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IAW Diskussionspapiere Nr. 88 September 2012 | No. 88 September 2012

The Impact of Random Help on the Dynamics of Indirect Reciprocity

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ISSN: 1617-5654

IAW-Diskussionspapiere

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The Impact of Random Help on the Dynamics of Indirect Reciprocity*

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Abstract

Cooperation via indirect reciprocity uses a partner's reputation to enable subjects to direct help to those who cooperated themselves. As a partner's reputation provides information whether the partner helped a third party in the past or not, subjects can help those partners with a good reputation. Whereas help in former studies implied a definite monetary transfer to a third party, the present study explores the implications for cooperation via indirect reciprocity if a helping decision does not necessarily involve a monetary transfer. The study employs a "repeated helping game" where a chance move determines whether help actually leads to a reward for the recipient or not. Hence, a good reputation may not coincide with a positive income for the third party. The experimental results show that, firstly, if a chance move determines the outcome of helping decisions, the information about the past decision of partners has a smaller effect on cooperation rates as compared to a situation where helping decisions definitely lead to rewards. This suggests that risk substantially influences the dynamics of indirect reciprocity. Secondly, subjects only reciprocate the recipient's good reputation and disregard whether a good reputation also involves a beneficial outcome for the third party. Here, findings oppose those found in studies on direct reciprocity where both the player's good intentions or good will and the actual monetary amount transferred affect reciprocal back-givings.

PsycINFO: 2260; 3000

JEL classification: C91; D8

Keywords: Indirect reciprocity; Reputation; Cooperation

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*I am grateful to the Max Planck Society for financial support through the IMPRS Uncertainty. I thank Kerstin Pull and participants at the GfeW annual meeting in Nürnberg for helpful comments. I especially wish to thank David Hugh-Jones for helpful suggestions. A large part of this paper has been written at the Max Planck Institute of Economics in Jena.

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1 Introduction

Theoretical and empirical work shows that providing information about a player's reputation is an effective means in order to enforce cooperation. Reputation may encourage cooperation in situations of repeated interaction where players meet more than once (Axelrod and Hamilton, 1981; Kreps et al., 1982), but also in situations where interaction is restricted to a single encounter. When future play is precluded, indirect reciprocity can explain the emergence of cooperative behavior (see Nowak and Sigmund, 2005, for a review). Indirect reciprocity differs from direct reciprocity (Rabin, 1993; Falk and Fischbacher, 2006) in that a player who receives a return for a friendly act from his partner did not provide that friendly act to his parter but to a third party. In order that players can reward friendly behavior, information about past actions is necessary. Reputation ensures that subjects can discriminate cooperative persons from free riders and direct rewards to those who cooperated.

Nowak and Sigmund (1998a,b) were the first to show that indirect reciprocity provides a basis for the evolution of cooperation among strangers. In their game-theoretic model, they introduce image scores that describe the reputation of their partner: individuals can have a good or bad reputation depending on whether or not they donated in the past. Individuals never interact with the same partner twice, but observe their partner's image score before deciding whether to donate. Nowak and Sigmund (1998b) show that in a finitely repeated game discriminating on the basis of the partner's last action is an evolutionarily stable strategy. They also show that the strategy's success is sensitive to the cost-to-benefit ratio of giving.

Experimental studies have supported the existence of indirect reciprocity and reputation building (Wedekind and Milinski, 2000; Bolton et al., 2005a; Greiner and Levati, 2005; Seinen and Schram, 2006; Servatka, 2009; Engelmann and Fischbacher, 2009). These experiments confirm that subjects indeed do discriminate givings on the basis of their partner's last action and that subjects form a good reputation in order to gain from cooperation.

These experiments have deterministically linked a subject's good reputation with a beneficial outcome for the recipient. However, one may consider a situation where a good reputation, i.e. a friendly act, does not necessarily coincide with a reward for the third party. For instance, chance may define whether a friendly act implies a beneficial outcome or not. The main focus of the present paper is to ask whether chance regarding the provision of help seriously harms the effects of indirect reciprocity.

The experiment implements a "repeated helping game" (see e.g. Wedekind and Milinski, 2000; Bolton et al., 2005a; Seinen and Schram, 2006; Engelmann and Fischbacher, 2009) where a donor can provide help to his partner in each round. A donor and his partner are matched only once and the donor receives information about the partner's last decision when he was a donor. In different treatments, the donor's help either surely leads to a reward for the partner or a chance move determines whether the helping decision yields a reward or not. Furthermore, we vary the information subjects receive: In treatments with (or without) reputation formation, the donor receives (or does not receive) information about the partner's last decision. We further ask donors whether they expect to be helped in the subsequent round.

