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Abstract: This paper conducts a laboratory experiment to investigate the role of social connections in behavioral indirect reciprocity. We provide the evidence of *spillover effects* of social ties, e.g., the recipient's indirect reciprocal act varies with the relations between the donor and a third party. Naturally occurring friendship is employed to study social connections. Thus, a beneficiary might either be a "friend" or a "stranger" of the donor. We demonstrate that knowing social connections significantly increases the recipient's repayment only if the donor is kind enough in the first place. Overall, recipients' indirect reciprocity almost doubles when introducing social networks among donors and beneficiaries. It is also shown that this spillover effect is unlikely the result of recipients' perception of donors' expectations. Major theories of social preferences, e.g., fairness, intention-based, guilt-aversion, cannot offer satisfactory explanations of our findings. We propose an explanation based on in-group and out-group differences but with endogenous group status, in which social connections play a crucial role.

Key words: indirect reciprocity, social connections, spillover, social preferences

JEL codes: C91, D03, D85

1. Introduction

It is well established that individuals usually exhibit reciprocal behavior in bilateral relationships, even in the absence of any contractual requirements or future interactions (Berg et al, 1995; McCabe et al, 1998).[4] As in the standard investment game, this reciprocal tendency, though violates self interests, often improves social welfare. In the real world, the possibility of *directly* reciprocating other's kindness is usually limited, since the high frequency of anonymous interactions makes the donor untraceable. As a consequence, to sustain mutual cooperation in a large group, it is crucial that there exists wide-spread *indirect* reciprocity, i.e., upon receiving other's help, the recipient is willing to return kindness to a third party who didn't help him before. [5]

This paper addresses the role of social connections in indirect reciprocal behavior. Previous studies suggest that since social networks facilitate information sharing or enforce social punishment (Greif, 1994; Kranton, 1996; Greiner and Levatti, 2005; Jackson, 2008), they affect the players' incentives to build up reputations in repeated interactions, consequently promote cooperative behavior. However, social relations might affect indirect reciprocal behavior even in one-shot interactions. We employ an indirect investment game (Dufwenberg et al., 2001; Buchan et al., 2003), which consists of donors, recipients, and beneficiaries, to understand non-strategic indirect reciprocity. Not only could social connections *directly* affect the behavior, e.g., the donor will be nicer to a socially close recipient, but also they *indirectly* influence the recipients' acts toward a third party, e.g., the social relations between the donor and the beneficiary might affect the recipient's behavior toward the latter. Our experiment is used to detect the second aspect, e.g., the *spillover effects* of social connections.

Many real-world examples about the spillover effect of social relations motivate our design: It is common to see people becoming nicer to a stranger if they learn that the stranger is a friend of somebody who happened to help them before. The business partners of a family corporate founder are more willing to help the founder's kin heir than an outsider. The operations of political dynasties in the democracies like Japan, Philippines rely on that voters are willing to elect the heir of the politician who did favor to them before.[6] Although sometime these spillover effects are not one-shot *ex post*, but *ex ante* the repeated interaction might not be the players' expectation. And it is quite likely that the indirect reciprocity itself makes their interaction repeated, or establishes new social networks. Therefore, the analysis about the "start-point" of connections is important as well. [7] We suggest that the value of social connections

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[4] Cox (2004), Ashraf et al (2006) have considered reciprocity as actions conditional on the actions or intentions of others, thus distinguished it from conventional other-regarding preferences (Fehr and Schmidt, 1999, Bolton and Ockenfels, 2000). Assessing the relative strength of these two types of preferences, however, is not our concern.

[5] In Nowak and Sigmund (2005) this is defined as "upstream reciprocity", just one type of indirect reciprocity. However, since we exclusively focus on this kind of indirect reciprocity, we use the general term "indirect reciprocity" to refer to it.

[6] Finan and Schechter (2012) show that social preferences play a role in vote-buying behavior in Paraguay. In particular, the politicians will target on reciprocal individuals. This shows the strategic use of non-strategic motivations in the arena of political competition.

[7] Understanding the meeting process prior to forming links is crucial to generate the network resembling real social networks. Jackson and Rogers (2007) show that a dynamic model of network formation in which nodes

could be greatly enhanced because the more nodes a person connects to, the more he might benefit from the connections' kind behavior.

The presence of spillover effect might be due to that recipients feel obligated to reward a third party connecting with a kind donor. In other words, social ties themselves generate the spillover effect. Alternatively, perhaps recipients perceive that a nice donor hopes him to reward a connected beneficiary, so social ties generate spillover effect since they convey the donors' implicit expectation. To assess these two possible channels, we also examine the role of expressed expectations in indirect reciprocal behavior.

Our laboratory experiment extends the standard investment game to a multilateral setting. In this game, a donor can choose to transfer a certain amount to a recipient, and this amount will be tripled by the experimenter. The recipient then decides how much to repay to a randomly selected beneficiary. We run four treatments: The Direct reciprocity (standard investment game), Baseline, Connection and Message Treatments. The game design in the Baseline Treatment is the same as just described above. In the Connection Treatment, there might exist social ties (friendship) between the donor and the beneficiary, and only the recipient (not the donor) was informed whether the donor and the beneficiary were friends.[8] In the Message Treatment, the donor could send a costly message to the recipient asking for a favorable treatment on the beneficiary.

We observe significant amounts of repayment in all treatments, which suggests considerable non-strategic pure indirect reciprocal behavior. After controlling for the amount of donors' transfer, the Friend Treatment shows the significant impact of social connections on the indirect reciprocal behavior. The recipient will repay more to a beneficiary connected with the donor if the donor's initial transfer is high. This a clear evidence of the positive spillover effect of social ties. Compared with the indirect reciprocal acts in the Baseline treatment, recipients are nicer to the friends of the donor, instead of being worse to the non-friends of the donor. In effect, we find that the Friend Treatment almost doubles B's indirect reciprocity ratio compared to the Baseline. On the other hand, we could not find out any significant effect of sending message in the Message Treatment, suggesting that the donor's expressed expectations plays a relatively minor role in the recipient's indirect reciprocal acts. Therefore, it is unlikely that the observed significant effect of connections is due to recipients' perception of the donor's expectations. Our experimental results thus cast doubts on the role of recipients' belief in indirect reciprocal behavior.

The most prominent existing theories of social preferences, e.g., outcome-based (Fehr and Schmidt, 1999), intention-based (Rabin, 1993, Dufwenberg and Kirchstaiger, 2004), type-based (Levine, 1998) and guilty-aversion (Charness and Dufwenberg), are not be able to provide a convincing explanation of the observed indirect reciprocal behavior. Therefore, by extending Malmendier and Schmidt (2012),

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might form links with friends of friends could result in many features exhibited by large social networks. Our findings also have the potential to provide a micro-foundation for the meeting process in their model, e.g., a friend might have the incentive to introduce her friend to you if she foresees that you will return more kindness to her friend.

