Another experimental look at reciprocal behavior: indirect reciprocity

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Abstract

This paper highlights a new social motivation, the indirect reciprocity, through a three-player dictator-ultimatum game. Player 2 has the opportunity to reward or punish indirectly the player 1 by inciting - with her share - player 3 to accept or reject the division. Player 2's offer provides a signal to player 3 about the fairness or unfairness of player 1. To underline such motivation, we implement four treatments of information where we vary player 2's available information, prior experience or player 3's information. Results show that between 28% and 73.68% of subjects - according to the treatment of information - behave as indirect reciprocity predicts. Another reciprocal behavior - the generalized reciprocity - is investigated through a three-player dictator game. Our data show that 80% of players 2 act according to this reciprocal behavior. Such findings confirm that the more complex the strategic interaction becomes the more self-regarding behavior is likely and the less other-regarding behaviors, such as reciprocity, dominate.

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1. Introduction

As mentioned by Becker (1962), economic men cannot be considered only as selfish and rational. Their actions can be influenced by other motives and reciprocity is one of them. Importance of reciprocity in societies[1] has been a long time considered by scholars as George Homans as well as by writers as Durkheim or Mauss. Reciprocity is considered as *"one of the human rocks on which societies are built"* (Mauss, 1954) and *"... appears as one of the basic interactions forces that keep a bundle of individuals into a society, along with a shared culture and mutual self-interest"* (Kolm, 2006, p.379). Nobody ventures nonetheless to give a straightforward definition of reciprocity until Gouldner (1960).

Reciprocity stills a very controversial issue. For many scholars reciprocity is an instance of enlightened self-interest favored by repeated encounters whereas for others - notably behavioral economists - reciprocity is a social norm that prescribes cooperation towards cooperators and punishment towards non-cooperators, even at personal cost. We positioned our article under the second point of view. Reciprocity represents an action which has *"a similar influence on another's payoff as another's action has on one's own"* (Bolton et al., 1998, p.207). Individuals are viewed as moral and emotional reciprocators.

At this point, we should highlight the difference between reciprocal altruism (Trivers 1971, Axelrod 1984, Fudenberg and Maskin, 1986) and strong reciprocity (Gintis, 2000). Strong reciprocity refers to the idea that subjects are willing to sacrifice resources to be kind to those who are being kind (strong positive reciprocity) and to be unkind to those who are being unkind (strong negative reciprocity). On the contrary, reciprocal altruism has the aim to obtain long-term net benefits and recommends cooperating only if others cooperate (rewarding) and punishing free-rider (punishment), even if it might be costly. Just like Fehr et al., (2002) we will use the term "selfish" to describe such behavior.

In this paper, we focus on strong reciprocity and more specifically on two of the various types of reciprocity that can be declined. The first one is the generalized reciprocity: *"you tend to be helpful if you have been helped, even by people different from those you help"* (Kolm, 2006, p.377). In other words, *A*'s kind act towards *B* implies that *B* acts similarly towards *C*. The generalized reciprocity implies a "*cascade effect*". Due to the interdisciplinary nature of reciprocity, ambiguities appear: when reciprocity refers to a *"...unilateral resource giving among n-persons. Social scientists call this type of exchange generalized-exchange, and biologists call this indirect reciprocity"* (Takahashi and Mashima, 2006, p.418). The term of indirect reciprocity was introduced by Alexander (1987). He argues that individuals' behaviors towards others are not only influenced by their own experience but by the observation of others' behaviors too. This concept of indirect reciprocity based on the

[1]See the impact of the purpose of reciprocity in public policy in Kahan (2005).

evolutionary biology (see the pioneering analyses of Nowack and Sigmund, 1998a, 1998b and further extensions as Leimar and Hammerstein (2001))[2] works toward status and reputation. It is noteworthy that indirect reciprocity implies that the *"return is expected from someone others than the recipient of the beneficence"* (Alexander, 1987, p. 85); This other individual could be involved in the original exchange or not. Economic works deal with the study of indirect reciprocity where subjects reward or punish another person, not involved in the original exchange (see for example the experiments of Dufwenberg et al., (2001), Buchan et al., (2002) or Seinen and Schram (2006)).

In this paper we propose to study another aspect of indirect reciprocity: return stills expected from someone others than the recipient of the initial beneficence but involved in the original exchange. Consider a negotiation between three actors who act sequentially. Indirect reciprocity proceeds as follow: following *A*'s kind act towards *B*, *B* cannot directly reward *A* by acting kindly towards her. *B* can just act kindly towards a third actor *C* to incite her to be kind toward A. This last actor, *C*, has the possibility to reward *A* by accepting the negotiation. Contrarily if *A* acts unkindly. This definition of indirect reciprocity has the advantage to be clearly distinguished from the concept of generalized reciprocity according to which following *A*'s kind act towards *B*, *B* acts similarly towards *C*, without any fallout on *A* (see Kirchsteiger and Sebald (2006) for investment in human capital). Conversely to authors but as Ben-Ner et al., (2004), we name such behavior generalized reciprocity since it implies no return towards the first investor. Such reciprocal behavior is noticeably different from our concept of indirect reciprocity which should occur in the following context. Suppose a competitive experimental market where three individuals intervene sequentially: boss's boss, boss and worker. If boss's boss provides a high monetary offer to the boss, the boss could give a high wage to worker in order to incite her to produce high effort and thereafter rewarding the boss's boss for her offer. High-wage worker could provide a higher effort than those she would provide if she has received a weaker wage. The high effort leading to higher productivity, it is beneficial for both. The boss acts according to positive indirect reciprocity[3]. An opposite argument holds if the boss's boss supplies a small monetary offer.

Such scenario can be analysed through a dictator-ultimatum game (henceforth DUG): a dictator game between player 1 and player 2 then an ultimatum game between player 2 and player 3. By the amount the player 2 offers to player 3, she has the capacity to incite her to accept (to reject) the offer - by sending a high (weak) share of player 1's offer - if player 1 makes a fair (unfair) offer. Depending

[2] See Takahashi and Mashima (2006) for an extended review on the evolution of the study of indirect reciprocity in mathematical biology.

[3] A propensity of strong positive reciprocity has already been shown in competitive experimental market through the gift exchange game when only two parties, employer and worker, intervene (see Fehr et al. 1997). The gift exchange model is based on the assumption of a positive relation between wages and effort. Workers respond to receiving a high wage by increasing effort and output (positive reciprocity) and low wage by decreasing output (negative reciprocity) to the minimum required as retaliation for a low wage. A large body of empirical evidence in support of reciprocity has been reported in the last two decades. More generally, numerous studies, both theoretical and empirical, have shown that reciprocally motivated individuals respond to fair treatments such as higher wages with higher levels of motivation and work efforts (Akerlof, 1982; Fehr and Falk, 1999).

on the feasible action set of player 1, player 2 compares player 1's action with the action expected. She evaluates it as fair or unfair and reciprocates accordingly thereafter. Player 2 has thus the opportunity to reward or to punish player 1, but in an indirect way, *via* the incitation given to player 3. Our results confirm the existence of indirect reciprocity: between 28% and 73.68% of subjects - according to the treatment of information - follow this norm.

The generalized reciprocity is more popular: 80% of subjects have such inclination. An explanation could refer to the weakness of strategic interactions in the study of this last reciprocal behavior. Our findings confirm that the more complex and strategic is the context the less other-regarding behaviors dominate.

The importance of reciprocity leads economists to incorporate it into rigorous models in order to have more coherent theoretical perspectives. However, the traditional economic approach has the weakness that it cannot account for reciprocity in unrepeated interactions. Experimental studies[4] allow supporting the existence of reciprocity in unrepeated situations and our experiment provides a supplementary proof.

The remainder of this paper is organized as follow. In section 2 we define the framework implemented then our concept of indirect reciprocity. Section 3 provides the experimental design and section 4 the course of the experiment. We present our main results in section 5 and section 6 concludes.

2. The indirect reciprocity

The indirect reciprocity has the aim to establish a social norm of fairness, which is assumed to prevail on such individuals' behavior. It studies deviations from self-regarding behavior: subjects try to reward the ones who have treated them fairly or punish otherwise. Nonetheless, it is necessary to underline that indirect reciprocity is not driven by the expectation of future material gain. Subjects respond solely to kind or unkind actions without any expected material payoff since the final decision is taken by another individual, i.e. outside their control.

2.1. Framework

The indirect reciprocity is analysed through a combination of two well-known games: the dictator game and the ultimatum game. In such game, named dictator-ultimatum game, three players act sequentially. Player 1 has the opportunity to divide an amount of money with two anonymously matched participants. She makes an offer to player 2 without determining the allocation of each opponent. Player 2 has no veto power. She has to propose a division of player 1's offer to player 3.

[4] For a survey and discussion of positive and negative reciprocity, see Fehr and Gachter (2000).

Finally, player 3 decides whether to accept or to reject player 2's offer and the game ends. If she rejects it, all players obtain zero, otherwise each player receives the payoff contracted. According to the non-cooperative game theory, player 1 keeps all of her endowment and gives nothing to player 2. This last gives nothing to player 3 who accepts such decision. The sub game perfect equilibrium (henceforth *SPE*) is $(X-\varepsilon, \varepsilon_1, \varepsilon_2)$, where X represents the amount of the initial endowment, and $\varepsilon, \varepsilon_1, \varepsilon_2$ are positive numbers, as small as possible (equal to minimal thresholds with $\varepsilon = \varepsilon_1 + \varepsilon_2$). Nonetheless, to avoid the equal split between player 2s and player 3s at equilibrium, i.e. ($X, 0, 0$), we introduce a minimal threshold for player 1s and player 2s' offers.

