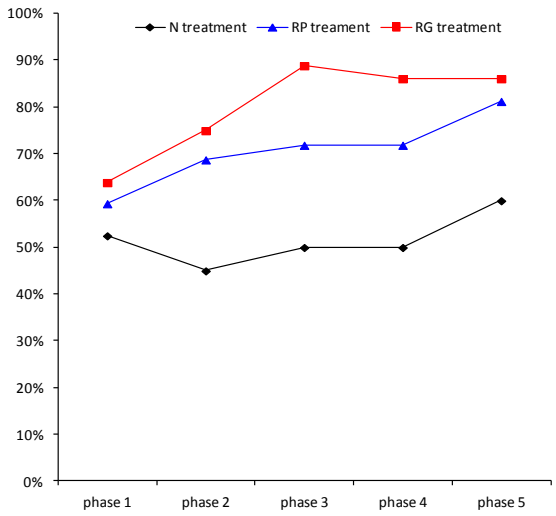
(b) RP-F treatment versus RP-C treatment



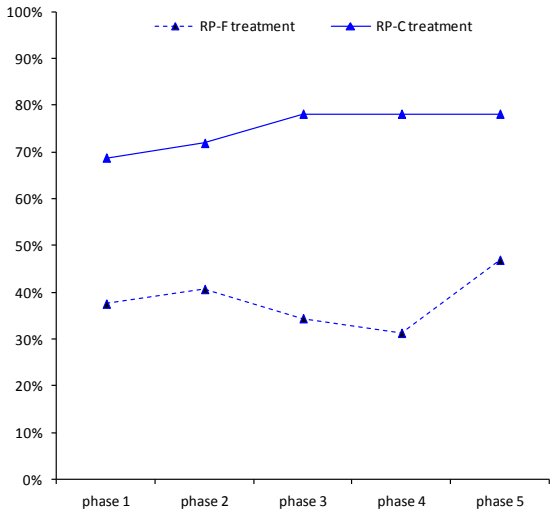
(c) RG-F treatment versus RG-C treatment

Notes: In order to calculate the average cooperation rate (each point in the figures) in a given phase, we first calculated each subject's average cooperation rate across all periods in that phase. 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 $c_{ti}^p = 1$ (0) if subject i selected cooperation (defection) in period t of phase p, N is the number of subjects in a given treatment, p is the phase number, T_P is the number of realized periods in phase p, $t \in \{1, 2, \ldots, T_P\}$. As for the statistical tests of the dynamics of the average cooperation rates, see Table 2 in the manuscript.

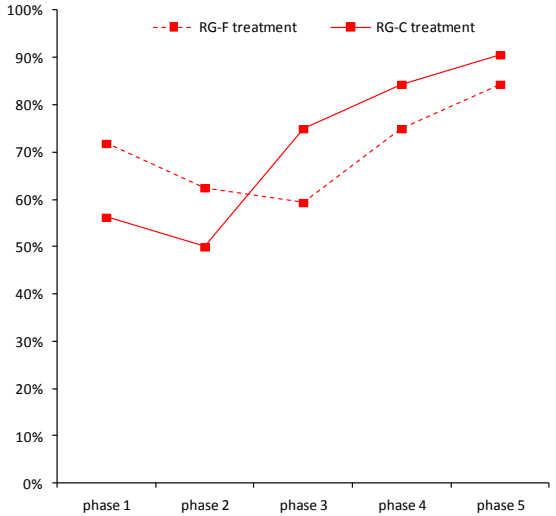
Figure A.2: Average Period 1 Cooperation Rates by Phase and by Treatment