With the help of the experimental design, we want to test whether chance regarding the outcome of help affects the dynamics of indirect reciprocity. Former experiment report that cooperative decision are greatly affected by chance underlying these decisions (Bolton et al., 2005b; Becker and Miller, 2009; Krawczyk and LeLec, 2010). Here, we want to explore whether uncertainties as well affect the cooperation enhancing effects of indirect reciprocity.

Further, we want to explore the question whether players only reciprocate a partner's good reputation and disregard whether a good reputation also involves a beneficial outcome for the third party. Here, we as well want to compare findings to those in studies on direct reciprocity where both the actual monetary outcome of decisions and the player's underlying intentions have been proven to affect reciprocal back-givings (Charness and Rabin, 2002; Offerman, 2002; Falk et al., 2003; Charness and Levine, 2007). For instance, Charness and Levine (2007) show that friendly acts that - by chance - lead to favorable outcome are rewarded more often by the beneficiary of the kind act than friendly acts that - by chance - lead to unfavorable outcomes. The present study tests whether indirect reciprocal responses that reward friendly acts provided to third parties similarly correspond to the outcome of choices. That is, we test whether donors rather help if their partner's help yielded -by chance- a reward than if -by chance- it did not yield a reward.

The present studies reports two main findings: First, if a chance move determines the outcome of helping decisions, the positive effect of reputational information on cooperation rates is lower as compared to a situation where helping decisions definitely lead to rewards. Findings suggests that chance damages the positive effects of indirect reciprocity on co-operation rates. Here, the risk subjects face may substantially influences the dynamics of indirect reciprocity: conditional cooperators who help in order to being helped themselves help less as they might draw fewer benefits from risky back-givings. Secondly, we find that subjects reciprocate the recipient's reputation; they disregard whether their reputation also involved a beneficial outcome for the third party or not. This contrasts with direct reciprocal behavior.

The remainder of this article is organized as follows. Section 5.2 presents the design of the experiment and provides the experimental procedures. Results are reported in section 5.3. Section 5.4 concludes.

2 Experimental design

The design of the experiment is based on Wedekind and Milinski (2000)'s helping game and manipulates one important factor: the likeliness that a helping decision actually leads to a beneficial outcome.

In the helping game, subjects are matched in pairs consisting of one donor and one recipient for each of the 14 rounds. No pair is matched together more than once to inhibit potential direct reciprocal motives. Subjects are in either the role of the donor or the recipient for half of the trials and they will rotate roles between rounds.

In any given round, only the donor has to make a decision. The donor chooses between either helping the recipient or playing keep. In case the donor chooses to help, with probability p he pays a cost c and the recipient receives a benefit b; with probability 1-p, both individuals receive 0. In case the donor chooses to keep, both individuals certainly receive 0.

We vary the probability p the recipient actually receives help. The recipient either receives

Treatment	Sessions	n n	Cost c for donor	Benefit b for recipient	Probability p of helping	Image score available?
RiskyInfo	2	64	-12	30	0.5	yes
SureInfo	1	32	-6	15	1	yes
RiskyNoInfo	1	32	-12	30	0.5	no
SureNoInfo	1	32	-6	15	1	no
RiskyInfoC	1	32	-12	20	0.5	yes
SureInfoC	1	30	-12	30	1	yes

Table 1: Treatment overview

help for sure or with 50% probability i.e. p equal to $p_1 = 1$ or $p_2 = 0.5$ respectively. To keep the expected benefit of a helping decision b/p>c constant, we also vary the size of benefit b and cost c. In case of sure help, donors have to pay $c_1 = 6$ to provide a benefit of $b_1 = 15$. When help is provided with a fifty percent chance, the costs amount to $c_2 = 12$ and the benefit to $b_2 = 30$.

Before donors make their choice, they will be informed about the recipient's image score: his decision of the previous round when the recipient had been a donor. They will learn about both: the recipient's choice to 'help' or 'keep' and the actual gain of the former recipient b or 0. After the donor's decisions are made, the actual recipient will learn about the donor's choice 'help' or 'keep' and his actual outcome b or 0. Hereafter, we will label these treatments *SureInfo* when help is forwarded for sure and *RiskyInfo* when help is only provided in half of the cases.

In two control treatments *SureNoInfo* and *RiskyNoInfo*, we do not provide information about the recipient's previous action. In these treatments without image scores, we again vary the probability of successful helping with $p_1 = 1$ or $p_2 = 0.5$. Accordingly, we can single out the cooperation enhancing factor of image scores for both - treatments with or without errors.

The experiment was conducted in the experimental laboratory of the Max Planck Institute of Economics in Jena, Germany. Subjects were students of the Friedrich-Schiller University of Jena, and were recruited using the online recruitment system ORSEE (Greiner (2003)).