In order to analyse the generalized reciprocity which implies no effect of player 3's decision on player 1's and player 2's payoffs, we need to avoid player 3's veto power. The situation is represented by a three-player dictator game (henceforth DG). To compare the results of the three-player dictator game with those obtained in the DUG, we adopt the same thresholds as in the DUG.

2.2. Theoretical process

Rabin (1993) argues that intentions play a crucial role when subjects are motivated by reciprocal considerations. Hence intentions depend on the beliefs of subjects and the kindness of a subject depends on her set of possibilities. As noted by Dufwenberg and Kirchsteiger (2004) when a subject *A* wants to be kind to *B* who was kind to her, and unkind to unkind *B*, *A* has to assess the kindness (or unkindness) of her own action as well as of *B*. To do this *A* has to consider the intentions that accompany an action. When subjects have the opportunity to divide an amount of money without any property rights on it and when the choice is deliberate and purposeful, the determination of intentions can be expressed as follow:

- If subject *A* gives an amount weaker than the equal split[5], subject *B* believes that *A* has undertaken an unkind action. This last has unkind intention.
- Otherwise *B* believes *A* has kind intention.

Knowing the intention behind the action undertaken toward her, she has to take an action which contains the same intention than that received. Such reciprocal behavior – through an indirect process – is analysed in this paper and proceeds as follow.

In the DUG a division has to be made between three players who sequentially intervene. Player 1 acts first. She has the opportunity to offer an amount of money to player 2. Then player 2 will offer a share of player 1's offer to player 3. The division made by player 1 represents her type.

[5] Without any property rights on the initial endowment, the fair split corresponds to the equal one.

Let t: the type of player 1, with $t \in T = \{0;1\}$ and $\bar{x}$, the equal split made by player 1, i.e. $\{\bar{x} / x = 2/3X\}$. So,

- If player 1 makes an offer $x < \bar{x}$, she is unfair. She has unkind intention and $t = 0$.
- If player 1 makes an offer $x \geq \bar{x}$, she is fair. She has kind intention and $t = 1$.

Thereafter, player 2 receives player 1's offer. She has private information compared to player 3 since she knows player 1's split. Knowing this and the amount of the initial endowment, player 2 learns by deduction the type, t, of player 1. We should be cautious since it might have subjects who misperceived an action performed by player 1 (Leimar and Hammerstein, 2001, call such subjects "*errors in perception*"). Nonetheless, it is noteworthy that in our study perceptual errors are minimized since player 2 knows player 1's intention through her own observation. It remains the question of the perception of player 1's intention. As noted by Kahan (2005) the logic of reciprocity depends on individual's moral and emotional priors. Due to the absence of property rights on the initial endowment, we assume that for all individuals the fair split corresponds to an equal split.

Even if at the beginning our game is a three-player game, we can without any problem refer us to a signalling two-person game. Indeed, with the division made, player 1 indicates without ambiguities her type to player 2. Conversely player 3 does not have any information about player 1's offer. Her sole information refers to the distribution of probability *a priori* of player 1's type, t. Since player 1 has the possibility to offer the amount wished each split has the same probability of occurrence. Knowing that and knowing that the equal split corresponds to $\bar{x} = 2/3X$, the amount sent to player 2 could correspond to an unfair behavior with a probability $\rho = 2/3$ and to a fair one with a probability $1 - \rho = 1/3$. With the knowledge of player 1's type, player 2 has the opportunity to send a signal, s, to player 3 in order to inform her about player 1's type. The incomplete information of player 3 is fundamental. This last allows player 2 to have a role of signal about player 1's decision. In fact, if player 3 had complete information, she would know the amount of the endowment, the player 1's offer and consequently player 1's type. In such case, player 2, who is only an intermediary proposer, would not have any role of signal. Player 3 could furthermore judge instead of player 2 the player 1's decision, which attenuates the role of player 2 and thereafter the prominence of indirect reciprocity.

Consequently, we face a traditional signalling game between two persons: player 2 has the possibility to send a signal, s, to player 3 which reveals her private information. Her signal aims to influence the decision of player 3 in the sense (acceptance or rejection) wished. The strategy of behavior of player 2, S, is given by the following function:

$$\sigma : T \times S \to [0,1] \quad / \quad \sum_s \sigma(t,s) = 1 \; \forall t$$

Where σ represents the probability that player 2 sends a message s when player 1 is of type t.

The signal of player 2 corresponds to the amount sent to player 3, this last being conditioned by player 1's offer. It is a take-it-or-leave-it signal, in the sense that player 3 can decide whether to accept or reject the offer proposed, through the action $a \in A = \{0;1\}$ undertaken. The action, a, of player 3 is given by the following function:

$$\alpha : S \times A \to [0,1] \quad / \quad \sum_a \alpha(s,a) = 1 \; \forall s$$

For example: player 3 makes the action a with a probability $\alpha(s,a)$ if the signal received is s. Thus,

- If player 3 decides to accept the amount proposed by player 2 then $a = 0$
- If player 3 decides to reject the amount proposed by player 2 then $a = 1$

If the signal of player 2 reveals the type of player 1 then:

$$\begin{cases} s \in [0, 1/2\,x[& if\ t = 0 \\ s \in [1/2\,x, x[& if\ t = 1 \end{cases}$$

We introduce an attitude function, as Kirschteiger and Sebald (2006) to describe the behavior of signalling of player 2. Her signal - the percentage of player 1's offer proposed to player 3 - is function to the player 1's offer:

$$s(x) \to [0;100]$$

We assume that $s(x)$ is continuous and differentiable. If player 1 gives nothing to player 2 ($x = 0$), player 2 has no choice and proposes nothing to player 3. Furthermore, the higher player 1's offer is, the more the share proposed by player 2 to player 3 is high. These considerations lead to:

$$s(0) = 0 \quad \text{and} \quad s'(x) > 0$$

Such signal corresponds to the behavior of indirect reciprocity: When player 1 is unfair ($t = 0$), player 2 sends a bad signal ($s \in [0, 1/2\,x[$) to player 3 in the aim of inciting her to reject the offer $(a = 1)$. On the contrary, when player 1 is fair ($t = 1$), player 2 sends a good signal

($s \in [1/2\,x, x]$) to player 3 in the aim of inciting her to accept the offer $(a = 0)$, as we can see on Figure 1. There is no dominant strategy in indirect reciprocal behavior: player 2 makes a fair split if player 1 is fair too and she makes an unfair split otherwise. Indirect reciprocity implies multiple equilibria: player 2's decision is conditioned by player 1's one but decisions prescribe best responses in all stage of the game, as long as the concern for material payoff does not overcome the concern for reciprocity.

The indirect reciprocity is characterized by a positive correlation between player 1's offer and player 2's share. If player 1 is unfair ($t = 0$), she offers a small amount. In that case player 2 sends a signal $s \in [0, 1/2\,x[$ smaller than the signal she would have sent if player 1 has been fair ($t = 1$) i.e. $s \in [1/2\,x, x]$. In others words, when player 1 offers only a small amount to player 2, player 2 makes a small offer ($s < 1/2\,x$) in the hope that player 3 rejects it. Player 2 punishes indirectly player 1 for her unfairness. Here player 2 can punish player 1 only in an indirect way, by means of her unfair offer to player 3. Player 2 is an intermediary player whom the only action consists to influence player 3's decision in the sense wished; This last being conditioned by player 1's offer. Conversely, if player 1 is fair ($t = 1$), player 2 sends a signal $s \in [1/2x, x]$ higher than the signal she would have sent if player 1 has been unfair ($t = 0$) i.e. $s \in [0,1/2x[$. When player 1 makes an offer close to the equal split ($x \geq \bar{x}$) then player 2 acts in the same way towards player 3 ($s \geq 1/2\,x$). She seeks to honour the generosity of player 1. But she rewards her indirectly through her fair offer to player 3.

Nonetheless this behavior could be less straightforward. Indirect reciprocity implies that player 2 wants to punish player 1 when she considers her offer as unfair, otherwise she seeks to reward her. Such behavior will be empirically confirmed if a positive and significant correlation between player 1's offer and player 2's share exists.

--*[Insert Figure 1]*---

The simultaneous study of positive and negative reciprocity is not common. Some experimental games are implemented to test the positive reciprocity like trust game or gift-exchange game (Falk, 2007, Falk and Zehnder, 2006) whereas others are implemented to test the negative reciprocity like ultimatum game or public good game with punishment (Fehr and Gachter, 2000, 2002). Nonetheless, few of them seek to test at the same time the existence of both positive and negative reciprocity within individual. Such studies report weak correlation between positive and negative reciprocity. For example, Dohmen et al., (2006) implement a large sample experiment. They attempt to highlight the difference between positive and negative reciprocity by means of six different measures of reciprocity on a 7-points scale. They find a weaker support for negative reciprocity than for the positive one: *"There are also substantial differences between positive and negative reciprocity:*

Not only are there more positively reciprocal respondents than negatively reciprocal ones, but the correlation between a respondent's positively and negatively reciprocal inclinations is surprisingly low. These latter findings point to an important complication. Positive and negative reciprocity might be expected to derive from the same underlying trait, a general tendency to respond kind. Instead our findings suggest that these traits are behaviorally distinct, with potentially different determinants." (Dohmen et al. 2006, p.2). Our concept of indirect reciprocity – which requires having both negative and positive reciprocal inclination – is consequently more restrictive. Nonetheless, we point out that it appears essential in our study to characterize subjects as reciprocal ones. If subjects make a fair split when player 1 is fair, we could say that they adopt a positive reciprocal behavior. But if they make a fair split even if player 1 is unfair, then they always make a fair split of the amount received. In that case, they are never influenced by the fairness or unfairness of player 1 when they take their decisions. They are only fair, whatever the behavior of previous subjects. An analogous argument holds in case of negative reciprocity where they adopt an unfair behavior and not a reciprocal one.