[8] In this experiment, we use naturally occurring friendship to represent social connections. It is reasonable to presume that the social distance between friends is shorter than that between non-friends.

we propose an explanation based on in-group favoritism, but with endogenous group formation and transitive social connections. High initial transfer creates social ties between donors and recipients, when the donor and the beneficiary has closer social distance, the kindly treated recipient cares the beneficiary's welfare more, consequently repay more to her. Thus, indirect reciprocity could flow through social connections.

This paper is related to several lines of research. Indirect reciprocity can be motivated by various reasons. The existing literature has primarily focused on strategic incentives, e.g., reputation-building (Alexander, 1987; Nowak and Sigmund, 1998, 2005; Seinen and Schram, 2006). Such strategic motives rely on repeated interaction and information transmission. However, it has been shown that indirect reciprocity exists even in one-shot interactions (Dufwenberg et al., 2001; Engelmann and Fischbacher, 2009). This finding significantly expands the scope for indirect reciprocity to maintain mutual cooperation in large groups, where information transmission is either too noisy or too slow to effectively build up reputation. Among these studies, Dufwenberg et al. (2001), Guth et al. (2001), Buchan et al. (2002) and Stanca (2009) have developed a one-shot four-person investment game, in which two pairs of donor and recipient consist a group. Instead of reciprocating to their own donors, the recipients could only repay to the donor previously not matched with. These papers demonstrate the existence of indirect reciprocity, even in the absence of incentives for strategic reputation building.[9] However, there is no conclusive comparison between the strength of indirect reciprocity and that of direct one. Besides, the intrinsic motivations of indirect reciprocity remain unclear.

Previous studies have found a decrease in perceived social distance increases cooperative behavior in bilateral interactions. A variety of methods are implemented to manipulate the social distance in laboratory, e.g., wording on the instructions (Hoffman et al. 1996; Buchan et al, 2002), revelation of the names of players (Charness and Gneezy, 2008), hypothetic social distances (Buchan and Croson, 2004), naturally occurring friends like Chinese undergraduate classmates (Song et al, 2012), etc.. The most common experimental manipulation employed is *ad hoc* group discussion procedure, in which participants are randomly assigned to different groups to discuss an assigned topic irrelevant to experiments for a short time period (Buchan et al, 2006). These papers demonstrate that the amount of reciprocity declines significantly with respect to the manipulated social distance. Our concept of social connections, however, differs from social distances discussed in the above papers in that the social distance in these papers measure social closeness between donors and recipients, but social connections in our paper reflect social relations between donors and beneficiaries. Therefore, while in the previous works it is difficult to distinguish the role of social distance in investing and returning behavior,[10] our design clearly demonstrates that social relations affect both the target and the amount of indirect reciprocity. In fact, the social distance between donors and recipients remain the same in our experiment.

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[9] Engelmann and Fischbacher (2009) have conducted a repeated helping game similar to Nowak and Sigmund (1998) and Seinen and Schram (2006). By controlling the information feedbacks in the experiment, they provide evidence for pure indirect reciprocity.

[10] In effect, the trust game experiment by Bicchieri et al (2011) shows that there is no difference in agents' beliefs regarding trusting friends and trusting strangers. However, in their experiment it seems that there is a norm of reciprocity conditional on social distances.

Our paper is structured as the follows: Section 2 lays out the experimental design and procedures; Section 3 describes the theoretical predictions; Section 4 presents the experimental results; Section 5 discusses possible explanations for our results, and proposes our explanation based on endogenous group formation. Section 6 concludes.

2. Experimental design and procedures

2.1 Experimental design

The basic design is similar to the investment game but with indirect reward (Dufwenberg et al. 2001, Buchan et al. 2002). There are two groups of subjects: Group A plays the role of donors/beneficiaries (A) and group B plays the role of recipients. Their roles are fixed during the experiment. We have four treatments: the Direct reciprocity treatment (standard investment game) as the control, the Baseline treatment, the Connection Treatment, and the Message Treatment. Here we clarify the latter three treatments.

In the Baseline (Stranger) Treatment, subjects in group A and group B receive an endowment of 30 RMB and 10 RMB, respectively. In stage 1, each subject in group A (A_i) plays the role of donor and decides how much of the 30 RMB she wants to transfer to a randomly and anonymously paired subject in group B (B_i). Any amounts offered X_i are tripled by the experimenter and sent to the paired subject. In stage 2, the recipient B_i will meet a randomly selected anonymous person in group A (A_k). Without knowing A_k's transfer decision in stage 1, B_i decides how to split his total wealth, i.e., the sum of his initial endowment plus the tripled amount he received, between himself and A_k. The amount B_i sent to A_k is denoted by Y_i. We can see that each subject in group A plays both the role of donor in stage 1 and that of beneficiary in stage 2, but paired with different subject B in these two stages. For instance, the beneficiary A_k is paired with B_k in stage 1 and makes transfer X_k, but receives repayment Y_i from another B_i in stage 2, as Figure 1 illustrates.

[Insert Figure 1]

The Connection (Friend) Treatment is similar to the Baseline Treatment, except that in stage 2 B_i will learn whether A_i and A_k are connected (friends) after receiving X_i and before repaying Y_i. However, it is public information that none of the subjects in group A knows the connections. Figure 2 illustrates the design.

[Insert Figure 2]

The Messages Treatment differs from the Baseline Treatment in that after A_i makes a transfer in stage 1, she has the option to send a structured message to B_i with the content "Please be kind to A_k". The message will cost A_i 1 RMB. A_k doesn't know whether B_i receives a message. Figure 3 illustrates the design.

[Insert Figure 3]

To collect enough data with reasonable cost, and to address the potential problem that agents may need some experience to actually understand the game (Charness and Kuhn, 2010), in each treatment the subjects play the same game six times with different counterparties. We make sure (the subjects also knew it) that no subject

could be re-matched with the same subject at a later point in the experiment. To avoid potential learning effects and strategic reputation-building, the amount Y_i was never revealed to A_i and A_k, and so there was no feedback on group A's payoff during the experiment.

2.2 Experimental procedures

The experiment sessions were conducted in Southwestern University of Finance and Economics (SWUFE), China, in 2012. A total of 120 individuals participated in the four treatments. Sessions took about one hour.

Half of the subjects were recruited from two students clubs (henceforth club members), with 30 coming from the chorus club and the others from the orchestra club. Subjects in the same club knew each other well and were naturally occurring friends.[11] In each treatment, clubs members were assigned to group A, corresponding to the role of "donors/beneficiaries". The remaining subjects (henceforth non-club participants) were recruited by posting notices on campus intranet discussion board and had "recipients" designation (group B) in each treatment. Most participants were undergraduates at SWUFE. Most of them have taken introductory economics, but no one has prior experience with an investment game. To control the possible information leaking among participants in different treatments, we ran four sessions simultaneously, each corresponding to one treatment.