Subjects were randomly and anonymously paired, and their identities were never revealed to one another. Table 1 outlines treatments with respect to their number of participants, payoff values, and availability of information about recipient's last moves. Apart from the treatments described above, we ran two additional control treatments *SureInfoC* and *RiskyInfoC*. *RiskyInfoC*, the first session, used slightly lower payoffs; the purpose of *SureInfoC* will be described later.

Each session was conducted with 32 subjects, for a total of 222 subjects[1]. Upon entering the laboratory, subjects were randomly assigned to 32 visually isolated computer terminals. Instructions for all required treatments (reproduced in the Appendix B) were distributed and read out loud by the experimenter. Questions were answered individually at the subjects' seats. Before beginning with the experiment, subjects filled out a short questionnaire testing

[1]Due to no show-ups, we only had 30 participants in the SureControl treatment.

The next donor will...	certainly help	probably help	Unsure	probably pass	certainly pass
You earn if the next donor chooses to help...	10 points	9 points	7 points	3 points	0 points
You earn if the next donor chooses to pass...	0 points	3 points	7 points	9 points	10 points

Table 2: Elicitation of first-order beliefs

comprehension of the rules for the three treatments.

Subjects received an endowment of 60 points. Each point earned in the experiment was exchanged for €0.1 and subjects earned on average €9.73. After making their choice and after learning about the actual benefit for the recipient, donors were asked in each round to state their first-order beliefs concerning the next round's donor's choice. Specifically, donors were asked to choose a column from the five point scale depicted in Table 4. Each column is associated with payoffs that depend on the decision made by their partner[2]. Feedback about correct guessing and earnings was given only at the very end of the experiment. Only one round was randomly chosen for payment of the correct guessing. The experiment was programmed and conducted with z-Tree (Fischbacher (2007)).

3 Results

The results first report on cooperation levels and expectations about cooperation in all treatments. Next, we discuss the impact of image scores on the probability to give. Then, we highlight distinct subject types and their frequencies in each treatment.

In all sessions and treatments, we find a more or less large fraction of donors providing help to their recipients. Figure 1 shows average giving rates in each round (up to rounnd 14) for all for treatments. In all treatments, average giving declines over rounds (see regressions (i) - (v) in appendix A). Figure 2 presents the fraction of helpful choices for all round separately for all four treatments.[3]

Result 1: There is a positive effect of the provision of reputational information on giving rates and expected help.

Regarding figures 1 and 2, several observations indicate that reputation formation and indirect reciprocity are relevant in *Info* treatments.

First of all, the provision of recipients' image scores greatly raises helping rates. In *Info* treatments, we find an average cooperation rate of 49%, whereas in *NoInfo* treatments, cooperation only amounts to 22%. Thus, reputational information significantly enhances

[2]we use the same method to measure beliefs as Vanberg (2008). The payoffs correspond to a quadratic scoring rule for the probabilities 55%,52%,50%,38%, and 28%. Beliefs are later scaled to 100%,80%,50%,20%, and 0%.

[3]As behavior in treatments *SureInfo* and *SureInfoC* as well as *RiskyInfo* and *RiskyInfoC* do not exhibit substantial differences (see regression (iv) and (v) in appendix A), we merge the data in Figure 1 and 2, and will refer to these as treatments *SureInfo(C)* and *RiskyInfo(C)*.