3. Experimental design

3.1. Treatments of information

We implement six treatments of information to underline either the indirect reciprocity or the generalized reciprocity.

These two behavioral inclinations are, in part, analysed through the comparison of behaviors adopted by subjects who face incomplete information about player 1's offer and those who face complete information. Such comparisons allow testing an "*income effect*" where subjects give a higher share to player 3 due to the higher amount to divide at their disposal and not due to the fairness of player 1. The "*income effect*" has to be avoided to confirm the influence of player 1's intention on player 2's decision. The incomplete information is formalized by the introduction of *a priori* probabilities on X: one half of player 1s has a "large" endowment (F) and other half has a "small" one[6] (f). We choose an equiprobability distribution of probability: players have an equal chance to be paired with a subject who has f or F. Consequently, in case of incomplete information, player 2 cannot consider the fair or unfair character of player 1's offer. Thereafter she cannot signal player 1's intention to player 3. This distribution of probability is common knowledge. Moreover, player 2's signal is very important since in all treatments, player 3 faces incomplete information about X.

In the two first treatments of information, player 3 has a veto power and we vary the available information of player 2. Nature chooses X with probability $1/2$ for X = F and $1/2$ for X = f. While the potential values of X and their probabilities are common knowledge, in treatment 1 (henceforth

[6] With F = 2f in all treatments of information.

T1) only player 1 learns which value of X has been chosen; player 2 and player 3 have incomplete information. In treatment 2 (henceforth T2) only player 3 has incomplete information. Player 2s in T1 cannot adopt the behavior of indirect reciprocity contrary to player 2s in T2. The comparison of behaviors observed in these two treatments of information points out if the intention of player 1's offer has an impact on player 2's behavior. If so, does indirect reciprocity appear?

The treatment 3 (henceforth T3) is similar to T2 except player 3's available information. Here, player 3 doesn't know the exact value of X in order to keep the role of player 2's signal – as in T2 – but player 3 knows the player 1's offer to player 2 when she takes her decision. With such information, player 3 is able to evaluate player 2's decision, in the sense whether player 2 makes a fair split of the offer received or not. This informational situation increases the ability of player 3 to understand player 2's signal. The study of repartitions in this treatment allows us to know if the understandings of player 2's signal by player 3 favor the behavior of indirect reciprocity.

In treatment 4 (henceforth T4) we implement two different games. The first one represents a usual dictator game. Player P – the proposer – has the opportunity to divide an amount of money with a receiver, player R. She can make an offer between 0€ and the amount of her endowment, X. Player R has no choice but to accept the amount given by player P and the game ends. The initial endowment is the same one for all players P and common knowledge. The SPE is such that player P keeps all of her endowment and player R obtains a null payoff ($X;0$). Once this game ends, all proposers take part to the second game, the DUG - as player 2s - with new subjects who have never participated in an experiment. In these two games, proposers and thereafter player 2s have complete information about the amount to share but we vary its origin. In the dictator game, the endowment comes from the experimenter whereas in the DUG, the endowment comes from player 1's division. This experiment allows us to see - by means of a within subject design - if subjects adopt the same behavior when they share an amount given by the experimenter and when the amount provides to a fair or unfair player[7]. Nonetheless, a difference can appear in behaviors adopted in these two games due to player 3's veto power in the second game. To avoid this problem, in the DUG, player 3 knows only a distribution of probability for X and she has no information about player 1's offer to player 2.

In the two last treatments, player 3 has no veto power. The DUG becomes a three-player dictator game. Consequently player 3 does not take any decision and the gains of all players depend on

[7] Blount (1995) implements several experiments on the ultimatum game by varying the origin of the share. In a first version, it came from a random pulling, carried out by a computer. In the second version, it came from a third person whereas in the third version, the division was carried out by player 1. The results obtained show the influence of the origin of the share: the threshold of acceptance is very weak when the division is carried out by a computer, it is a little higher when it is carried out by a third person whereas individuals show a social motivation and establish the highest thresholds of acceptance when the division comes from player 1.

the decisions of player 1 and player 2. Here player 2 cannot fear of player 3's rejection and her behavior highlights her true reaction to player 1's offer. She cannot punish or reward the player 1, even though indirectly. Player 2 reacts to the fair or unfair player 1's offer but her signal has hence no impact. In that case player 2 can adopt a behavior of generalized reciprocity: The higher player 1's offer is, the more player 2 will offer a high share to player 3 without any possible fallout on player 1. This modification does not imply any change on theoretical equilibrium. In treatment 5 (henceforth T5), only player 1 knows the true amount of the initial endowment. Player 2 and player 3 face incomplete information, as in T1. Conversely, in treatment 6 (henceforth T6), player 1 and player 2 know the true amount of the initial endowment whereas player 3 has incomplete information (as in T2). The comparison of repartitions made in these two treatments allows us to study the impact of a fair or unfair player 1's offer on player 2's decision and to see if a behavior of generalized reciprocity appears. To resume, the six treatments of information are presented in Table 1.

---*[Insert Table 1]*---

3.2. Behavioral hypotheses

Add to indirect and generalized reciprocity, other behavioral hypotheses are likely to occur due to the experimental design implemented.

<u>H1. True motivations: selfishness or social motivations?</u>

T5 allows highlighting the true motivations of player 2s since they cannot be influenced by player 1s' offer due to their incomplete information; neither by the fear of rejection since player 3 has no veto power. Player 2 can have two types of motivations. Note y the player 2's offer and $\bar{y}$ the player 2's offer equals to the equal split[8]. Player 2 has either selfish motivation: $y = 0$ (Hypothesis H1A). Either she has altruistic motivation: she gives a positive share of player 1's offer $y > 0$ (Hypothesis H1B). In this last case, two types of positive offers can be made. If y is such that $0 < y < \bar{y}$, then player 2 makes an unfair offer (Hypothesis H1B-1). Conversely, if y is such that $y \geq \bar{y}$ then player 2 makes a fair offer (Hypothesis H1B-2).

[8] According to the literature, without property right, we consider that the threshold departs from which a person is fair is such that she sends 40% of player 1's offer (the strict equal split would be equal to 50%).

H2. Fear of rejection

If player 2 in the three-player DG makes, on average, higher offers than those in the DUG - for a given available information - then offers in the DUG have to be justified by the fear of rejection and not by a sense of fairness[9] (i.e. mean offer (T1) > mean offer (T5); mean offer (T2) > mean offer (T6)).

H3. Influence of proposers' behaviors

In T2, T3, T4 and T6, player 2 has complete information about X. She can be influenced by player 1's intention when she takes her decision (Hypothesis H3A).

In T2, this influence results from the comparison of behaviors adopted in T1 and T2, for each player 1's possible offer. If player 2 is influenced by player 1's offer, player 2 who faces incomplete information acts in a different way than the one who has complete information. The "*income effect*" does not exist.

In T4, this influence results from the comparison of behaviors adopted in the dictator game (where she is a proposer of an endowment given by the experimenter) and behaviors adopted in the DUG (where she has to divide an amount coming from a fair or unfair split of player 1).

In, T2 and T4, if player 2 is influenced by player 1's offer, she could adopt two types of behaviors. Either she adopts a behavior of indirect reciprocity (Hypothesis H3A-1). Either she adopts a strategic behavior to maximize her expected gain (Hypothesis H3A-2). In that case, player 2 is influenced by player 1's offer, not to signal player 1's behavior but to maximize her expected payoff. In other words, the higher player 1's offer is, the fewer player 2 is willing to offer a high share to player 3.

Data observed in T2 will be confronted with those obtained in T3 in the aim to study the impact of player 3's available information on player 2's behavior. It will be noteworthy to examine whether player 3's understanding of signal favors the behavior of indirect reciprocity. In another way nonetheless, player 2 could be influenced by player 3's available information, not to signal the fairness or unfairness of player 1 but the fear of player 3's judgement could force her to make a fair split of the amount received, whatever player 1's share. In the hope that player 3 believes player 2 is fair.

In the three-player DG, this influence results from the comparison of behaviors adopted in T5 and T6, for each player 1's possible offer. If player 2 is influenced by player 1's offer, player 2 who has incomplete information acts in a different way than the one who has complete information. Yet, the "*income effect*" does not exist. Here she could adopt a strategic behavior to maximize her gain (Hypothesis H3A-2). But she could adopt a behavior of generalized reciprocity (Hypothesis H3A-3)

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[9] We cannot compare offers in T3 (or T4) with T6 since we recall that in T3 player 3 has an information which is not tested in the three player DG and in T4 player 2s have taken part in a dictator game in the first part of the experiment.

where she gives an increasing share of player 1's offer, with the increase of it, without having the opportunity to punish or reward player 1.

On the other side, player 2 could not be influenced by player 1's share (Hypothesis H3B). In that case, no difference in player 2's offers is noted between T1 and T2, the dictator game and the DUG in T4 or between T5 and T6, for each player 1's offer. Either player 2 has selfish motivation: she tries to maximize her own payoff by making a null offer (Hypothesis H3B-1). Either player 2 has altruistic motivation and proposes a positive offer without any correlation with the level of the player 1's one (Hypothesis H3B-2).