We recruit naturally occurring connected subjects to form group A mainly because of building up reliable connections for the Connection Treatment. As Buchan et al. (2006) demonstrate, a laboratory group formation manipulation might not be applicable for Chinese subjects, because of the collectivist cultural inclination. Therefore, bringing naturally occurring social relations to the laboratory is more convincing in our setting.

The experimental sessions were run manually. For each treatment, club members and non-club participants were equally allocated to the group A and group B rooms, respectively, with each club contributing the same number of participants in the group A room. To implement the Connection Treatment, on the outset of the session we put all club members and non-club participants in one single room. The non-club participants were seated in the middle of the classroom, and the members of the two clubs were seated in the two sides of the room, respectively. To make it more credible that the connection is not the outcome of laboratory manipulation, a randomly chosen member from each club said "Hello, we are from the university chorus (orchestra) club" to the non-club participants on behalf of his/her club.

In each room A and room B, subjects were randomly assigned an identification number and sat in the assigned place. They received a specific instruction that illustrated the game with figures and numerical examples. Participants were asked to complete a short quiz to make sure that they completely understood the game.

[11] After discussion with the instructors of the clubs and the members, we confirm that there are many regular group activities within each club, hence we could infer that they are both quite cohesive and form close ties. Besides, their group identities are quite similar (both are music clubs) in front of the outsiders. The demographic characteristics of these two clubs are also similar.

The experiment formally began at that point. We first describe the procedure of the Baseline Treatment. Experimenters used decision record forms and envelops to communicate role A's and B's decisions to each other in a double-blind procedure. Each subject in role A first played the role of donor and wrote down his/her transfer to B in the decision record form and put this into an envelope. Experimenters then collected the envelopes and delivered them to the experimenters in the room of role B who tripled the amounts transferred, placed the forms back into the envelopes, and distributed the envelops to the matched subjects in role B. To facilitate implementing the experiment, with a little abuse of terminology, in each round the subjects were informed about the "group" they belonged to. Each "group" consists of a donor (A_i), a reciprocator (B), and a beneficiary (A_k). The labeled number of "group" varied across rounds. And the subjects were assigned to different "groups" in different rounds. The number of group is written on the decision record form.

Upon receiving transfers, each subject in the role B wrote down his/her decision on the repayment in the form, and put the form into the envelop again. Experimenters then collected the envelopes and gave them to the research assistant in the control room who recorded all the decisions by participant identification number in isolation.

In the Connection Treatment, after the recipient received the decision record form from the paired donor, he/she was informed privately by the experimenter about whether the donor and the beneficiary were "friends", but not about which club they were from. To send a message in the Messages Treatment, in the room of role A, two additional notes were distributed to each donor after they completed the decision record forms. One note was blank, and the other was written with the sentence "Please be kind to A_k ". The donor decided which note to be delivered to the recipient together with the decision record form in the sealed envelope.

At the end of the experiment, subjects were asked to complete a short post-experiment questionnaire for their demographic information. After completing the questionnaire, a random round was chosen to calculate their final payment. Participants were paid with a sealed envelope which contained the cash. Including the 25 RMB show-up fee, each subject earned on average 50 RMB (about 8 USD). This is higher than the average wage of 25 RMB an hour for jobs on this campus.

3. Theoretical predictions

Our analysis focuses on the reciprocating behavior of the recipient. We outline predictions of related theories on B's behavior.

Standard *homo economicus* theory, which assumes that all individuals are only concerned about personal payoffs, predicts that the recipient should repay zero to the beneficiary. Besides, complete anonymity guarantees that there is no reputation concern.[12] This could serve as our benchmark hypothesis.

[12] Some subjects may have the strategic motivations in interactions, such as encouraging the donor (recipient) to transfer (repay) in the future, or group reputation concerns even in the absence of disclosure of group identity. But it should be limited because relative to the size of the group, the behavior of a single subject has limited influence. We also do not observe any decline of reciprocating behavior, indicating no evidence for this motivation as a major force.

Selfishness hypothesis: the amount of repayment, Y_i , will be zero for all transfers in all treatments.

The selfishness hypothesis is often violated in the standard investment game as recipients will return a significant amount of money to donors. There are many theories of reciprocity in the bilateral setting, and some of them can be naturally extended to the case of non-strategic indirect reciprocity. In this paper, we also would like to test whether the recipient cares about fair outcome as prescribed in outcome-based social preferences (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002), whether the selfish or altruistic type of the third party is important (Levine, 1998; Strassmair, 2009; Gul and Pesendorfer, 2010), and whether the recipient wants to avoid disappointing the donor (Charness and Dufwenberg, 2006). Rabin (1993), Dufwenberg and Kirchsteiger (2004) develop the models of intention-based reciprocity, based on the premise that people like to return those who help them and punish those who hurt them. However, it is not immediately clear how to formally apply these models to our setting, because by definition the beneficiary does not take any action that affects the payoff of the recipient, so there is no intention to be revealed. In effect, if we insist on theories of intention-based reciprocity, then the derived theoretical predictions would be the same as the selfishness hypothesis that the repayment would be zero.

Outcome-based social preferences assume that individuals are altruistic and care about fairness in various forms, e.g., the equity of final payoff distributions, social welfare. This motivation may affect the level of Y_i because as A_i gave more to B_i, the payoff distribution is more uneven, and this inequality may motivate B_i to transfer more. However, this theory does not predict any significant impact of social connections, because they do not directly affect the payoff distribution. This theory may predict more transfer by B_i when a message is sent, since a costly message would change the payoff distribution. But, the change should be marginal since it only costs A_i 1 RMB.

Outcome-based social preferences hypothesis: the amount of repayment, Y_i, does not vary with social connections but may increase marginally with messages.

There are abundant experimental evidence that expressed preferences might affect reciprocating behavior (Charness and Rabin, 2005; Ellingsen and Johannesson, 2004). Charness and Dufwenberg (2006) stress that people may exhibit *guilt aversion*, i.e., people strive to live up to others' (selfish or not) expectations so as to avoid guilt. In our setting, the recipient might respond to the expectation of donors or beneficiaries. However, only in the Message Treatment the donor has the opportunity to directly express her hope. Thus, if a message is delivered to the recipient, he forms the belief that the donor expects him to repay more to the beneficiary. Consequently, he will repay more to the beneficiary. In the Connection Treatment, since A_i did not learn about her social relations with A_k, there should be no difference in A_i's expressed expectations between this treatment and the Baseline Treatment, so there is no reason for the recipient to repay more.

Guilt aversion hypothesis: the amount of repayment, Y_i, will be higher if the donor sends a message but will not vary in other treatments.

Type-based reciprocity (Levine 1998) assumes that people are either selfish or altruistic. Selfish type always cares about self interest, and altruistic type also cares

about others' welfare conditioning on other people being altruistic as well. If A_i gives a large amount to B_i, then it is a clear signal of altruistic type. Similarly, sending a costly message asking for a favor to A_k is also a strong signal of A_i's altruistic type. However, these signals do not directly reveal A_k's type and so Y_i should not depend on these factors.