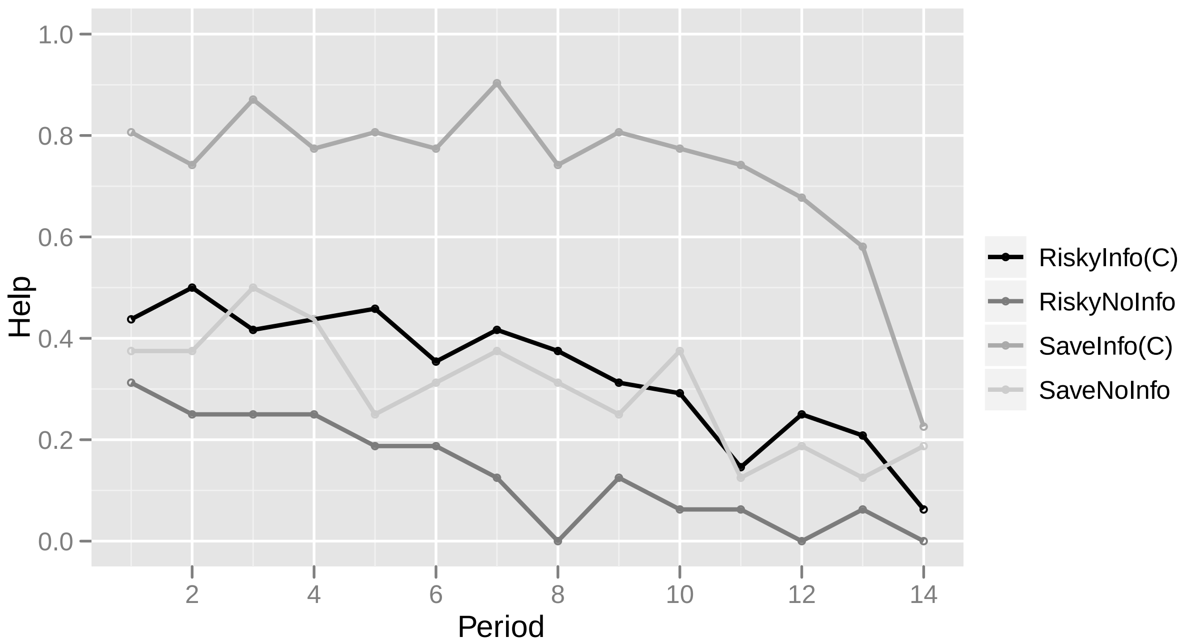

Figure 1: Average Help by Period separately for treatments *SureInfo(C)*, *RiskyInfo(C)*,*SureNoInfo*, and *RiskyNoInfo*.

cooperation (Fisher exact test p=0.0000 for both comparisons, see regressions (i) and (ii) in appendix A). Apparently, subjects are more likely to help if they know that their decision will be passed on to the next donor. This is consistent with indirect reciprocity being at work.

Secondly, we only observe a significant decline in givings between rounds 13 and 14 in treatments when image scores are available (see regression (ii), (iv), and (v)) in appendix A). As subjects' will not receive any returns from a good image score in round 14 as there is no subsequent players, the incentive to form a good reputation disappears. The drop in helping rates in the *Info* treatments therefore may reveal that help - to a large extent- is driven by expectation of receiving help in return.

Lastly, in order that subject have an incentives to form a reputation, they need to expect monetary gains from reputation formation in the next round. Recall that we asked donors in all treatments to estimate whether the next donor they encounter will play give or keep. Donors expect significantly more helping in treatments where information about the recipient's last action is available (49.5%) than without such information (32.4%, Wilcoxon rank-sum test p=0.000). Donors' guesses about next donors' behavior reveal that subjects correctly predict the positive effect of image scores.

Result 2: The positive effect of the provision of reputational information on giving rates is larger in the Sure treatments.

More interestingly, the impact of indirect reciprocity on cooperation rates seems to differ between the *Sure* and the *Risky* treatment. First of all, average giving rate is substantially higher in *SureInfo(C)* (73%) than in *RiskyInfo* treatment (30%, Fisher's exact test p=0.000). Further, expectations about back-givings of next round's donors are higher in *SureInfo(C)* (63%) than in *RiskyInfo(C)* (41%, Wilcoxon rank sum test p=0.000).[4] That is, giving is greatly reduced when the outcome of help is random and subjects as well expect that. Lower expected returns from reputation building weaken the subject willingness to invest in a good reputation.

Apparently, when image scores are available, subjects willingness to provide help is lower in the *Risky* than in the *Sure* treatment. But, the same holds for treatments without image scores (30% vs. 13%, Fisher's exact test p=0.000)[5]. Hence, the decrease in helping in *Info* treatments may not arise due to less indirect reciprocal behavior as the same holds for *noInfo* treatments. To investigate the different impact of indirect reciprocal behavior in *Risky* and *Sure* treatments, one has to compare the different influence of image scores in these treatments. As the positive effect of image scores on cooperation rates is lower in *Risky* treatments, we can conclude that chance seriously damages indirect reciprocity. We observe that giving raises by 43% when comparing helping rates between *SureInfo(C)* and *SurenoInfo* and by only 20% when comparing helping rates of *RiskyInfo(C)* and *RiskynoInfo* (see regression (ii) in appendix A). Hence, the positive effect of information are lower in *Risky* treatments. This speak in favor of the fact that random help weakens the dynamics of indirect reciprocity. The risk subjects face might explain that result.[6] Cooperation entails an additional risk for conditional cooperators: expected risky back-givings after helpful choices might be considered less beneficial if subjects are risk averse. As a result, a good reputation might yields less attractive gains and subject invest less in a good reputation. Apparently, cooperation though indirect reciprocity is more effective when helpful choices are not random as rewards from cooperation are stronger.

Furthermore, we run an additional control treatment *SureInfoC* in order to explain the difference in cooperation rates between *SureInfo* and *RiskyInfo*. In treatment *SureInfoC*, cost and benefits of helping are the same as in *RiskyInfo* where these are only implemented in half of the cases i.e. c=12 and b=30 for both treatments. The control treatment allows us to test whether the differences in cooperation rates are merely due to the fact that the cost (and benefits) of providing help are different in *SureInfo* and *RiskyInfo*. As subjects in *SureInfoC* and *SureInfo* exhibit the same helping behavior (see regression (v) in appendix A), we can exclude that different monetary consequences explain the drop in cooperation and further substantiate that most likely that the risk in *RiskyInfo* is the driving factor that causes the change.