4. Participants and procedures

To insure that no one knew the role to each others, subjects drew personal code from a box to determine who will be player 1, 2 or 3 (anonymity). In this way, the role of subjects was randomly allocated and they were never informed about the identity of their partners. Each subject answered to the questionnaire corresponding to her role. We implemented a one-shot game to guaranty that no subject could ever gain a reputation for being, for example fair. This experimental procedure allows avoiding the fear of further retaliations or conversely the hope of further rewards.

We used the Strategy Method, proposed by Selten (1967) to elicit subjects' strategy. Player 2s answered all player 1's offers that were likely to be made (Figure 2). This process allowed us to learn player 2's share according to a fair or unfair player 1's offer. To determine final results (negotiation accepted or rejected in the DUG), we had selected answers of all members of a group. For player 1's offer, we had associated player 2's share, and once this division selected, we had observed if player 3 accepted or rejected player 2's offer; this last step concerning only the DUG since in the three-player DG player 3 has no veto power. Moreover, player 3 could take two types of decisions in the DUG: either she rejected player's 2 share - whatever the amount - either she decided to accept starting from a threshold.

Lastly, we recall that to avoid the equal split between player 2s and player 3s at equilibrium we introduce a minimal threshold for player 1s and player 2s' offers. In T1 and T2 this threshold is equal to 300 experimental points for player 1s and 100 points for player 2s (with the conversion rate: 100 experimental points = 1€ and offers are made by interval of 100 points). To reinforce the possibility for player 2 to signal player 1' selfishness, in T3 and T4 the threshold is equal to 100 experimental points for player 1 and player 2 can send nothing to player 3. To compare the results obtained in the three-player DG with those obtained in the DUG, we adopt the same thresholds as in the T1 and T2.

---*[Insert Figure 2]*---

357 undergraduates' students[10] were recruited from the University of Montpellier to take part in our experiment. We organized three sessions for T1, three sessions for T2 with 18 subjects by session, three sessions for T3 with 21 subjects by session and four sessions for T5, four sessions for T6 with 15 subjects by sessions. According to a recommendation of Cubitt et al. (2001), we adopted a between subjects design in these four treatments, to provide inter individual comparisons. The procedure implemented for T4 was different. We used a within subject design to compare behaviors adopted in the dictator game and thereafter in the DUG. Such comparison could reveal a correlation between the types of repartitions made in the two games. For that, we organized three sessions with 24 subjects by session (12 subjects for the dictator game and 18 subjects for the DUG including 6 subjects who have taken part in the dictator game). More precisely, each session was made in two steps. First of all, 12 subjects took part in the dictator game (6 players P and 6 players R). The role of subjects was randomly allocated. According to their role, subjects went in one of the two experimental rooms, player Ps and player Rs being in two separate rooms. Player Ps were provided with sealed envelopes[11] to make their choice. At the beginning, 10 "fictitious Tickets of 100 experimental points" were deposited in their envelope and they could give all of it, anything or nothing to player R. They deposited the sum corresponding to their offer to player R in the envelope for player R then they gave the envelope to the experimenter. The experimenter transmitted the envelopes to the experimenter who was with player Rs. Each player R then chose randomly one envelope and received the corresponding sum before leaving. Player Ps gave next their envelopes to the experimenter. The personal code of each player was noted on their envelope to proceed to their remuneration at the end of the experiment. Once the first game finished, player Ps selected randomly a new personal code - corresponding to the role of player 2 - for the second game. In this manner, all player Ps became player 2s. To compare behaviors adopted in these two games, we asked them to register their personal code corresponding to the two games on the forms of the DUG. Once the new codes allocated to player 2s, 12 new subjects arrived. These new subjects had the role of player 1 or player 3 and they did not know that subjects already sat in this room had taken part in an experiment before. The second step of the experiment could start with 18 subjects by session. The course of this game was similar to those of others treatments. Moreover, player 2s knew at the beginning of the experiment that they took part in two scenarios with different subjects.

In all treatments, the remuneration of subjects included a show up (3€) and the amount corresponding to their performance in the experiment. The role of subjects was explained with

[10] Altogether we recruited 357 participants which include the ones who are player 1, player 2 and player 3. This paper focuses on player 2's behavior which corresponds to: 18 subjects in T1, 18 in T2, 19 in T3, 18 in T4; 20 in T5 and 20 in T6. Unfortunately, due to the exclusion of subjects who haven't understood correctly the instruction, we could not have the same number of data in each treatment.

[11] This system of envelope is usually used in the dictator game, see for example Hoffman et al., (1994). It enables us to preserve the anonymity of subjects towards other participants.

handwritten instructions[12] distributed at the beginning of the experiment. After all subjects had read instructions, an oral version was given. Then they had to fill out an experimental pre questionnaire, to check their complete understanding of instructions. Once this questionnaire corrected, the experiment began. For each treatment, one session lasted one hour.

5. Results[13]

5.1 True motivations

In T5, player 2s have only incomplete information about player 1's endowment and player 3 has no veto power. In that case, player 2s cannot be influenced by other players when they take their decisions. This treatment allows us to know their true motivations. The average division corresponds to an unfair division (28.32%) that results from heterogeneity of behaviors at the individual level (Table 2 and Figure 3). 15% of subjects have selfish motivations by giving nothing to player 3. Among 85% of altruistic subjects, only 35.30% of them act in a fair way by offering 43.79% but none of them offers on average more than half of player 1's offer. The major part (64.70%) of subjects makes a positive but unfair offer (27.60% on average).

---*[Insert Table 2 & Figure 3]*---

Result 1: ***Heterogeneity of player 2s' motivations***
The average division corresponds to an unfair one even if a diversity of individuals' behaviors from purely selfish behaviors (Hypothesis H1A) to fair behaviors (Hypothesis H1B-2) exists.

5.2. Impact of player 3's veto power on player 2's decision

Comparison of behaviors observed in the DUG and in the three-player DG points out the impact of player 3's veto power on decisions taken (see Figure 4).

When player 2s face incomplete information about player 1s' endowment, offers are significantly different in the two games. On average, player 2s offer 45.19% in T1 and only 28.32% in T5 ($p< 0.001$). This difference is also significant when we compare the type of player 2's repartition. Firstly no selfish behavior is observed when player 3 has a veto power (T1), contrarily to T5. Secondly, unfair player 2s offer 36.22% in T1 and 27.60% in T5 ($p = 0.069$); In the same way, fair

[12] Instructions are available upon request to authors.
[13] We focus on results obtained for player 2s where their repartitions are expressed in percentage of player 1's offer. A discussion of player 1's and player 3's behaviors in this experiment is provided in Bonein, Serra (2004).

player 2s offer 48.64% in T1 and 43.79% in T4 (p = 0.009). Finally, the frequency of fair repartitions increases drastically when player 3 has a veto power (from 35.30% in T5 to 72.22% in T1).

Our data point the same mainstream when player 2s have complete information about player 1s' endowment. On average, player 2s offer 40.11% in T2 and only 30.21% in T6 (p = 0.126). As previously, no selfish behavior is observed in the DUG in comparison to the three-player DG (5%). The difference of repartitions is here only significant when we compare unfair player 2s' repartition: they offer 30.58% in T2 and 16.50% in T6 (p = 0.021) whereas fair player 2s offer 47.73% in T2 and 45.57% in T6 (p = 0.280). Now if we differentiate a fair from an unfair player 1's offer[14], differences in behaviors adopted in T2 and T6 are solely significant when player 1 makes an unfair split. When player 1's offer is unfair player 2s offer on average 41.32% in T2 and 28.04% in T6 (p = 0.035). Whereas, when player 1's offer is fair player 2s offer on average 38.44% in T2 and 33.57% in T6 (p = 0.534). The difference of trend in T2 and T6 (from 41.32% to 38.44% in T2 and from 28.04% to 33.57% in T6) suggests different strategies within individuals in these two treatments. This will be tested in the next analysis.

--*[Insert Figure 4]*--

Result 2: ***Impact of player 3's veto power***

The introduction of player 3's veto power leads to higher average offer, the disappearance of selfish behaviors, unfair offers less pronounced and fair offers more pronounced and more frequent, whatever player 2's available information.

5.3. Influence of player 1's offer on player 2's decision

A first look at mean repartitions made by player 2 in case of incomplete information and complete information, under the same condition of veto power, does not highlight significant differences. This observation is confirmed by both Mann-Whitney test (p = 0.104 for T1/T2 and p= 0.369 for T5/T6) and one-way Anova test (p = 0.103 for T1/T2 and p = 0.728 for T5/T6) or paired-samples T test (p = 0.606) and Wilcoxon sign rank test (Z = -0.936, p = 0.349) for T4. Nonetheless slight differences can be noted (see Figure 5) about the variance of the repartitions in each treatment. The Levene statistic reveals that the hypothesis of homogeneity of variance is rejected[15] for T1/T2 (p= 0.103) and T4 (p < 0.001) but not for T5/T6 (p = 0.193).

---*[Figure 5]*--

[14] Such comparisons can be made only in case of player 2's complete information, i.e. T2 and T6.

[15] Even though the hypothesis of homogeneity of variance is rejected, the one-way Anova test works since the size of sample for compared treatments is the same.