Most researchers in social and economic networks view social ties as the structure in which players interact with each other (Jackson, 2008). However, in the view of some sociologists, social ties might serve as a device to signaling unobserved characteristics (Podolny, 1993). The status in a social hierarchy may flow through social ties, in the sense that a player's ties to higher-status actors enhance the others' perception of her prestige. In our setup, this logic would imply that recipients might perceive that a friend of a nice person is more likely a kind guy. Therefore, if we make a further assumption that connected people are more likely to be of the same type, e.g., recipients treat the payoff of a group of friends as a whole,[13] then we might obtain an extended type-based reciprocity hypothesis that predicts that Y_i depends on social connections.

Type-based hypothesis: the amount of repayment, Y_i, does not vary with social connections and messages.

Extended Type-based hypothesis: If we assume that connected people are more likely to be of the same type, then Y_i will be higher if X_i is large and A_i and A_k are friends.

4. Results

Figure 4 graphs the player A_i's transfer and B_i's repayment across the four treatments. It is straightforward to observe a monotonic relationship in all treatments: the more the player A_i transferred, the more the player B_i was likely to send back. In the treatments of indirect reciprocity, there are about 17%, 20% and 15% of the observed A's transfer equalizing zero under the Baseline, Connection, and Message treatments, respectively. Conditioning on receiving a positive transfer from A, about 16%, 19% and 21% of the observed B's repayment were zero under the three treatments. These results suggest roughly the percentage of pure selfish behavior in our observations. There are two players in the Baseline Treatment and one player in the Connection Treatment who consistently gave 30 RMB, which was their entire endowment. We delete them due to the consideration of outliers. We can infer from Figure 4:

Result 1. A significant number of subjects exhibit pure indirect reciprocal behavior.

Figure 5 and Figure 6 illustrate player A_i's and player B_i's average transfer by round for the four treatments, respectively. In general, there is no clear trend across

[13] Maximiano et al. (2013) study indirect reciprocity in a gift-exchange experiment. Their focus is whether the separation of firm owners (beneficiaries) and managers (donors) affects the worker's effort contribution. Their results support the hypothesis that workers treat the firm as a whole, thus ignore that the manager's payoff is independent of the reciprocal behavior. However, in their work this hypothesis is derived from the fact that the owner is the one who affords the cost of gift, thus, it might be natural that workers consider the owner as a donor.

rounds, suggesting that our random re-matching and anonymous interaction might successfully prevent learning effects. In Figure 5, we see that player A_i's transfer is on average significantly higher under the Direct reciprocity Treatment than in the other three treatments, indicating more trust in bilateral interactions. However, in Figure 6 we do not see such a big difference in terms of player B_i's repayment.

Figure 7 further summarizes the amount of player B_i's repayment across treatments and situations. We see that the average A_i transfer is 12.4 in the Direct reciprocity Treatment, 5.6 in the Baseline Treatment, 4.9 in the Connection Treatment, and 5.2 in the Message Treatment. The corresponding average B_i repayment is 8, 3.4, 6.7 and 3.1, respectively. Thus, the reciprocity ratio in the Connections Treatment is significantly higher than that in other treatments. The important message comes from Figure 8. It is shown that if A_i and A_k were friends, the average repayment is 8.7, significantly higher than the average repayment under the treatment. Given that A_i and A_k were friends, we further divide the sample by whether A_i's transfer is higher or lower than 5, the median of all observed A's transfer. We observe that when A_i transferred high, B_i's average repayment was as high as 16.5, whereas provided with low A_i transfer B_i on average reciprocated only about 5, slightly lower than the situation that A_i and A_k were not friends. The amount of B_i's repayment is slightly higher if A_i sent a message, and this increase occurs mostly when A_i gave high transfer. Overall, we observe a strong connection effect and a weak message effect.

We first examine the connection effect in more details. Table 1 reports the results of panel data analysis using observations from the Connection Treatment only. The dependent variable is B_i's repayment, and the independent variables include A_i's transfer, a dummy variable "Friend" indicating that A_i and A_k were friends, and the interaction term between these two. Whether controlling for the possible nonlinearity in the transfer-repayment relationship does not affect our treatment effect.

Consistent with the Result 1, across all columns we observe a significantly positive effect of A_i's transfer. For every unit increase in A_i's transfer, B_i's repayment increases by about 0.9 unit in Column (1)--(3) and 0.6 in Column (4), significantly different from zero at the 95% confidence level. In Column (1) we only add A_i's transfer and the Friend dummy. However, we do not observe that B_i's repayment was higher if A_i and A_k were friends. This result remains even after we control for the round dummy and the subject dummy in Column (2) and (3). [14]

Overall we do not observe any significant effects of simply being friends. However, when we add the two-way interaction term between A_i's transfer and the Friend dummy in Column (4), we obtain a significant interaction term. The coefficient of 0.623 on this two-way interaction term implies that a beneficiary, who was also a friend of the donor, received 0.62 RMB more repayment from the recipient for every one more RMB initial transfer. Based on Table 1, we make the crucial observation:

Result 2. If a donor has transferred more to a recipient, the latter will repay more to a beneficiary who is a friend of the donor than to the one who is a stranger.

[14] Therefore, we could preclude the possible demand effect, which predicts that Bi would have reacted to the information of being friends from the experimenters by increasing repayments.

This suggests that the impact of social ties crucially depends on whether the donor has released enough kindness. The more A_i gave, the more likely that B_i will reciprocate to A_i's friend. In fact, when A_i gave only a very small amount, being friends even decreases B_i's giving by 2.433, although this negative spillover effect is not statistically significant. Result 2 establishes the strong positive spillover effect of social ties.

Now we turn to examine the effect of messages. Table 2 reports the estimation result of a regression that is similar to the one reported in Table 1, but uses observations from the Message Treatment only and includes the dummy variable "Message" to represent whether a message was received. In this treatment, about 46% of the subjects chose to send a structured message despite its cost.

We again observe the significantly positive impact of A_i's transfer on B_i's repayment, but the magnitude of the impact is slightly smaller than that in the Connection Treatment. Surprisingly, the fact that A_i sent a costly message, which requests B_i for a favorable treatment on A_k, does not produce any significant effects on B's repayment. Although the coefficients on the variable Message and the two-way interaction term between Message and A_i's transfer are both positive, these coefficients are not significant at all. Considering Table 2 and Figure 8, we observe:

Result 3. Receiving binary messages does not have any significant effects on the reciprocal acts.

We would like to compare outcomes in the Connection and the Message Treatments to the Baseline. Simply having the opportunity to learn about the friendship status and send a message might potentially change player A_i's and B_i's behavior. For instance, learning that A_i and A_k are not friends could be quite different from knowing nothing about the connections between them. While the former signals social relations, the latter situation is neutral. The fact that A_i did not send a message when she has the opportunity may signal to B about A_i's type, but not allowing A_i to communicate does not reveal this.