(a) No-Choice Treatments



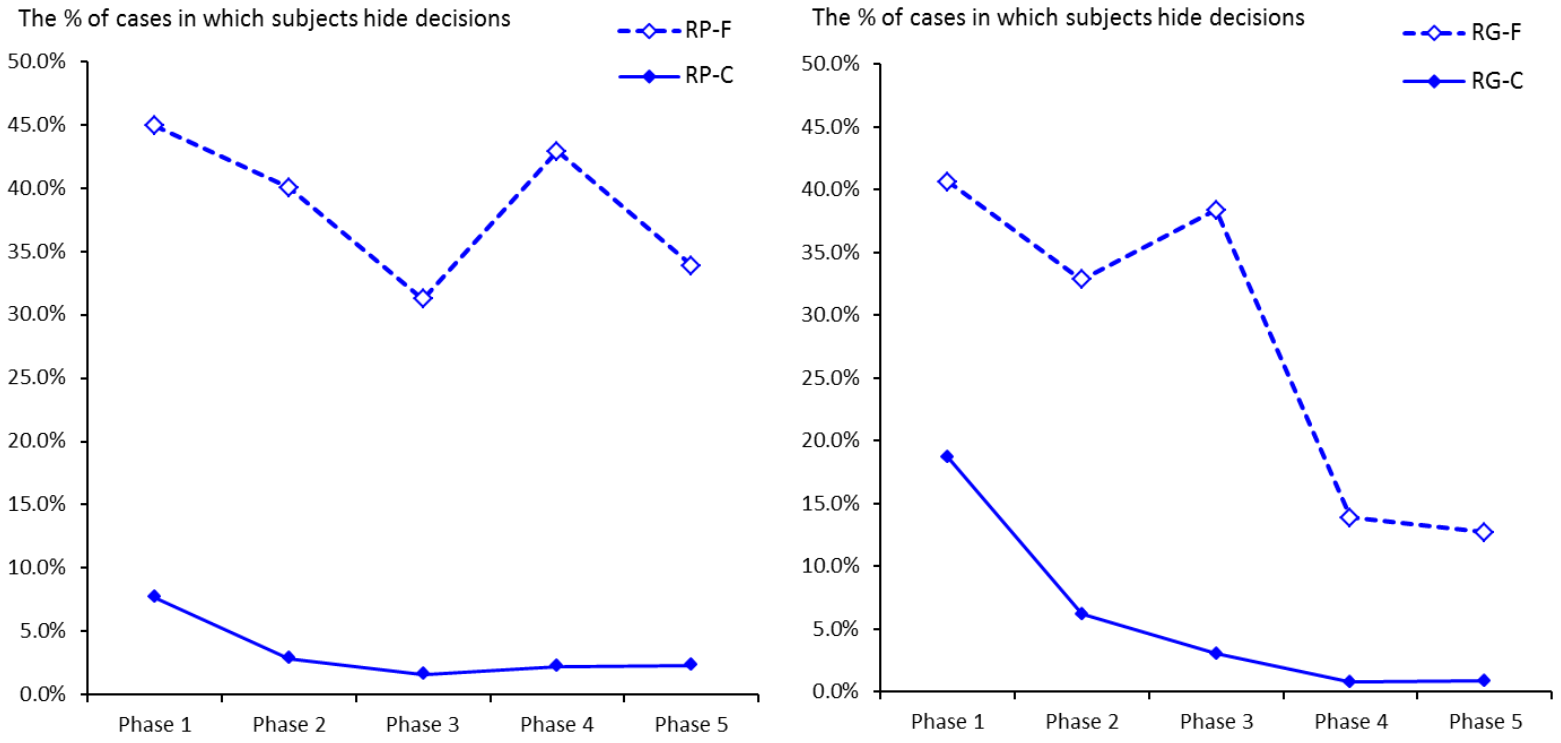
(b) RP-F treatment versus RP-C treatment



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

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

Figure A.3: The Phase-by-Phase Percentages of Cases in which Subjects Hide their IDs by Treatment (supplementing Figure 3 of the manuscript)