It is noteworthy that even if, on average (i.e. for all amount offered by player 1), similar offers are observed - under the same player 3's veto power condition - some differences appear within individuals. In treatment 2, the mean offer is equal to 41.32% when player 1 is unfair and 38.44% otherwise (Z = -0.893, p = 0.372). The opposite and significant tendency is observed in T6 where player 2s offer on average 28.04% when player 1 is unfair and 33.57% otherwise (Z = -3.428, p < 0.001). This last result catches a glimpse of the prevalence of reciprocal behaviors at the individual level and more generally an impact of player 1's offer on player 2's repartition. To confirm this intuition we rely on the comparison of the distributions of the share offered according to player 1's offer in each treatment. The Kruskal Wallis test confirms the influence of player 1's offer on player 2's division ($\chi^2(4) = 151.106$). More precisely, the distribution of player 2's share between T1 and T2, T5 and T6 are significant at 1% level. Such results suggest that subjects are really influenced by player 1's intentions. The "*income effect*" does not constitute an explanation of repartitions observed.

In a first step we study results obtained in the DUG - when player 2s have complete information – to test the indirect reciprocity then in a second step we will study the generalized reciprocity through results obtained in the three-player DG (Table 3, Figures 6 & 7).

--*[Table 3, Figures 6 & 7]*---

A first exam to individual correlations between player 1's offer and player 2's share is necessary to determine the existence of indirect reciprocity. It results heterogeneity of individual behaviors since 45% give a decreasing part of player 1's offer when this last becomes fair whereas 55% offer an increasing share. These findings indicate that, 45% of player 2s adopt a strategic behavior (Hypothesis H3A-2): their offers are decreasing with player 1's offer. In others words, when player 1 makes a small offer, they offer a high proportion to player 3 to maximize the probability of acceptance. On the contrary, when player 1 makes a higher offer, they offer a smaller share to maximize their expected payoffs, the share offered being enough high to lead player 3 to accept the repartition. This behavior is confirmed by the Spearman rank correlation coefficient[16] (r = -0.656, p < 0.001 when X = F and r = - 0.906, p < 0.001 when X = f). On the other side, 55% of player 2s act according to indirect reciprocity (Hypothesis H3A-1): the higher player 1's offer is, the more the player 2's share offered is high to reward the fairness of player 1. In the same way, the smaller player 1's offer is, the fewer player 2's share offered is high to punish the unfairness of player 1. The increase of player 2's offer with the increase of player 1's offer is confirmed by the Spearman rank correlation coefficient (r = 0.650, p < 0.001 when X = F and r = 0.899, p < 0.001 when X = f). Furthermore, we observe substantial heterogeneity in the degree of reciprocity across individuals.

[16] This coefficient of correlation is computed on the average of player 2's share, for each player 1's offer. Nonetheless, the distinction between subjects paired with player 1s who have f and those who have F is required since the threshold for fair offers differs according to the amount of the initial endowment.

Indeed if we study player 2's repartition when player 1 makes an unfair offer and thereafter a fair offer, we note few change in player 2's behavior[17] (Z = -2.805, p = 0.005 for reciprocal subjects and Z = -2.521, p = 0.012 for strategic ones). In case of indirect reciprocity, for example, subjects do not make a null offer to player 3 when player 1 is unfair and thereafter an equal split when player 1 is fair. The change of behavior is weaker. When subjects act strategically, 50% of subjects adapt their behaviors according to player 1's offer: They make a fair division when player 1 makes an unfair split; otherwise, they make an unfair division. For the others, the higher player 1's offer is, the less the share proposed to player 3 is high, without changing the type – fair or unfair – of their repartitions. This change of strategy is less pronounced in case on indirect reciprocity. Only 20% of subjects make an unfair division if player 1 makes an unfair split and a fair division otherwise. For the others, the higher player 1's offer is, the more the share proposed to player 3 is high. In others words, if player 1 makes a fair division, player 2 offers a higher share of the amount received than if player 1 is selfish in the hope to reward indirectly the player 1. But if player 1 is unfair, player 2 offers only a weak share of the amount received to incite player 3 to reject the offer. She punishes then indirectly the player 1.

To confirm the existence of these two types of behavior we lead an OLS regression[18]. Coefficients are estimates from OLS regressions but we were concerned about possible heteroscedasticity[19] in each regression. Homoscedasticity should not be assumed, but should be tested. The White test rejects the null hypothesis of no heteroscedasticity for seven regressions. Consequently, we add the White correction (1980) for the heteroscedasticity of standard errors to our OLS estimates of equations concerned and standard errors shown in brackets are robust. The full specification, with all coefficients is shown in Table 3. Both strategic and reciprocal behaviors are confirmed with the sign of coefficients estimates from OLS regression notably with the sign and significativity of player 1's offer.

In treatment 3, repartitions made when player 1 is unfair and thereafter fair provide a first indication on the existence of the influence of player 1's offer on player 2's decision: player 2 proposes 40.01% of the amount received when player 1 is unfair and 42.56% otherwise (Z= -1.853, p= 0.064). Data observed confirm our intuition: player 3's available information favors the behavior of indirect reciprocity. 73.68% of player 2s act according to the indirect reciprocity (and only 55% in T2). In others words, a positive and significant correlation exists between player 1's offer and player 2's share (r = 0.936, p < 0.001 when X = F and r = 0.614, p = 0.007 when X = f). Yet, we note

[17] This observation explains that the introduction of a dummy variable representing the intention of player 1 (this variable being equal to 1 if player 1 makes a fair offer and 0 otherwise) is rarely significant in further OLS regressions. Furthermore, in some regressions, its introduction leads to worst fit to the data. That's why regressions are implemented without it.
[18] The choice of the model estimates results of two goals: having a model with an economic meaning and that satisfies usual econometric hypotheses such as the absence of colinearity between independent variables and the normality of residuals.
[19] Under heteroscedasticity, the coefficient estimates are unbiased but inefficient.

substantial heterogeneity in the degree of reciprocity across individuals. Among reciprocal subjects, only 35.71% change the nature of their repartition according to the player 1's one. For the others, we note only an increasing trend of player 2's offer when player 1 becomes fair. Nonetheless variations in repartitions are more pronounced in this treatment ($Z = -3.239$, $p < 0.001$). The remainder of subjects, 26.32%, acts strategically by proposing a decreasing share of player 1's offer ($r = -0.243$, $p= 0.142$ when $X = F$ and $r= -0.633$, $p= 0.005$ when $X = f$). The slump of strategic behaviors is noticeably at the same time by the frequency of subjects who adopt such behavior and by the weaker negative correlation noted in T3 than in T2. The less significance of strategic behaviors in this treatment is confirmed by the OLS regression (Table 7) where player 1's offer acts negatively on player 2's share - which justifies the strategic behavior - but not significantly. Player 3's available information, i.e. her ability to judge player 2's share, deters player 2's to act strategically. This result implies that player 2 is influenced by player 3's regard when she takes her decision.

For T4, the influence of player 1's behavior on player 2's decision is analysed through the comparison of behaviors adopted in the dictator game and thereafter in the DUG. Even if mean divisions made in the two games are close, we note that player 2's share varies according to player 1's offer. In other words, player 2's offer is sensitive to the fair or unfair character of player 1's offer (Hypothesis H3A is checked). Yet, strategic behavior and indirect reciprocity can be noted (Table 3): 72% of subjects adopt a strategic behavior ($r = - 0.893$, $p < 0.001$ when $X = F$ and $r = -0.574$, $p < 0.001$ when $X = f$). Whereas only 28% of subjects act as indirect reciprocity ($r = 0.271$, $p= 0.6372$ when $X = F$ and $r = 0.740$, $p < 0.001$ when $X = f$).

Even if the mean repartition corresponds to an unfair one (only 5.55% of subjects make on average a fair split), small variations appear when we differentiate an unfair player 1's offer and a fair one. As in T2, if we study behaviors adopted by these two types of subjects, only few subjects change radically their strategies according to the fair or unfair offer ($Z = -1.214$, $p=0.225$ for reciprocal subjects and $Z = -2.970$, $p = 0.003$ for strategic subjects). First, when subjects adopt a strategic behavior, only 7.69% of subjects change their strategies when player 1 makes an unfair offer and thereafter a fair one: They make a fair division when player 1 is unfair; otherwise, they make an unfair division. Such variation is more pronounced in case on indirect reciprocity: 20% of them adopt an unfair behavior if player 1 is unfair too; Otherwise they make a fair division.

Lastly, 50% of subjects want to punish the unfairness of player 1: they make a null offer to player 3 when player 1 gives an amount lower than 10% of her endowment. This behavior highlights a straightforward signal of the rejection of player 1s' unfairness. With an offer equals to 0 to player 3, player 2 is sure to its rejection. This act enables her to punish indirectly, by means of her null offer to player 3, the player 1's unfairness. The possibility to offer 0 to player 3 explains the difference of indirect reciprocity observed on Figure 6. A finer analysis of repartitions within individuals points out interesting and somewhat surprising results. 66.66% of player 2s make a higher mean offer in the

DUG than in the dictator game (Figure 8). This result suggests that despite player 3's incomplete information, the veto power influences player 2's decision. A surprising result appears in the study of a possible correlation between the type of repartitions made in the two games. Despite the prominence of unfair repartition in the dictator game and strategic behavior in the DUG, data do not show a clear correlation between these two types. More precisely, whatever the offer in the dictator game, i.e. fair or unfair, in the two cases strategic behaviors dominate in the DUG: Among unfair player in the dictator game, 75% act strategically in the second game and among fair player 66.66% act strategically in the second game. Nevertheless, it is noteworthy that it is in case of fair split in the dictator game that reciprocal behavior are more frequent, even if strategic behavior dominates. From another point of view, we note that among reciprocal subjects, 40% make a fair offer in the dictator game whereas among strategic subjects, only 30.77% of them make a fair offer. Such analysis highlights an inclination for fair subjects to adopt a reciprocal behavior even if strategic one dominates.