Table 3 reports the econometric analysis result. In this regression, we cannot control for the subject dummy because we have different subjects across different treatments. The subject dummy and any treatment effects cannot be separately indentified.

Column (1) and (2) of Table 3 includes observations from the Connection Treatment and the Baseline, whereas Column (3) and (4) compare the Message Treatment to the Baseline. To avoid being driven by outliers, we drops observations related to those A_i who transferred her entire wealth. In addition to the Friend and Message dummy variables, we include the other two dummies "Friend Treatment" and "Message Treatment" to indicate that the observation is from the corresponding treatment.

Result 4: Social connections induce recipients to repay more to a friend of a donor. There is no evidence that recipients discriminate against a "stranger" beneficiary in the Connection Treatment.

Column (1) suggests that B's repayment in the Connection Treatment is significantly higher than that in the Baseline, after controlling for A_i's initial transfer.

When we additionally add the Friend dummy in Column (2), the significant coefficient of this dummy suggests that compared to the Baseline Treatment, knowing that A_i and A_k are friends significantly increases B's transfer by 2.557 RMB. However, knowing they are not friends does not generate a different result from the Baseline Treatment, as indicated by the insignificant coefficient of the "Friend Treatment" dummy. Combine the results with Figure 8, it implies that the observed significant impact of social relations in the Connection Treatment is mainly driven by that recipients are inclined to be nicer to a friend of a kind donor. However, recipients do not discriminate against a "stranger" of a donor. Actually, as Figure 7 demonstrates, we find that the Friend Treatment almost doubles B's indirect reciprocity ratio compared to the Baseline. Therefore, there is no evidence that introducing social networks in a "society" benefits the connected persons, on the expense of the welfare of the strangers.

Similarly, in Column (3) and Column (4) we also do not observe significant differences of the Message Treatment from the Baseline Treatment, either in terms of the average transfer level or whether there was a message sent. This is consistent with Result 3.

5. Discussions

Our econometric analysis demonstrates the significant impact of social connections. The magnitude of the indirect impact of connections on recipients' reciprocal behavior crucially depends on donors' transfer in the first place. Higher A_i's initial transfer leads to stronger spillover effects of connections. However, the effect of message is not significant and does not vary with A_i's transfer. We also have the robust finding that A_i's transfer significantly increases B_i's transfer in all treatments. These results provide some evidence to understand the motivations of indirect reciprocal behavior.

The fact that A_i's transfer is strongly correlated with B_i's repayment under all treatments makes it clear that the recipient's reciprocal acts can be extended to an anonymous third party who didn't help him before. Therefore, the selfishness hypothesis is rejected. On the other hand, outcome-based social preferences can explain this monotonic transfer-repayment relationship pretty well, because higher X_i makes the payoff distribution more unequal. However, this theory cannot explain the significant impact of friendship status between A_i and A_k, because this has no impacts on the player's outcome distribution.[15] Besides, this theory also makes the prediction that messages have marginal positive effects on repayment, which is not supported in our results. Therefore, the outcome-based social preferences hypothesis is not fully supported.

[15] Noteworthy, Cox et al (2007) developed a tractable model which incorporates the emotional state. In their model, when treated nicely by another, the agent's emotional state becomes positive and he gains utility from the other's payoffs, and vice versa. This could explain the positive correlation between transfers and repayments, but could not shed lights on the role of social connections. As a complementary, our findings might suggest that the target of the influences of the emotional state is based on certain social networks. Beneficiaries of closer social distance to the donor are more likely to be affected by the emotion state of the recipient.

Guilt aversion model has the potential to explain the significant effects of social connections. Noteworthy, if we assume that there is a social norm that expects the recipient to repay more to friends of kind donors, this expectation as well as recipients' beliefs of this expectation might affect indirect reciprocal acts. However, this explanation implies that even the implicit expectation derived from contextual social norms matters. If it is the case, donors' costly expressed expectations would have been more salient as expected. Our Message Treatment thus provides a setting to test guilt aversion hypothesis. Though we didn't directly elicit the players' first-order and second-order beliefs, sending a costly structured message clearly indicates the donor's expectations in our setting. However, the coefficient of the "Message" dummy is insignificantly different from zero. Hence, the guilt-aversion hypothesis receives limited support from our data. This also casts doubts on the role of guilt aversion in the situation of indirect interactions. [16]

The original version of type-based hypothesis suggests that the reciprocal behavior is affected by whether the other party is of altruistic or selfish type. Thus, it predicts that repayments will be the same across all treatments, since the beneficiaries have no chance to signal their types. This is not supported by our results. But, the extended type-based hypothesis that assumes that members of the same club tend to have the same selfish or altruistic type is consistent with the significant impact of social relations.

However, the consistency of our results and the theoretical predictions doesn't lead to the full confidence in this hypothesis. Clearly, we need to test whether the conjectured channel is valid before accepting the reasoning. We would like to know whether there is any significant difference in the within and between-group correlations of donors/beneficiaries' actual transfer behavior. We run a one-way analysis-of-variance on X_i across two clubs in the Connection Treatment. The calculated between-group mean squared error is 1.2, while the within-group mean squared error is 66.2. Hence, most of the variation of X_i comes from the within-group difference. Even though it is possible that subjects in the role of recipient might perceive that the friendship status signals the similar type, there is no evidence that members of the same club acted as if they were of the same type. Therefore, we think that neither version of type-based hypothesis can provide a convincing explanation of the strong effect of social connections.

The most prominent models of reciprocity in bilateral interactions, including intention-based, guilt-aversion, and type-based, all rely on modeling the agent's belief system, e.g., whether the second mover believes in the first mover's good intention, kind type, or avoids her disappointment. But our experimental results suggest that this approach could not be naturally extended to the context of multilateral interaction, belief system might play a minor role in indirect reciprocal behavior.

The most salient observations from our experiment are that social connections between the donor and the beneficiary have significant positive spillover effects on indirect reciprocal behavior. Unfortunately, none of the prominent theories of social preferences can provide satisfactory explanation. Recently, Malmendier and Schmidt

[16] Ellingsen et al. (2010) investigated guilt aversion in bilateral interactions controlling for consensus effects, and concluded that guilt aversion appears to play a relatively minor role in their experiments. Charness and Dufwenberg (2010) suggest that only the free-form communication might affect the beliefs of the players.

(2012) propose a theoretical model to explain the reciprocal behavior in the presence of negative externalities. Following the ideas in the anthropological and sociological literature where reciprocity is an internalized social norm,[17] they extend standard outcome-based social preferences by endogenizing the reference group. Decision maker is assumed to care about the weighted sum of one's own consumption utility and others' utilities, but the weights attached to others' welfare are conditional on people's actions. If their actions are "nicer" than expected, then the weights attached to their welfare are also higher.