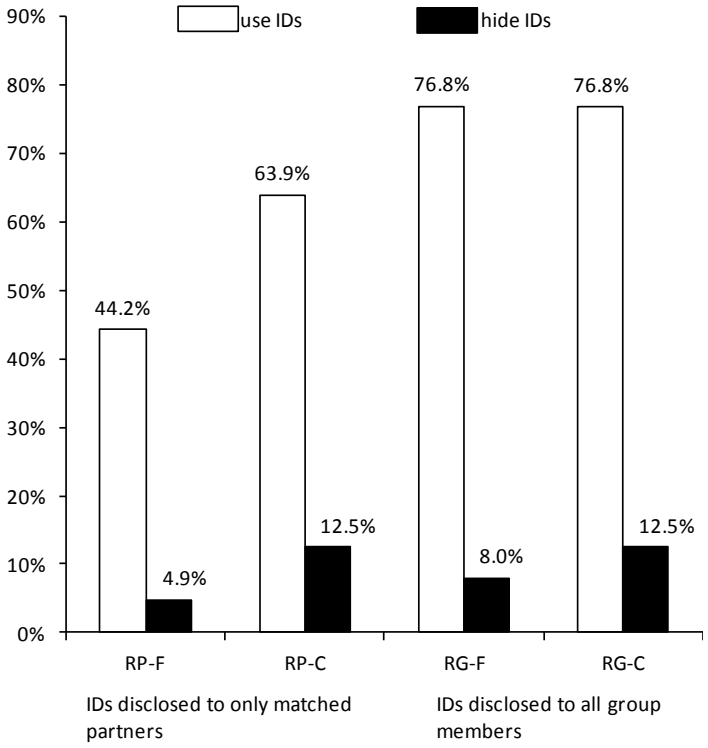


(a) IDs disclosed to only marched persons

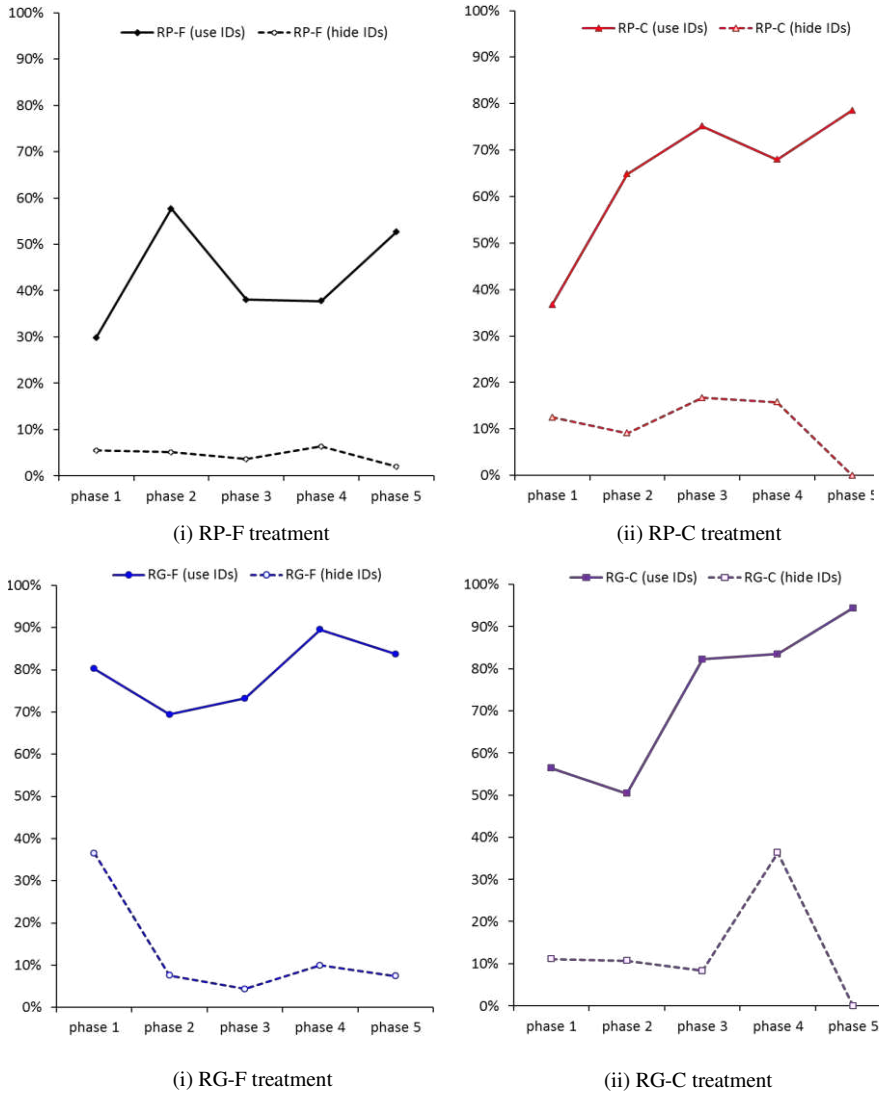
(b) IDs disclosed to all group members

Notes: The percentages of subjects' hiding decisions are calculated by: (the total number of subjects' hiding decisions in a given phase)/(the total number of decisions in a given phase)·100. A phase-by-phase comparison of the percentages between the choice treatments can be found in Appendix Table A.2.

Figure A.4: Average Cooperation Rates by the Use of IDs



(a) Average cooperation rates across all phases[1]



(i) RP-F treatment (ii) RP-C treatment

(i) RG-F treatment (ii) RG-C treatment

(b) Phase-by-phase average cooperation rates[1]

Note: [1] Each number in a given category was calculated as: the number of the subjects' choices of cooperation divided by the total number of decisions.