As noted by Fehr and Gachter (2000) there is a substantial proportion of subjects who behave reciprocally but there is also a non-trivial fraction of individuals who behave completely selfish. The proportion of indirect reciprocal subjects in our data is quite similar to those of Fehr et al., (1997) who find that between 40% and 60% of subjects have an inclination for strong reciprocity, the others behaving selfishly.

--*[Insert Figure 8]*--

Result 3: Influence of player 1s' offer on repartitions made by player 2s

Player 2 is influenced by player 1's offer when she takes her decision. Both strategic and indirect reciprocal behaviors are observed.

The three-player DG allows testing the generalized reciprocity. The comparison of player 2's repartition with respect to player 1's offer in T5 and T6 underlines that player 2 is sensitive to player 1's offer when she takes her decision. More precisely, in T6, 80% of player 2s give an increasing share of player 1's offer to player 3 ($r = 0.702$, $p < 0.001$ when $X = F$ and $r = 0.963$, $p < 0.001$ when $X = f$). This result implies that in a dictator game, although player 2 could take advantage to player 3's no veto power and adopt a strategic behavior to maximize their gains, without risk, on the contrary, 80% of them act as generalized reciprocity predicts. The higher player 1's offer is, the more player 2's share offered is high. Only few subjects (20%) adopt a strategic behavior to maximize their gains. This strategy is confirmed by the Spearman rank coefficient correlation ($r = -0.549$, $p < 0.001$ when $X = F$ and $r = -0.275$, $p = 0.1461$ when $X = f$). In T6, variations in behaviors adopted according to the unfairness or fairness of player 1 are more pronounced but only for reciprocal[20] subjects ($Z= -3.422$, $p < 0.001$). It turns out that the large majority of player 2s agrees with the above mentioned statements, implying that generalized reciprocal inclinations are the rule rather than the exception. A closer inspection, however, reveals that there is substantial individual heterogeneity in the strength of reciprocal inclinations.

Result 4: ***generalized reciprocity***
Most of player 2s act as generalized reciprocity predicts: They are kind with player 3 if player 1 has been kind and conversely if player 1 has been unkind, knowing that this behavior cannot be led by the fear of player 3's reaction.

Finally, our data underline a higher proportion of generalized reciprocal inclination than the indirect reciprocal one: 55% or 28% of subjects according to the experimental design act according to the indirect reciprocity whereas 80% of subjects act as generalized reciprocity predicts. Only when player 3 has the capacity to understand player 2's signal without ambiguities, the frequency of indirect reciprocal subjects is closed to that of generalized reciprocal ones. Fehr and Schmidt (2006) highlight in their survey that the more complex the strategic interaction[21] becomes, the more the self-regarding behavior is likely. Our observation tends to confirm such proposition. The complexity of the strategic context of the DUG tends to reduce other-regarding behavior, especially the reciprocal one.

6. Conclusion

In this paper, we have shown that a sophisticated behavior of reciprocity could exist. We find that between 28% and 73.68% of subjects – according to the treatment of information – have such inclinations: intermediary subjects seek to punish or reward the proposers by their offers to responders. Our data underline a substantial heterogeneity in the degree of reciprocity across individuals: some makes an unfair split when the proposer is unfair; otherwise they make a fair split. But in majority, they do not change radically their split according to the unfair or fair proposition; they solely propose an increasing part of proposer's offer to responder, when proposer becomes fair.

Nonetheless, there is a non-trivial fraction of subjects who behave completely selfish. They adopt their offer with respect to the proposer's one in the aim to maximize the probability of acceptance. Like Fehr and Schmidt (2006), we believe that the most important heterogeneity in strategic games is the one between purely selfish subjects – who seek to maximize their expected payoffs – and subjects with a preference for reciprocity.

[20] We haven't got enough data for strategic subjects to compute this test.
[21] Like Fehr and Schmidt (2006, p. 657) we define strategic interaction to be those in which the potential gift recipients are also capable of affecting the gift givers' material payoffs.

Our findings add the understanding of behaviors adopted in labor relations with several hierarchical levels. By taking our original example, under indirect reciprocity, if the boss's boss gives only weak monetary offer to the boss, this last, due to her discontentment, will propose a small wage to worker who will be not incited to produce high effort. The small level of effort will not satisfy the boss's boss. Conversely, if the boss's boss provides a high monetary offer to the boss, the boss will give a high wage to worker to incite her to produce a high effort and to reward the boss's boss. But selfish motivation can appear, as noted in our experiment in such labor context. If we associate the desire to punish or reward the boss's boss to the desire to perpetuate the labor relation, the strategic behavior observed in our experiment could be an explanation of existing labor behavior: if the boss's boss gives a small monetary incitation to the boss, this last, in the hope to satisfy her boss and to carry on their relations, could give a high part of the boss's boss's offer. But if the boss's boss provides a high offer, the boss could give a part enough high to incite the worker to produce a high effort, but smaller than that if the boss's boss would give a small monetary incitation, to maximize her payoff, without compromising the satisfaction of the boss's boss.

Another reciprocal behavior – the generalized reciprocity – has been investigated in this paper. In that case neither reward nor punishment can intervene, solely a behavior of replication of those adopted by the previous generation. In such situation, reciprocal behaviors are prevailing since only 20% of subjects act in a strategic way.

Our findings support the idea that the more complex the strategic setting is, the more self-regarding behavior is likely and the less other-regarding behaviors dominate.

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Appendices

Figure 1: Indirect reciprocity Vs Equal split

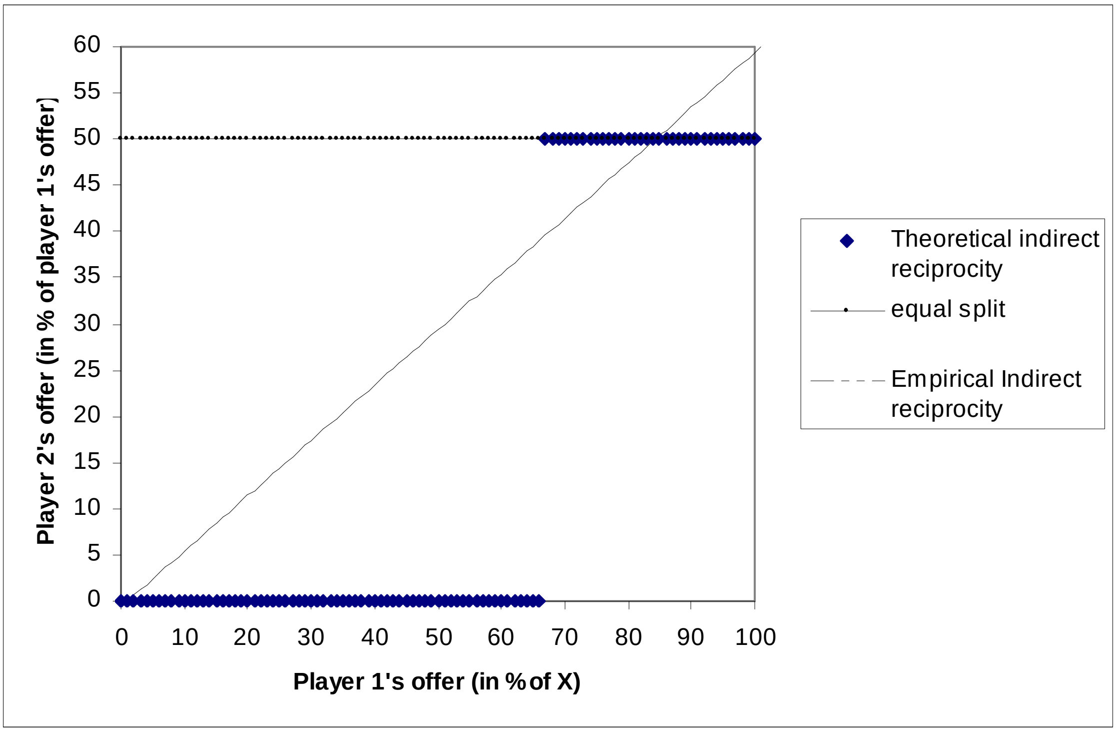


Table 1: Treatments of information

	Player 2's available information about X	Player 3'savailable Information about x	Player 3's veto power	Prior experiment for player 2
T1	incomplete	incomplete	yes	no
T2	complete	incomplete	yes	no
T3	complete	complete	yes	no
T4	complete	incomplete	yes	yes
T5	incomplete	incomplete	no	no
T6	complete	incomplete	no	no

Figure 2: Player 2's decision task

Please make a mark with "X" to the amount you will give to player 3, for each player 1's offer to you in the following table:

Amount given to player 3

Player 1's offer To you		0	100	200	300	400	500	600	…
	0								
	100								
	200								
	300								
	400								
	500								
	600								
	…								

Table 2: Player 2s'offers according to their motivations

			T1	T2	T3	T4	T5	T6
Selfish behavior		Frequency	0%	0%	0%	0%	15%	5%
Altruist behavior	Unfair split	Frequency*	27.78%	44.45%	31.57%	94.45%	64.70%	47.37%
		Mean offer	36.22%	30.58%	28.63%	29.01%	27.60%	16.50%
	Fair split	Frequency*	72.22%	55.55%	68.43%	5.55%	35.30%	52.63%
		Mean offer	48.64%	47.73%	43.53	53.47%	43.79%	45.57%
All subjects		Mean offer	45.19%	40.11%	41.08%	30.37%	28.32%	30.21%