Our preferred explanation is an extension of their idea of endogenous reference group. We assume conditional outcome-based altruism, in which conditional on the others' previous actions, decision maker derives utilities from increasing the others' welfare. In our set-up, we assume that these welfare weights are monotonically related to the degree of social connections. Social connections should have two important features: First, social connections can be endogenous to actions such as gift giving. In our setting, an unexpected large amount of A_i's giving strengthens the social ties between A_i and B_i. Second, social connections have the property of transitivity. In other words, if A_i is socially close to B_i, and A_i socially close to A_k, then B_i feels socially close to A_k. This transitivity creates a sense of in-group and out-group bias based on social networks. The donor's large transfer increases the level of recipients' intrinsic care about donors. Knowing the donor and the beneficiary were friends, the recipient raises his care about beneficiaries as well. As a result, recipients are more willing to repay to the beneficiary. Literally, friends of friends are also my friends.

6. Conclusion

In this paper, we have conducted a laboratory experiment to examine the behavioral motivations underlying indirect reciprocity. In our experimental one-shot indirect investment game, the donor and the beneficiary are not the same person, the social connections between the donor and the beneficiary might vary, and the donor might have the opportunity to send a message to the recipient to express her expectations. We introduce real social relations in our experiment by using naturally occurring friends to proxy different degree of social distance.

We provide clear evidence for the existence of pure indirect reciprocal behavior. Moreover, we show that social connections have spillover effects in that they significantly affect recipients' reciprocal behavior. However, they operate in a conditional way in that close social ties pays off only if the donor has been kind to the recipient. This doesn't sacrifice the welfare of the unconnected people. On the other hand, expressed expectations play a relatively minor role in affecting the reciprocal acts in our experiment. This undermines the role of belief system, which is the driving force in most prominent theories of reciprocity, in explaining indirect reciprocal behavior.

We derive hypothesis from competing models of social preferences, including outcome-based theories, intentions-based theories, guilt-aversion theories, and type-based theories. However, it is shown that none of them succeeds in providing

[17] See the footnote 25 and 26 of their paper for the references in anthropology, sociology, and economics.

satisfactory explanations. Therefore, based on the idea of conditional altruism in Malmendier and Schmidt (2012), we propose an explanation based on in-group and out-group differences of social preferences, but with the group formation endogenously determined by initial transfers, and group status flows along social ties.

Most human interactions are embedded into certain social networks, and there is a large body of literature investigating the role of social ties in economic interactions. Our results suggest that, in addition to facilitating information transmission, punishment enforcement, risk sharing, etc., social connections play an important role in determining the target and strength of reciprocal behavior. Thus, an implication of our work is that social ties significantly expand the scope of reciprocal acts even in the absence of any strategic incentives, consequently facilitate sustaining mutual cooperation in a large group.

In our experiment, we only examine a certain type of naturally occurring social relations: club membership. It would be interesting to learn the impact of different types of social ties. We use naturally occurring friendship to overcome the failure of commonly used group formation procedure in China due to the collectivist cultural inclination (Buchan et al, 2006). To what extent the culture contributes to the significant role of social ties in reciprocal behavior still waits for future research.

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Table 1 Friend Treatment

Dependent Variable: B_i's Transfer				
Independent Variable	(1)	(2)	(3)	(4)
A_i's transfer	0.884***	0.908***	0.904***	0.572**
	[0.216]	[0.214]	[0.184]	[0.225]
Friend	2.307	2.061	0.688	-2.433
	[1.823]	[1.799]	[1.328]	[1.854]
Friend*A_i's transfer				0.623**
				[0.285]
Constant	1.466	0.916	-4.945***	-3.638**
	[1.384]	[2.033]	[1.583]	[1.509]
Round dummy		√	√	√
Subject dummy			√	√
Adjusted R-squared	0.272	0.306	0.761	0.787
Observations	78	78	78	78

Note: Robust standard errors are reported in parentheses with *** p<0.01, ** p<0.05, * p<0.1.

Table 2 Message Treatment

Dependent Variable: B_i's Transfer				
Independent Variable	(1)	(2)	(3)	(4)
A_i's transfer	0.251**	0.251**	0.188*	0.135
	[0.109]	[0.103]	[0.094]	[0.112]
Message	0.424	0.429	0.219	-0.283
	[0.769]	[0.774]	[0.732]	[1.139]
Message*A_i's transfer				0.096
				[0.204]
Constant	1.632**	1.274	0.589	0.987
	[0.790]	[1.010]	[1.256]	[1.243]
Round dummy		√	√	√
Subject dummy			√	√
Adjusted R-squared	0.099	0.168	0.445	0.581
Observations	84	84	84	84

Note: Robust standard errors are reported in parentheses with *** p<0.01, ** p<0.05, * p<0.1.

Table 3 Compare the Friend and the Message Treatment to the Baseline

Dependent Variable: B_i's Transfer				
Independent Variable	(1)	(2)	(3)	(4)
Ai's transfer	0.626***	0.616***	0.385***	0.383***
	(0.148)	(0.147)	(0.108)	(0.108)
Friend Treatment	3.557*	2.535		
	(1.778)	(1.674)		
Friend		2.557*		
		(1.316)		
Message Treatment			-0.255	-0.454
			(0.903)	(1.120)
Message				0.426
				(1.078)
Constant	-1.264	-1.105	0.505	0.481
	(1.297)	(1.286)	(0.936)	(0.937)
Round dummy	√	√	√	√
Adjusted R-squared	0.284	0.298	0.221	0.222
Observations	172	172	178	178

Note: Standard errors clustered by subjects are reported in parentheses with *** p<0.01, ** p<0.05, * p<0.1. We cannot control for subject dummy in these regressions because different treatments consist of different subjects, and so the treatment effect is not identifiable if we control for subject dummy.