Table A.1: Test Results concerning Table 2 in the Manuscript

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

- H_0: Variable (i) = Variable (ii)
  Chi-squared = 11.01
  p-value (two-sided) = .0009***

  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) = .7615

  Result: The average cooperation rate in the RP-F treatment is statistically similar to that in the N treatment.

- H_0: Variable (ii) + Variable (v) = 0
  Chi-squared = 3.85
  p-value (two-sided) = .0496**

  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) = .3574

  Result: The average cooperation rate in the RP-C treatment is statistically similar to that in the RP treatment.

- H_0: Variable (v) + Variable (vi) = 0
  Chi-squared = .17
  p-value (two-sided) = .6820

  Result: The average cooperation rate in the RG-C treatment is statistically similar to that in the RG treatment.

(B) Chi-Squared Tests for the coefficient estimates in column (2)

- H_0: Variable (i) = Variable (ii)
  Chi-squared = 7.15
  p-value (two-sided) = .0075***

- H_0: Variable (i) + Variable (iii) = 0
  Chi-squared = 6.89
  p-value (two-sided) = .0087***

- H_0: Variable (ii) + Variable (v) = 0
  Chi-squared = 1.15
  p-value (two-sided) = .2839

- H_0: Variable (iii) + Variable (iv) = 0
  Chi-squared = .13
  p-value (two-sided) = .7164

- H_0: Variable (v) + Variable (vi) = 0
  Chi-squared = 30.39
  p-value (two-sided) = .0000***

- H_0: The Phase Number variable + the Variable (i) × Phase Number variable = 0
  Chi-squared = 23.10
  p-value (two-sided) = .0000***

Result: The average cooperation rate significantly increases over the phases in the RP treatment.

- H_0: The Phase Number variable + the Variable (ii) × Phase Number variable = 0
  Chi-squared = 12.99
  p-value (two-sided) = .0003***

Result: The average cooperation rate significantly increases over the phases in the RG treatment.

Table A.2: Additional Analyses on the Subjects' Decisions about Whether to Use or Hide Their IDs (supplementing Figure 3 of the manuscript and Figure A.3 of the online Appendix)

(1) Testing the Differences in the Subjects' Use/Hide Decisions of their Assigned IDs without versus with a Cost for Hiding

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

Independent Variable	All phases (1)	Phase 1 (2)	Phase 2 (3)	Phase 3 (4)	Phase 4 (5)	Phase 5 (5)
(i) The RG-F dummy {= 1 for the RG-F treatment; 0 otherwise}	.092 (.087)	.13 (.11)	.057 (.12)	.10 (.16)	.20 (.12)	.13 (.11)
(ii) The RP-C dummy {= 1 for the RP-C treatment; 0 otherwise}	.35*** (.081)	.47*** (.097)	.40*** (.11)	.35*** (.10)	.32*** (.12)	.24** (.12)
(iii) The RG-C dummy {= 1 for the RG-C treatment; 0 otherwise}	.35*** (.081)	.35*** (.10)	.36*** (.11)	.32*** (.11)	.33*** (.12)	.25** (.12)
Constant	.62*** (.080)	.47*** (.095)	.56*** (.10)	.64*** (.10)	.66*** (.12)	.74*** (.12)
# of Observations	12736	1280	2576	2512	4016	2352
Wald Chi-squared	75.88	54.74	45.91	16.55	195.62	119.63
Prob > Wald Chi-squared	.0000	.0000	.0000	.0009	.0000	.0000
R-Squared	.1703	.1352	.1500	.1506	.2717	.1255
Chi-squared test results						
H_0: (i) = (iii)						
Chi-squared	51.85	10.24	19.31	3.04	187.21	58.44
Prob > Chi-squared	.0000***	.0014***	.0000***	.0813*	.0000***	.0000***
H_0: (ii) = (iii)						
Chi-squared	.29	8.91	1.68	1.37	1.55	.14
Prob > Chi-squared	.5931	.0028***	.1950	.2410	.2132	.7105

Notes: Random effects linear regressions with robust standard errors clustered by session id. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

(2) The Trends of the Subjects' Decisions to Use their Assigned IDs over the Phases