*In percentage of altruistic subjects

Figure 3: Heterogeneity of player 2s' behaviors in treatment 5

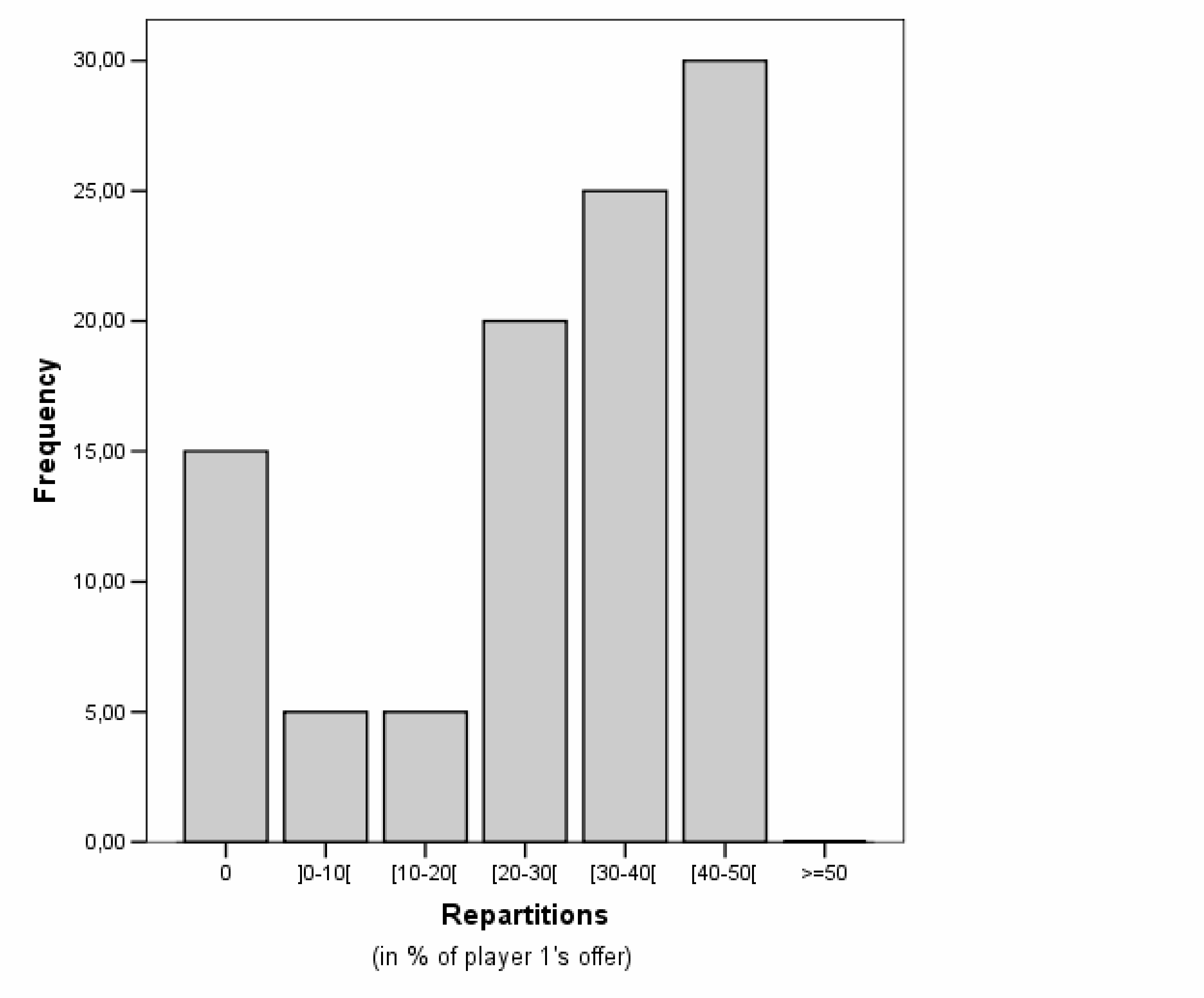
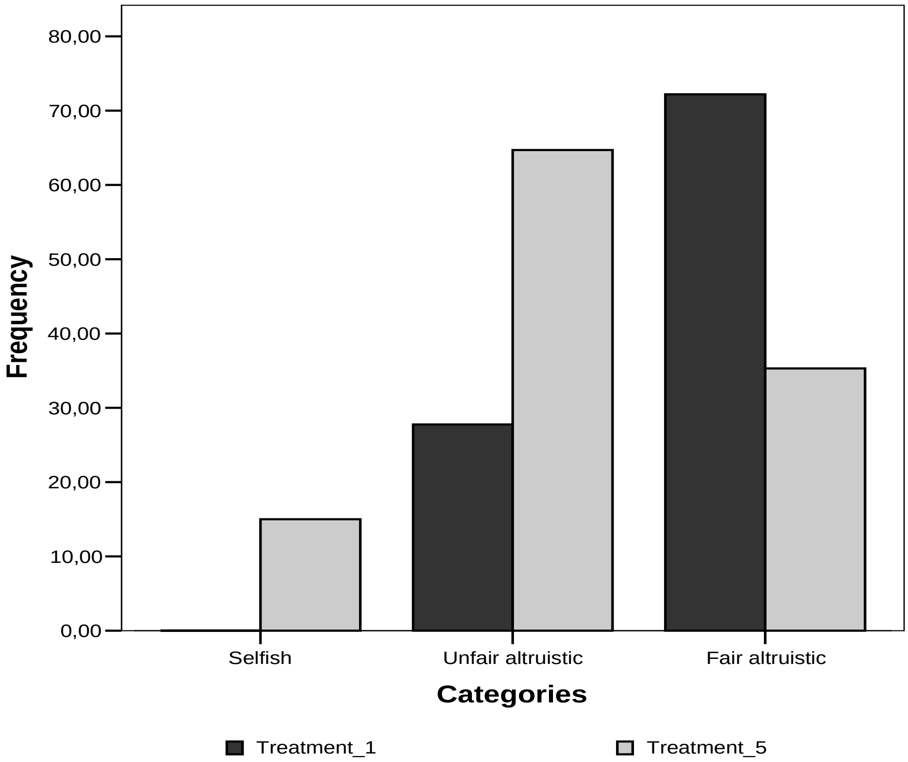


Figure 4: Impact of player 3's veto power on player 2's repartition

In case of incomplete information



In case of complete information

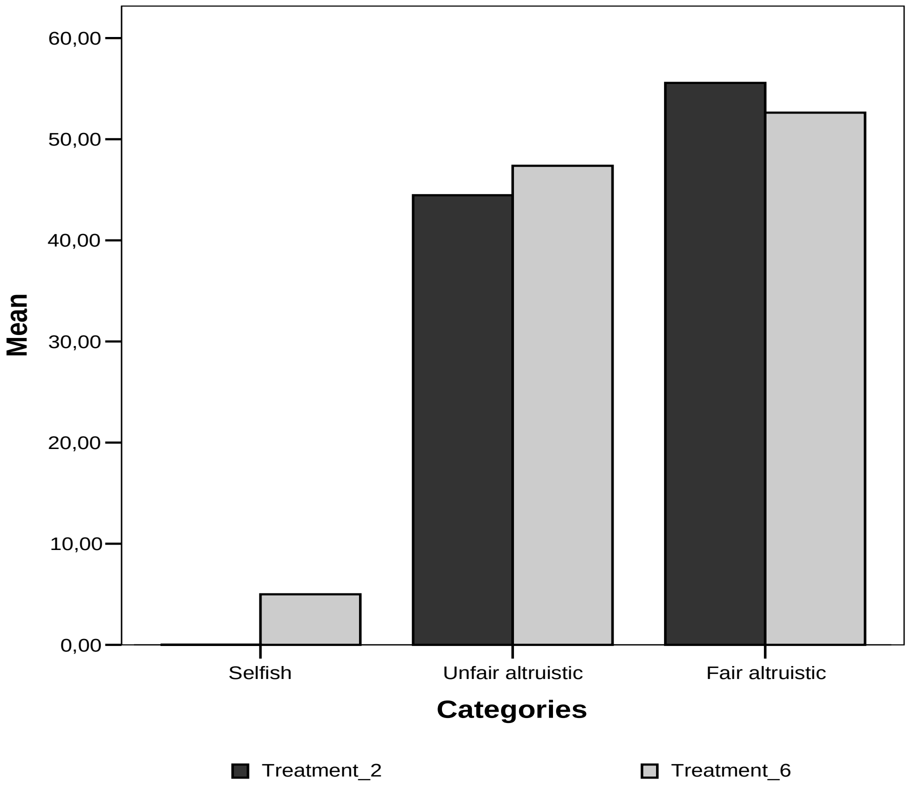


Figure 5: Mean and variance of player 2's repartitions in each treatment of information