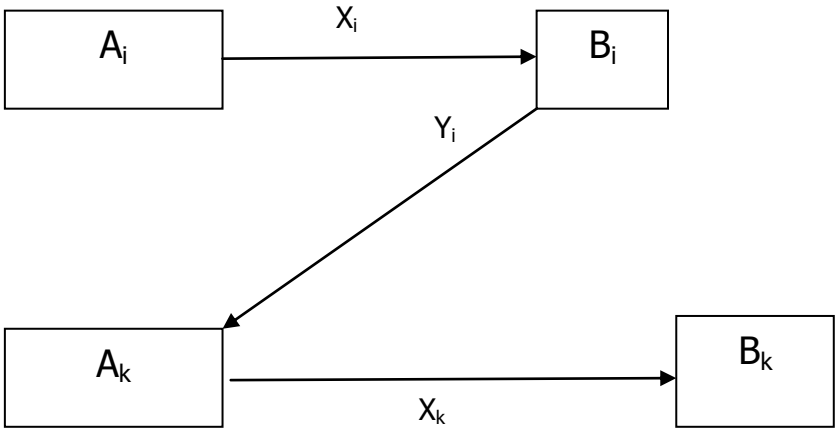

Figure 1: Design of the Baseline Treatment

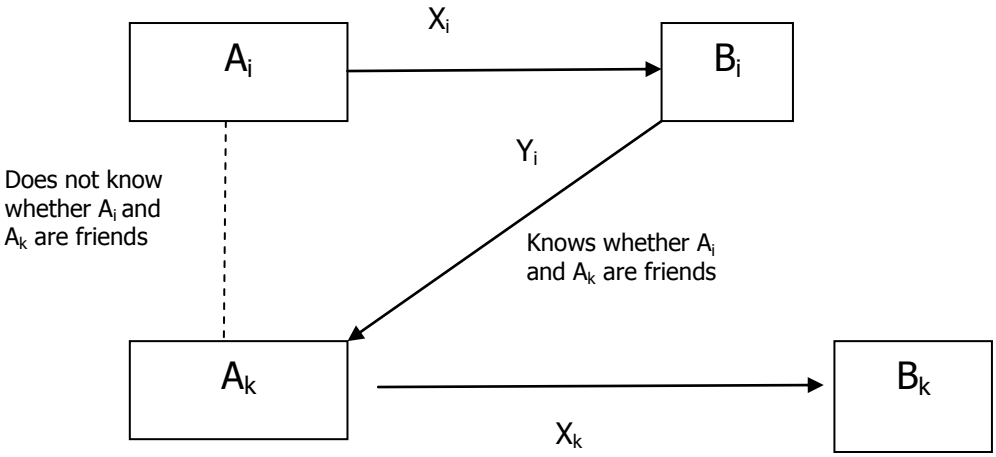

Figure 2: Design of the Connection Treatment

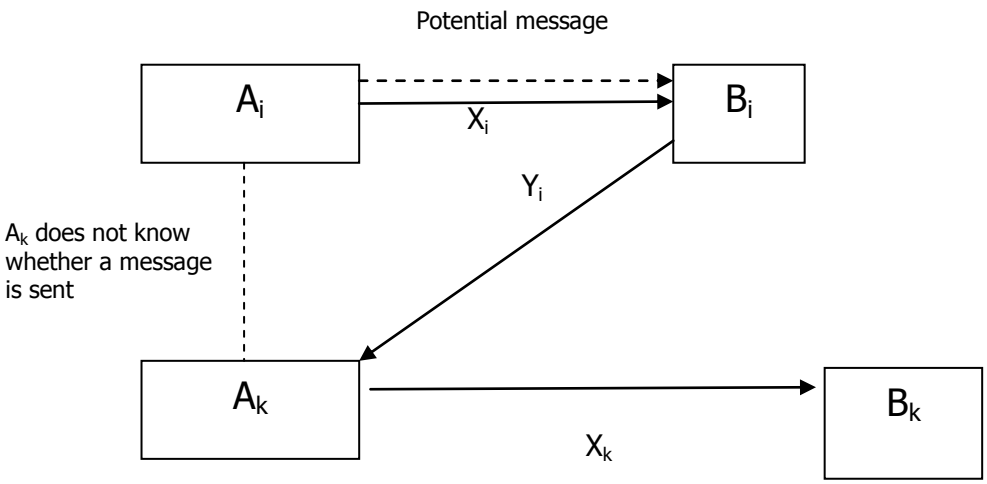

Figure 3: Design of the Message Treatment

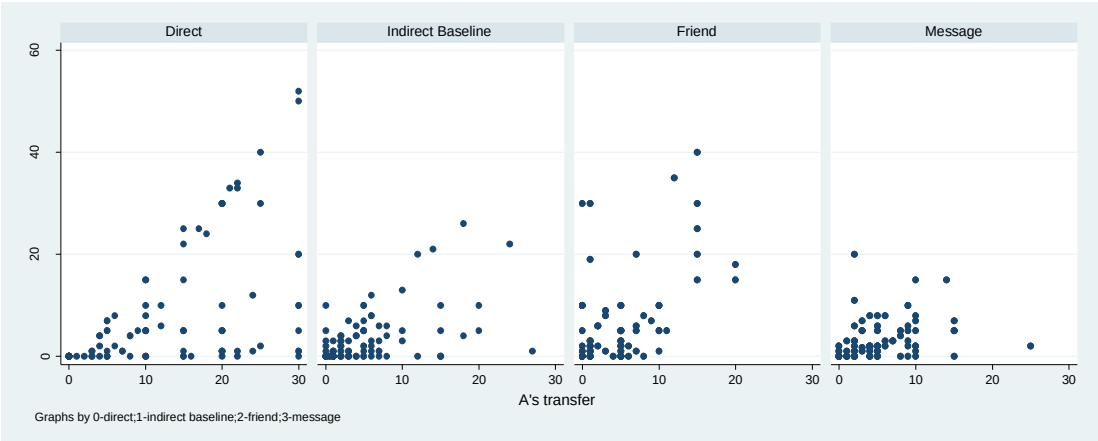

Figure 4: Player A_i's and B_i's Transfer Summary

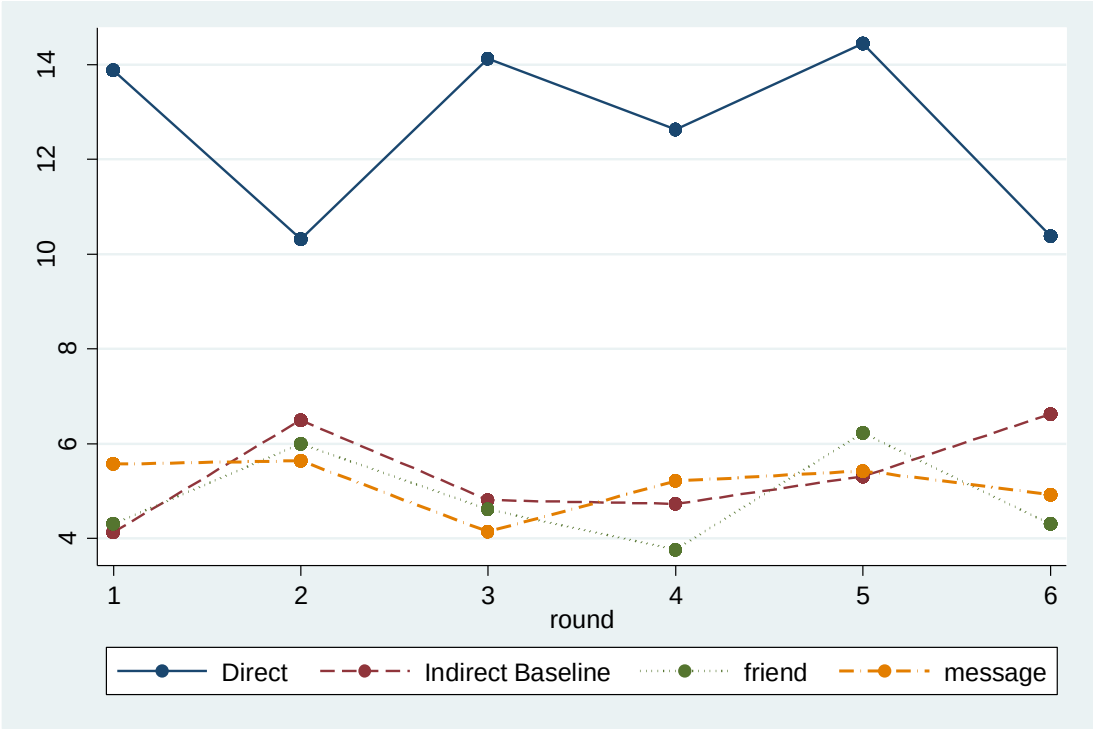