Result 3: Donors discriminate their givings on the recipients last action and rather return help if the the recipient helped before. Donors do not discriminate whether the recipients last action as well yielded a reward or not.

[4] Notably, the difference in expectations even holds in the first round where expectations in *SureInfo(C)* (59%) are as well higher than in *RiskyInfo(C)* (38%, Wilcoxon rank sum test p=0.000). Hence, learning in the course of the experiment cannot explain the difference in expectations.

[5] A discussion why this is so exceeds the aim of this paper.

[6] Although under standard utility theory, the decision to give or not to give should not depend on the probability of the decision being implemented.

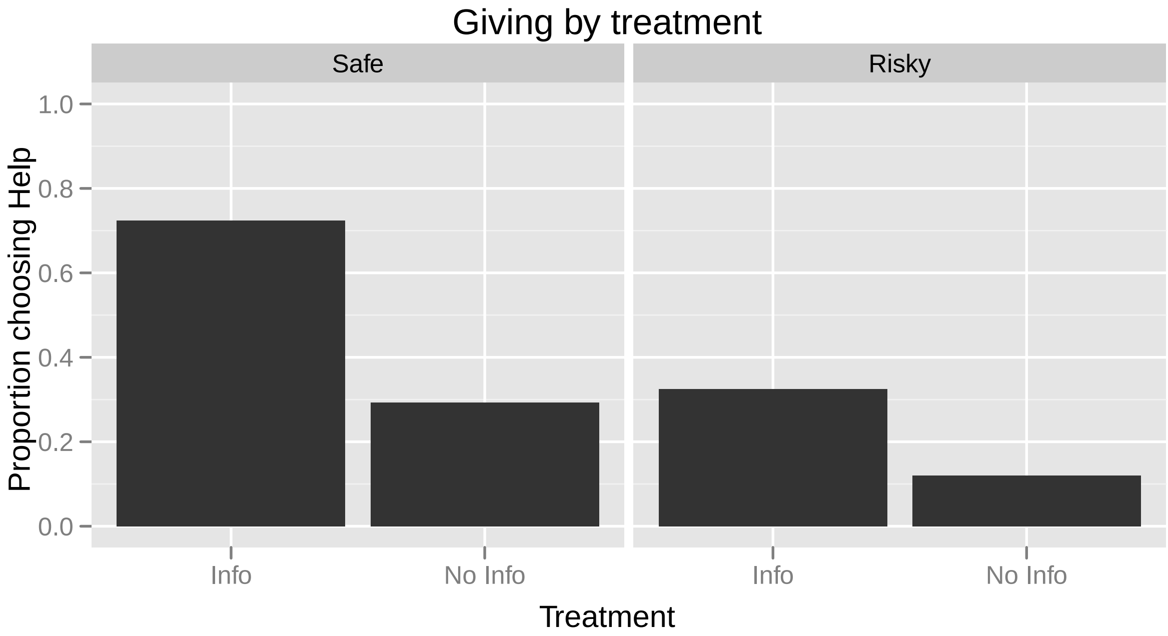

Figure 2: Average giving rate separately for treatments with and without image scores (Info vs. No Info) as well as with and without chance move.

For indirect reciprocity being at work in treatments with image scores, subjects also have to reward recipients for their helping. Figure 3 depicts the effect of the recipient's last action as a donor on the donor's probability to give. In the risky treatment, we separate these effects for recipient's successful (Give (OK)) and failed giving (Give (failed)).

Apparently, subjects do discriminate their actions on the basis of their partner's image score. In the *SureInfo(C)* treatment, donors help on average in 77.4% of the cases when the recipient chose to give and in 55.9% of the cases when he chose to keep the last time. In the*RiskyInfo* treatment, donors help in 38.5% of the cases when the recipient chose to give and in 29.3% of the cases when he chose to keep. In both treatments, these differences are significant (Fisher's exact test, p=0.0125 for treatments with a chance move, p=0.0000 for treatments without a chance move). However, the difference is substantively much larger in the Sure treatments (21.5 percentage change versus 9.2 percentage change, see also regression (iii) in appendix A).

Similarly, donor's guesses about the next donor's decision reveal that subjects correctly predict the positive effect of a good reputation on future donations. In the *SureInfo(C)* treatment, they expect next donors to help with an average probability of 78.3% when they actually helped the recipient and with an average probability of 52.2% when they chose to keep. In the *RiskyInfo(C)* treatment, they expect next donors to help with an average probability of 67.6% in case they helped and with an average probability of 55.6% in case they did not do so. A Wilcoxon rank-sum test reveals that helping indeed increases donor's expectations in both treatments (p=0.000 for both comparisons). Not surprisingly, there is no such increase in expectations in treatments without image scores (p=0.4998).