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; 0 otherwise}	.10 (.11)	.027 (.15)
(ii) The RP-C dummy {= 1 for the RP-C treatment; 0 otherwise}	.35*** (.11)	.53*** (.090)
(iii) The RG-C dummy {= 1 for the RG-C treatment; 0 otherwise}	.34*** (.11)	.47*** (.10)
(iv) Phase Number {= 1, 2, 3, 4, 5}	.052*** (.013)	.066*** (.0073)
(v) Variable (i) × Phase Number	-----	.026 (.022)
(vi) Variable (ii) × Phase Number	-----	-.053*** (.0074)
(vii) Variable (iii) × Phase Number	-----	-.039*** (.014)
Constant	.45*** (.10)	.40*** (.090)
# of Observations R-Squared	12736 .1713	12736 .1708
Chi-squared test results		
H_0: (i) = (iii) Chi-squared Prob > Chi-squared	 24.90 .0000***	 11.53*** .0007
H_0: (ii) = (iii) Chi-squared Prob > Chi-squared	 .49 .4850	 1.15 .2826
H_0: (iv) + (v) = 0 Chi-squared Prob > Chi-squared	 ----- -----	 19.58 .0000***
H_0: (iv) + (vi) = 0 Chi-squared Prob > Chi-squared	 ----- -----	 117.75 .0000***
H_0: (iv) + (vii) = 0 Chi-squared Prob > Chi-squared	 ----- -----	 5.18 .0228***

Notes: Random effects linear regressions with robust standard errors clustered by session id. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

Table A.3: Non-parametric Tests for Equality of the Average Cooperation Rates between Those Who Use their Assigned IDs versus Those Who Hide their Assigned IDs (supplementing Appendix Figure A.4 Panel (a))

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

Step 1: For each subject, compute (i) the average cooperation rate when she uses her assigned ID and (ii) the average cooperation rate when she hides her assigned ID.

Step 2: Perform individual-level Wilcoxon Signed Ranks tests.

Results are summarized as below:

	The RP-F treatment	The RP-C treatment	The RG-F treatment	The RG-C treatment
p-value (two-sided)	.0010*** (25)	.0186** (14)	.0000*** (24)	.0064*** (13)

Notes: The observations of subjects who hid their IDs in all periods and of those who showed their IDs in all periods are excluded in the analyses. The numbers in parenthesis are the numbers of subjects used for the tests. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.

In the manuscript, we also performed a regression analysis by (1) including the Use-ID dummy variable and (2) using the data of all subjects. The results are similar to the non-parametric test results reported here. See Table 3 of the manuscript for the details.

Table A.4: History Information and Cooperation Decisions in the RG-F and RG-C Treatments (supplementing Table 3 of the manuscript)

Dependent Variable: A dummy variable that equals 1 (0) if subject *i* chooses cooperation (defection) to her matched partner in period *t*

Independent Variable	Period within phase = 1 (1)	Period within phase > 1 (2)	Period within phase > 1 (3)
(i) Use-ID dummy {= 1 if subject *i* used her assigned ID in period *t*; 0 otherwise}	.47** (.15)	.34*** (.042)	.41*** (.023)
(ii) Observe-ID dummy {= 1 if the matched partner of subject *i* revealed his assigned ID in period *t*; 0 otherwise}	.14** (.042)	.58*** (.016)	.53*** (.030)
(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*)	----	-.20** (.041)	-.27*** (.015)
(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]	----	-.57*** (.089)	-.28** (.073)
(v) Phase variable {= 1, 2, 3, 4, 5}	.032 (.035)	.023 (.012)	-.0076* (.0032)
(vi) Variable (i) × Costly hiding dummy[#2]	----	----	-.17 (.086)
(vii) Variable (ii) × Costly hiding dummy	----	----	.0034 (.035)
(viii) Variable (iii) × Costly hiding dummy	----	----	.019 (.045)
(ix) Variable (iv) × Costly hiding dummy	----	----	-.36** (.083)
(x) Variable (v) × Costly hiding dummy	----	----	.049** (.013)
Constant	.12 (.077)	-.078** (.020)	-.0043 (.030)
# of Observations	320	5616	5616
R-Squared	.2410	.4869	.5073

Notes: Fixed effects linear regressions with robust standard errors clustered by session id. [#1] The Observe-No-History dummy variable equals 0 in period *t* if the partner of subject *i* revealed his ID to subject *i* at least once before period *t* in the RP-F and RP-C treatments; and if the partner revealed his ID to some member at least once before period *t* in the RG-F and RG-C treatments; 1 otherwise. This variable equals 1 for any periods greater than 1 within phases in the RG treatment. [#2] The Costly hiding dummy equals 1 for the RP-C and RG-C treatments; 0 otherwise. *, **, and *** indicate significance at the .10 level, at the .05 level and at the .01 level, respectively.