Figure 5: Player A_i's Average Transfer by Round

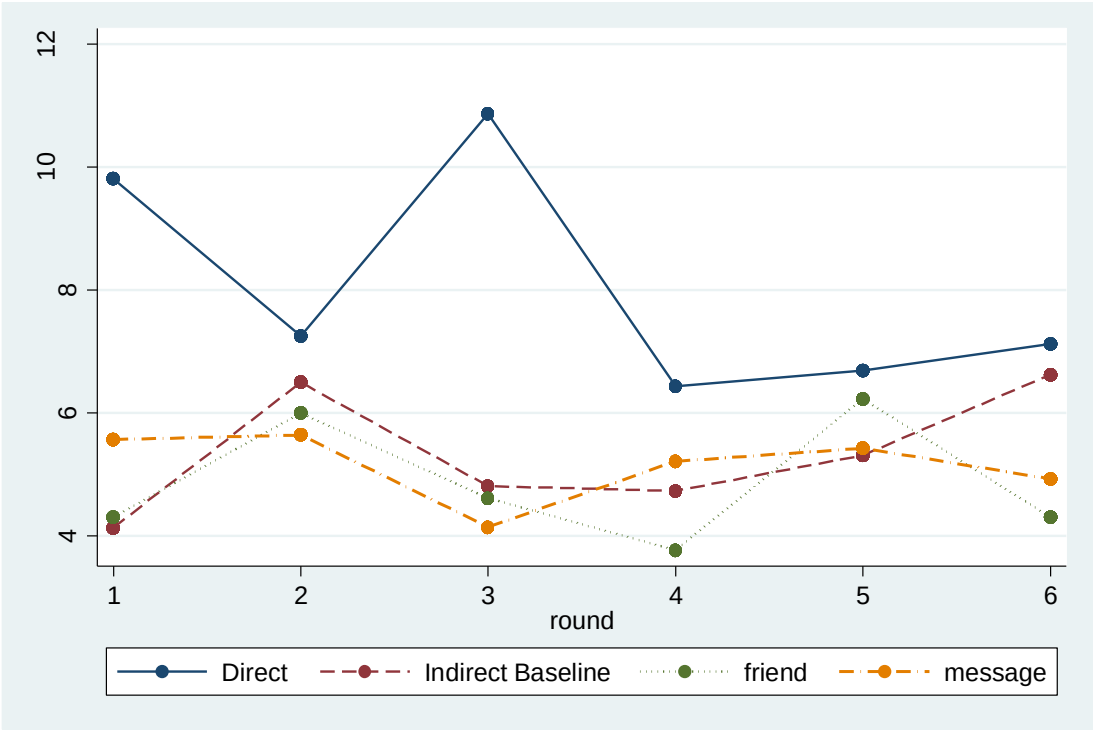

Figure 6: Player B_i's Average Transfer by Round

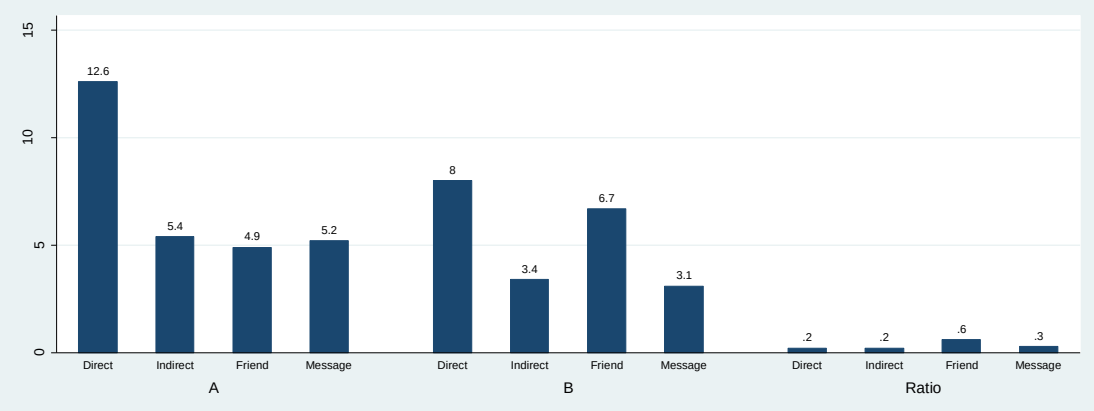

Figure 7: The Average A_i 's and B_i's Average Transfer by Treatment

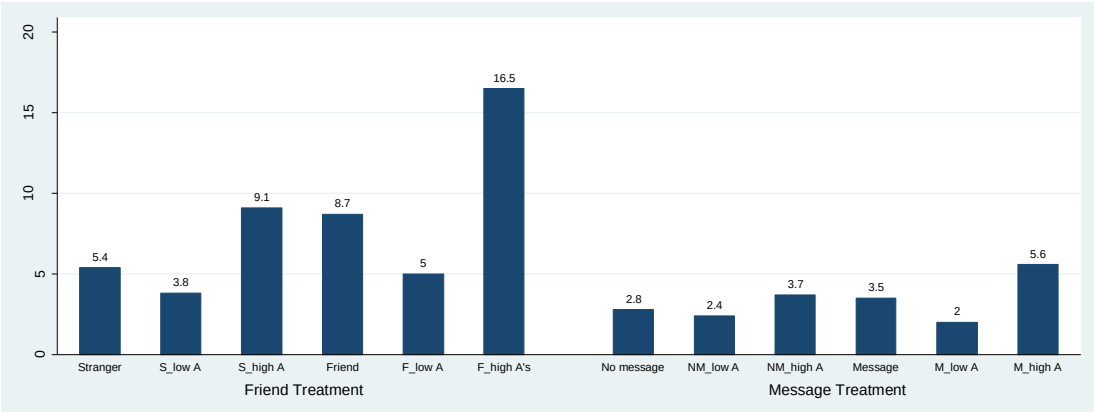

Figure 8: The Average A_i 's and B_i's Average Transfer by High and Low A's transfers