Donor's expectations also reflect the greater discrimination in the Sure treatments. In

Figure 3: Average helping in treatments with image scores separately for all possible recipient's last round choices

SureInfo(C), a donor who gave is 26.1 percentage points more likely to expect a return than a donor who did not give; in *RiskyInfo(C)*, the difference is only 12 percentage points . This, apart from risk aversion, may cut down on the effects of indirect reciprocity as result 2 points out.

We will now turn to the question whether donors only base their reciprocal responses on recipient's reputation or whether the actual outcome of the recipient's decision as well influences their back-givings. The helping rates in the *RiskyInfo(C)* treatment reveal that helping after failed and successful giving are not significantly different (Fisher exact test p=0.2169).[7] Hence, subjects do not consider the actual outcome of the recipient's decision. The subject's good reputation appears to be the only factor that induces reciprocal help.

In contrast, studies of direct reciprocal behavior regularly show that both outcomes and intentions matter for reciprocal rewarding (Charness and Rabin, 2002; Offerman, 2002; Falk et al., 2003). For instance, Charness and Levine (2007) find that outcomes do influence reciprocal rewarding even if the same intentions underlie these decisions. With respect to direct reciprocal monetary transfers, the desire to achieve equality in payoffs between the reciprocator and his opponent might drive reciprocation (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000). In the experiment, equality in payoffs between the donor and the recipient can not be restored by return donations. As inequity concerns do not apply here, donors might only respond to reputations but not outcomes.

To sum up: in both risky and sure treatments, donors condition their donation on the

[7] In contrast, donors' expectations predict fewer back-givings in case of failed giving (Wilcoxon rank-sum test p=0.0250). This pessimistic view might as well cut down on conditional helping in the treatment with errors.

recipient's previous giving and recipients anticipate the positive effect of a good reputation. We also find that intensity of that effect is more pronounced in treatments without chance move. In the treatments with chance move, subjects only reciprocate the recipient's good reputation, and disregard the actual outcome.

Result 4: There is the same amount of subjects who discriminate their givings on the basis of the partners last action in Risky and Sure treatments. There are more subject who always help and less subjects who never help in the Sure than in the Risky treatment.

Next, we will analyze subject types on an individual basis for all treatments. Here, we rely on subjects types introduced by Nowak and Sigmund (1998a) to identify indirect reciprocity as stable strategy. Hence, we distinguish different types - ALLC, ALLD, DISC. Subjects of type ALLD always play keep in all seven rounds they are donors irrespective of the recipient's decision in the previous round. Subjects of type ALLC always help. As we are also interested in the strategic component of cooperation and ALLC types might only cooperate in order to keep a good reputation, we allow ALLC types to play keep in the last round. In the last round, the incentive to play give in order to have a good image score is missing. Subjects of type DISC discriminate their givings on the basis of their partners last action: They help more often in case their partner played give than if he played keep. A further subject type RAND does not exhibit any of the other described strategies.

Table 3 depicts the frequencies and numbers of each type for all four treatments. In treatments without image scores *SureNoInfo* and *RiskyNoInfo*, there are, of course, no subjects of type DISC as they can not discriminate their helping on any information. The table also provides information about average helping rates and average earnings of the respective type in the respective treatment.

First of all, we only find subjects who always help but not in the last round in treatments with image scores.[8] In treatments without information about the recipient's last action, we do not find subjects with the respective behavior. This again speaks in favor of the strategic component of helping in treatments with image scores: cooperators tend to help in order to gain a good image score and being helped themselves.

Further, the table reveals that the distribution of types clearly differs across treatments. A Fisher's exact test reveals that the shares of subject types are different between *RiskyInfo* and *SureInfo*, *RiskyInfo* and *RiskyNoInfo*, as well as *SureInfo* and *SureNoInfo* (p=0.0000 for all comparisons)[9]. The same test does not give evidence of any differences in shares between *RiskyNoInfo* and *SureNoInfo* (p=0.2589).

In risky and sure treatments, the provision of image scores decreases the share of defectors and increases the share of cooperators. The fraction of defectors is 46.9% in *SureNoInfo* and 62.5% in *RiskyNoInfo* and significantly drops down to 9.7% in *SureInfo* and 39.6% in *RiskyInfo* respectively (Fisher's exact test p=0.0001 and p=0.0393). The fraction of cooperators is 12.5% in *SureNoInfo* and 3.1% in *RiskyNoInfo* and significantly raises up to 46.8% in SureInfo and 9.4% in RiskyInfo(Fisher's exact test p=0.0012 and p=0.0422). As helping promises gains of reciprocal giving in treatments with image scores, strategies of

[8] There are 4 (6.5%) of such subjects in the *SureInfo* treatment and 5 (5.2%) in the *RiskyInfo* treatment.

