Elicited Beliefs and Social Information in Modified Dictator Games: What Do Dictators Believe Other Dictators Do?*

Nagore Iriberri+
Universitat Pompeu Fabra

Pedro Rey-Biel**
Universitat Autònoma de Barcelona

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Abstract

We use subjects' actions in modified dictator games to perform a within-subject classification of individuals into four different types of interdependent preferences: Selfish, Social Welfare maximizers, Inequity Averse and Competitive. We elicit beliefs about other subjects' actions in the same modified dictator games to test how much of the existent heterogeneity in others' actions is known by subjects. We find that subjects with different interdependent preferences in fact have different beliefs about others' actions. In particular, Selfish individuals cannot conceive others being non-Selfish while Social Welfare maximizers are closest to the actual distribution of others' actions. We finally provide subjects with information on other subjects' actions and re-classify individuals according to their (new) actions in the same modified dictator games. We find that social information does not affect Selfish individuals, but that individuals with interdependent preferences are more likely to change their behavior and tend to behave more selfishly.

Keywords: interdependent preferences, social welfare maximizing, inequity aversion, belief elicitation, social information, experiments, mixture-of-types models.

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+ Nagore Iriberri. Departament d'Economia i Empresa. Universitat Pompeu Fabra, Ramón Trías Fargas 25-27, 08005 Barcelona (Spain). Tel: (+34) 935422690. E-mail: nagore.iriberri@upf.edu.
** Pedro Rey-Biel. Universitat Autònoma de Barcelona. Department d´Economia i d´Historia Econòmica. 08193, Bellaterra. Barcelona (Spain). Tel: (+34) 935812113. E-mail: pedro.rey@uab.es.

1. **Introduction**

In the last twenty years the experimental literature has challenged the classic assumption that individuals are only motivated by their own individual material payoff, as they may in fact take into account the outcome of their decisions on others' payoffs.[1] This evidence has given rise to extensive work on interdependent (or "social") preferences.[2] Different preferences have been proposed. Standard "Selfish" preferences assume individuals only care about their own material payoff. "Social Welfare" maximizing preferences correspond to individuals caring positively about others' payoffs. "Inequity Averse" preferences include both positive and negative concerns about others' payoffs depending on subjects' relative standing. They assume individuals care positively about others' payoffs when ahead (better-off than others) but negatively when behind (worse-off than others) (Fehr and Schmidt (1999) and Bolton and Ockenfels (2000)). Finally, "Competitive" preferences assume individuals care negatively about others' payoffs. Charness and Rabin (2002) (CR from here on), encompass these four different models of interdependent preferences in a simple piece-wise linear utility model with two parameters that capture the weight on others' payoffs.[3] Figure 1 shows indifference curves for these four types of preferences.

Several studies have aimed to find the interdependent utility function that explains best the distributional choices made by subjects in experiments performed in the laboratory.[4] More recently, researchers have aimed to identify and quantify different types of interdependent preferences in experiments where subjects take distributive decisions (Andreoni and Miller (2002), Blanco et al. (2007), and Fisman et al. (2007)). An important finding of these studies is that the existence of heterogeneity in interdependent preferences cannot be ignored. In particular, around half of the subjects

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[1] See Fehr and Schmidt (2000) and Sobel (2005) for comprehensive and excellent surveys.

[2] "Social preferences" and "other-regarding preferences" have been used to refer to distributional preferences as well as reciprocity concerns. Since our setting is non-strategic we focus on purely distributional preferences and thus use the term "interdependent preferences" to refer to purely distributional concerns. See also Fisman et al (2007) for a discussion on the difference between preferences for giving and social preferences.

[3] We refer to the model presented on page 822 in Charness and Rabin (2002), where parameter q is set to be equal to zero (no reciprocity issues considered). Thus, there are only two relevant parameters in the model, ρ and σ, the weights for others' payoffs when ahead and behind respectively (as reproduced in our equation (1), section 4). It should be noted that our Social Welfare maximizer type is defined within this model, by setting ρ and σ to be strictly positive. That is, it is not based on the more general Social Welfare maximizer model depicted in their Appendix, in which there exists a trade-off between the total surplus and the payoff of the individual who is worst-off. Charness and Grosskopf (2001) find that this more complicated Social Welfare maximizer represents individuals' preferences better.