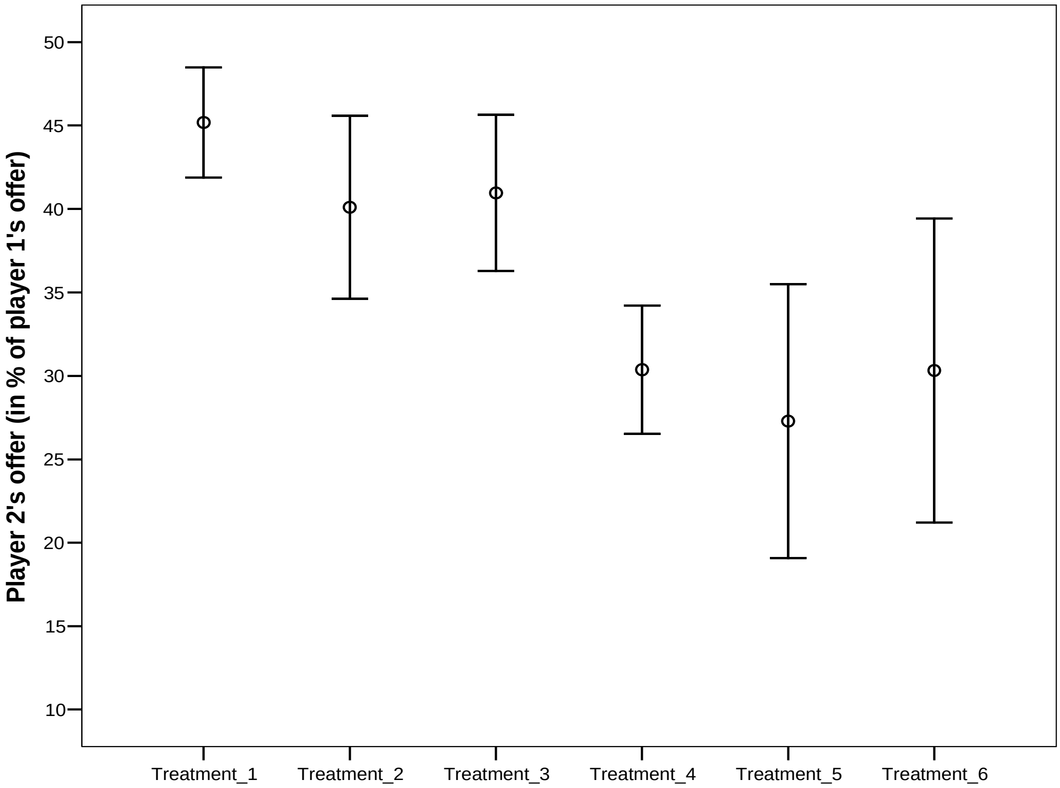


Table 3: OLS regression with White correction

on player 2s' repartition according to the type of behaviors

Behavior:	Reciprocity				Strategic			
	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Constant	48,4169***	43,1239***	21,8348***	1,4202	52,553***	35,9507***	18,9295***	2,5276
	[1,746]	[1,8844]	[6,4506]	[3,1116]	[3,744]	[3,9310]	[3,2247]	[3,5428]
Endowment	-0,004***	-0,0014**	0,0937	0,0088***	-0,002*	-0,0002	0,3848***	0,0059***
	[0,0007]	[0,0006]	[0,1797]	[0,0009]	[0,001]	[0,0015]	[0,0916]	[0,0012]
Player 1's offer	0,0032***	0,0030***	0,2049*	0,0043***	-0,004***	-0,0007	-0,1328*	-0,0005
	[0,0007]	[0,0005]	[0,1214]	[0,0006]	[0,001]	[0,0013]	[0,0734]	[0,0012]
Adjusted R	0,1179	8,90E-03	2,88E-02	0,4099	0,122	5,80E-03	3,27E-02	5,06E-02
No of observation	320	426	165	445	200	135	510	140

Coefficients are estimates from OLS regression with White correction only when heteroscedasticity appears in OLS regressions, i.e. regressions implement in case of reciprocal behavior in treatment 2, 3, 4 and 5 and in case of strategic behavior in treatment 3, 4 and 5. Moreover, regressions have been computed when player 2 has only complete information. Robust Standard errors are in brackets.

***, **, * indicate significance at 1-, 5-, 10- level, respectively

Figure 6: Player 2s' repartition when they adopt a behavior of reciprocity

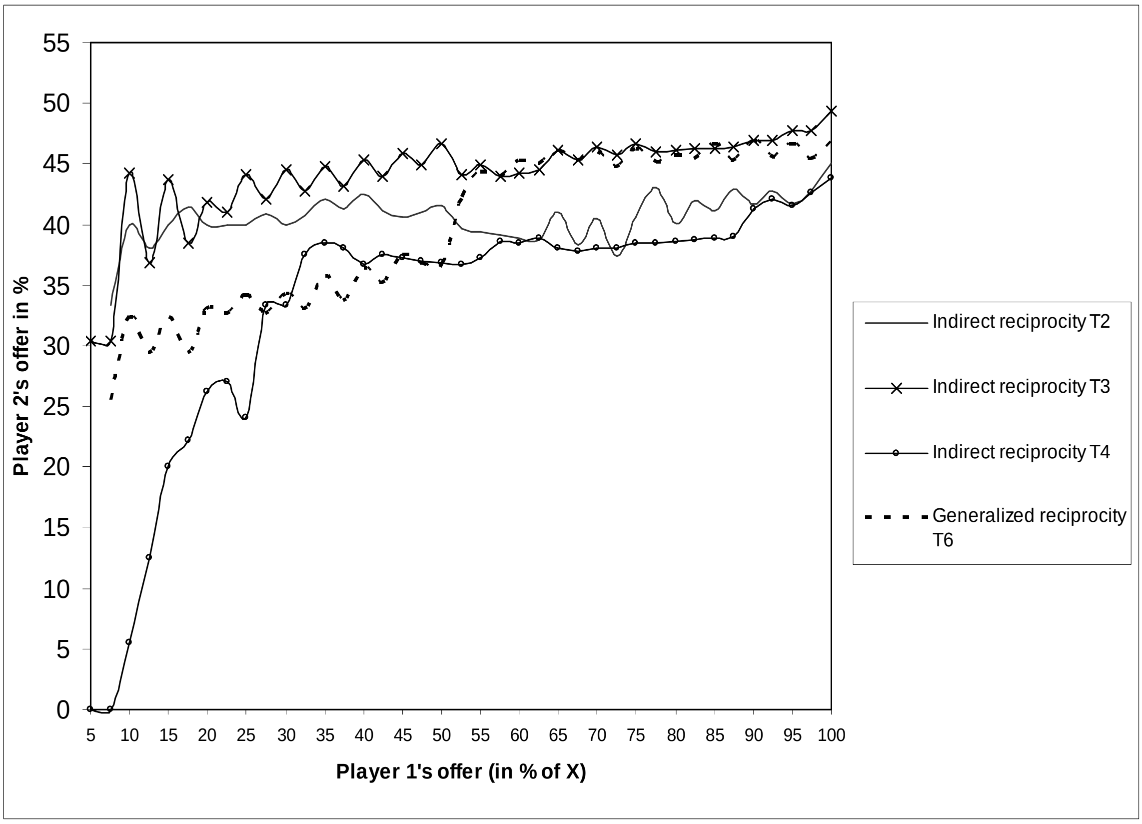


Figure 7: Player 2s' repartition when they adopt a strategic behavior

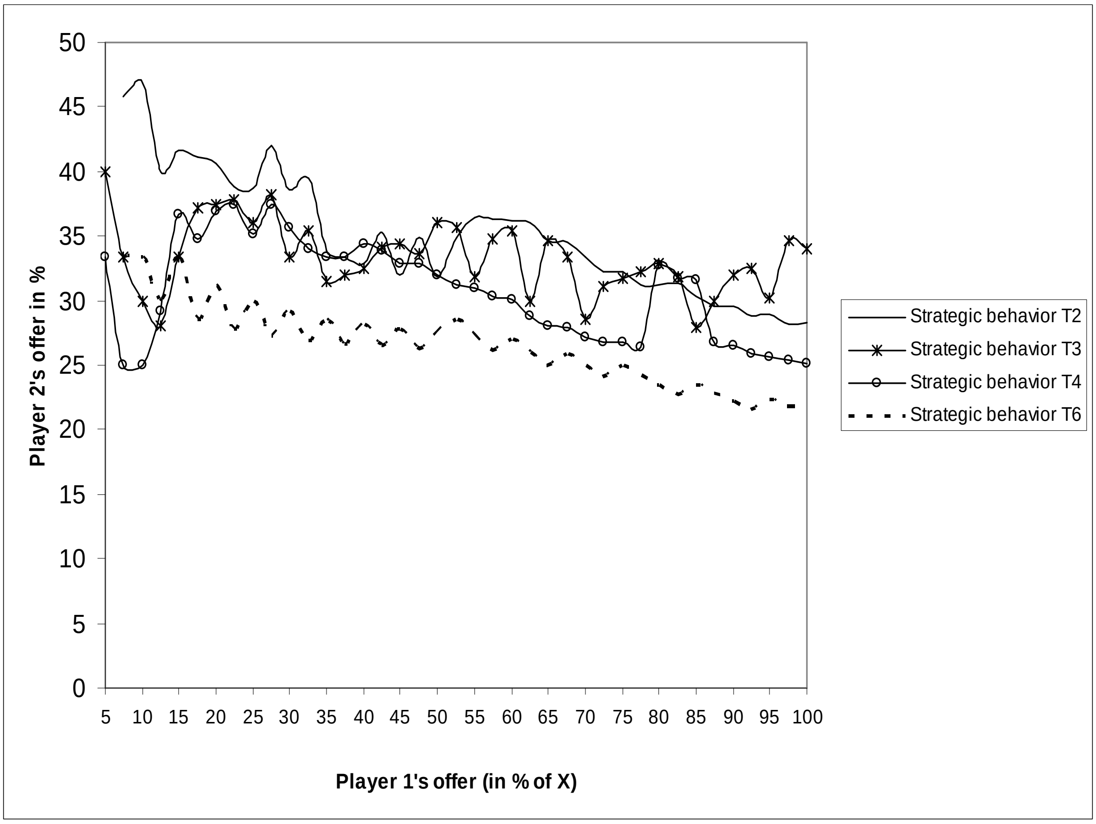


Figure 8: Offers made by proposers in the dictator game and thereafter player 2s