[9] In the last two comparisons, we match DISC and RAND subjects to one type.

Subject types		Sure				Risky			
Info(C)	Fraction	46.8%	9.7%	25.8%	17.7%	9.4%	39.6%	37.5%	13.5%
	Number	29	6	16	11	17	38	36	13
	Helping	94.6%	0%	66.9%	64.9%	92.0%	0%	48.0%	49.5%
	Earning	123.3	160	127.7	121.3	72.9	92.9	68.1	60.5
NoInfo	Fraction	12.5%	46.9%	0%	40.6%	3.1%	62.5%	0%	34.4%
	Number	4	15	0	13	1	20	0	11
	Helping	100%	0%	-	42.9%	100%	0%	-	29.9%
	Earning	63	85	-	77	54	70.5	-	66
		ALLC	ALLD	DISC	RAND	ALLC	ALLD	DISC	RAND

Table 3: Fraction and numbers of subject types as well as their helping rates and average earnings for all four treatments *SureInfo(C)*, *RiskyInfo(C)*, *SureNoInfo*, and *RiskyNoInfo*.

type ALLC become more attractive, while strategies of type ALLD become less attractive. And, a good reputation indeed yields gains: we find a substantial fraction of subjects that do discriminate their givings according to the partner's last rounds action. In the SureInfo(C) treatment, 25.8% of subjects are of type DISC and, in the RiskyInfo(C) treatment, there are 37.5% of type DISC.

But why are fraction of subject types different in SureInfo(C) and RiskyInfo(C)? The shares of DISC types are not significantly different in both treatments (Fisher's exact test. p=0.1654). Hence, we can exclude that the decrease in cooperation in the helping game with a chance move as described in result 2 is due the lack of discriminating subjects. However, we do observe a substantial decline of individuals of type ALLC and an increase of ALLD types (46.8% vs. 9.4%, p=0.0001 , and 9.7% vs. 39.6%, p=0.0000). As discussed above, cooperators might diminish in RiskyInfo(C) as they expect fewer gains from risky back-transfers. Although subjects face the same amount of discriminators in the RiskyInfo(C) treatment, the ALLC strategy is less attractive as earnings from reciprocal givings are risky. Altogether, the results suggest that cooperation through image scoring still persists. Subject's in RiskyInfo(C) still base their decisions on image scores. But, the results of the experiment suggest that risk regarding the provision of help severely damage the dynamics of indirect reciprocity because subject's risk aversion affects the promises of its gains.

4 Final remarks

This paper tries to shed new light on indirect reciprocity though image scoring in a more comprehensive manner: We allow for chance to determine the outcome of help in order to test whether this affects cooperation. Former experimental settings hinge completely on the assumption that nature never changes the outcome of choices.

In this regard, we have conducted an experimental helping game where chance interferes with the transfer of help: Donations to recipients will only be forwarded with a certain probability.

Firstly, we have found that the provision of information about the partner's previous action increases cooperation. Hence, indirect reciprocal behavior fosters cooperation in repeated interactions. Further, the results show that if a chance move determines the outcome of help the cooperation enhancing effects of reputational information are lower. Donors risk aversion might lower the expected benefits from a good reputation and explain the fewer help observed. Next, we find that subjects do discriminate their givings on the basis of the partner's last action and rather help those who helped before. However, the extent to which subjects discriminate their givings is lower if chance interferes with the outcome of help. Whether help leads to a reward for the third party or not does not influence subject's back-givings. Apparently, indirect reciprocity only responds to good reputations and does not take into account whether a good reputation also yielded positive gains for the third party. Additionally, we find the same amount of subject who discriminate their givings on the basis of their partner's last action if a chance move determines the outcome of help. That is, fewer subjects exhibiting indirect reciprocal behavior cannot explain the detrimental effects of chance on cooperation rates. This suggests again that risk aversion explain the fewer helping rates.

The results show that chance regarding the transfer of help does not completely inhibit indirect reciprocal behavior - agents still discriminate their givings on the basis of their partner's last action and information about partner's reputation still enhances cooperation. However, we show that chance is sufficient to harm the gains of indirect reciprocity. Results suggest that the risk subjects face lowers subjects willingness to invest in a good reputation. As uncertainty is a central part in decision making, it is important to understand to which extent cooperation is undermined if chance interferes in decisions.

A Appendix: Regressions

The regressions (i) to (v) show logistic regressions with random effects for each subject. The regressions (iii) to (v) only use part of the data as indicated in line "Data". All regressions analyze the impact of distinct dummy variables on the probability to play give. Dummy variable "Risky" denotes that a chance move determines the outcome of help. Dummy variable "Info" implies that subjects received information about the recipient's last action. The dummy variable "Image score" shows that the recipient played give the last round when he was a donor. The interaction variables "Risky × Info" and "Image score × Risky" examine the interaction effect of both variables. Dummy variables "RiskyInfoC" and "SureInfoC" represent both control treatments.

	(i)	(ii)	(iii)	(iv)	(v)
Risky		-2.219*	-3.100***		
		(0.960)	(0.652)		
Info	-0.829*	4.404***			
	(1.399)	(0.777)			
Risky × Info		-1.839*			
		(1.117)			
Image score			1.698***		
			(0.455)		
Image score × Risky			-1.031*		
			(0.538)		
RiskyInfoC				0.025	
				(0.719)	
SureInfoC					0.558
					(0.815)
Period	-0.230***	-0.232***	-0.222***	-0.232***	-0.140**
	(0.025)	(0.026)	(0.033)	(0.035)	(0.046)
Last Round	-0.829	-2.869	-3.150	-2.360**	-4.153***
	(1.050)	(0.555)	(0.640)	(0.887)	(0.835)
Last Round × Info	-2.382*				
	(1.205)				
const	-1.372	-0.043	2.923***	0.077	3.116***
	(1.193)	(0.616)	(0.606)	(0.624)	(0.688)
N	1554	1554	1027	672	434
log likelihood	-621.5	-610.4	-424.9	-294.5	-170.4
Data	All	All	Info	RiskyInfo(C)	SureInfo(C)

Table 4: Random-effects logit model for help choices in all treatments. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.1.

B Appendix: Instructions

Please read the following instructions carefully. The instructions will provide you with all the information you require for participation in the experiment. Please ask for assistance if there is something that you do not understand. Your question will be answered at your workplace. There is a strict prohibition of communication during the experiment.

You will receive an initial endowment of 60 points euros at the beginning of the experiment. You can earn additional money over the course of the experiment by collecting points. All of the points which you accrue over the course of the experiment will be converted to euros at the end of the experiment. Please note that: 1 point = 10 cents.

Caution: In this experiment, it is possible to make losses. However, this is very unlikely.

At the end of the experiment, you will receive the income which you earned over the course of the experiment plus the 2.50 euros of initial endowment in cash.

Description of the experiment:

The game you will play consists of several rounds. In each round, you will be paired with a different participant in a group of two. Each group consists of a decider and a recipient. The decider can choose between KEEP or GIVE. In case the decider chooses KEEP, both he and the recipient receive no points. In case he decides to play GIVE, a eight-sided dice will be rolled (The dice is simulated by the computer. All sides are chosen with equal probability.) If a number between 1-4 is rolled, the recipient receives 30 points and the decider pays 12 points. If a number between 5-8 is rolled, the recipient does not receive any points and, accordingly, the decider does not have to pay for it. The table below outlines decisions and their payoffs once more:

	The decider receives	The recipient receives
The decider plays KEEP	0 points	0 points
The decider plays GIVE, dice=5,6,7 or 8	0 points	0 points
The decider plays GIVE, dice=1,2,3 or 4	-12 points	30 points

Before choosing whether to GIVE or to KEEP, the decider will be informed about the recipient's move in the last round when the latter was the decider. This information can contain three distinct messages:

- The recipient of this round chose to GIVE in the last round, in doing so he paid costs of 12 points and forwarded 30 points.
- The recipient of this round chose to GIVE in the last round, in doing so he did not pay any costs nor did he forward any points.
- The recipient of this round chose to KEEP in the last round, in doing so he did not pay any costs nor did he forward any points.

Of course, you will not receive such a message in the first round, as the recipient not yet made a decision.

At the end of each round, the decider and the recipient will receive feedback about the actual payoffs of the round. The recipient will also be informed about whether the decider chose to KEEP or GIVE.

Bonus: At the end of the first six (of all seven) rounds in which you are the decider, you are asked to guess the behavior of the next decider. That is, you have to guess whether the decider, you will meet in the next round, is going to choose GIVE or KEEP. No other participant or the decider will be informed about your answer.

In case you guess correctly, you can earn additional points (see table below). At the end of the experiment, one of your six guesses you made is randomly picked and you will be paid for this guess according to the table.

The next decider will...	certainly GIVE	probably GIVE	Unsure	probably KEEP	certainly KEEP
You earn if the next decider chooses to GIVE...	10 points	9 points	7 points	3 points	0 points
You earn if the next decider chooses to KEEP...	0 points	3 points	7 points	9 points	10 points

You can choose one of five different guesses. For instance, if you choose "Probably GIVE" and the decider actually chooses to GIVE, you will earn 9 points. If he chooses KEEP though, you will earn 3 points. If you choose "Unsure", you earn 7 points irrespective of the decider's choice.

Do you have any further questions?

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