[4] See, for example, Fehr and Schmidt (1999), Bolton and Ockenfels (2000) and Engelmann and Strobel (2004).

in these experiments behave as Selfish while a minority behaves as Competitive. Moreover, there exists a significant portion of subjects whose behaviour is consistent with both Social Welfare maximizing preferences and Inequity Aversion.

This paper goes one step further and studies the role *beliefs* and knowledge about others' distributional decisions (*social information*) play in interdependent preferences. Any application assuming heterogeneity of interdependent preferences requires assumptions about individuals' beliefs about others' actions and thus preferences. One standard assumption in incomplete information applications is that preferences are private knowledge but that the distribution of different preferences is commonly known. We elicit beliefs about others' actions and therefore preferences, in order to test how much of this heterogeneity in preferences is actually known to the subjects. In particular, we test whether individuals with different interdependent preferences have indeed a different perception about the existent heterogeneity. For instance, do Selfish and Social Welfare maximizers expect the same behaviour from others? Furthermore, in purely interdependent preferences, the knowledge of this heterogeneity is assumed not to affect own behaviour. We provide social information in order to test whether it has any relevance for individual decision making. In particular, we inform subjects about the distribution of other decision makers' actions and we check whether this information affects their own decision making.[5]

We depart from the current experimental literature on belief elicitation by using a purely decision making and therefore, non-strategic setting.[6] In our experiment, subjects express their beliefs about actions taken by other subjects with whom they never interact and whose actions can never affect own payoffs. We proceeded in this way due to two reasons. First, this offers a clean test for the role beliefs and knowledge of heterogeneity in others' actions might play, if any, in purely interdependent preferences. Beliefs in our context can only capture uncertainty about others' actions and therefore preferences. Second, non-strategic environments control for issues such as intention-based utilities, perceptions of kindness and unkindness and/or reciprocal behaviour.[7]

[5] As it will become clear in the description of the experimental design, elicited beliefs as well as social information are about others' *actions* and not directly about others' *preferences*. However, given that in our experimental design different preferences yield different action profiles, these two concepts are related.
[6] See, for example, Croson (2000), Nyarko and Schotter (2002), Costa-Gomes and Weizsäcker (in press), Rey-Biel (in press) and Ivanov (2006).
[7] Dufwenberg and Gneezy (2000), Cabrales et al. (2006), Gächter and Renner (2006) and Bellemare et al. (in press) study beliefs in relation to interdependent preferences. However, elicited beliefs in their settings refer to actions taken by subjects whose choices affect own payoffs. That is, they study the effect of beliefs on social preferences in strategic settings.

Thus, non-strategic settings such as modified dictator games are an ideal bed test for whether beliefs and social information are relevant in modelling other-regarding behaviour.

Our experimental design is a modified dictator game inspired by the designs of both Andreoni and Miller (2002) and Fisman et al. (2007), but it includes differences that are crucial for our research questions.[8] Deciders in our experiment have to choose in sixteen different decision tables among three different options that yield different payoff distributions for a Decider and a Receiver. The three options consist of a self-payoff maximizing choice, a surplus creating choice, in which Deciders give up one payoff unit to allow the Receiver to obtain $s>1$ more units, and a surplus destroying choice, in which Deciders give up one payoff unit to destroy Receiver's payoff in $s>1$ units. The sixteen decision tables differ on whether the Decider is better-off or worse-off than the Receiver, as well as in the number of created or destroyed units, $s>1$. This simple design allows us to identify the four most prominent types of interdependent preferences included in the CR model (2002): Selfish (SF), Social Welfare maximizing (SW), Inequity Averse (IA) and Competitive (CP) preferences. Notice that a SF Decider should always choose the self-payoff maximizing choice. A SW Decider should either choose the selfish or surplus creating action but never a surplus destroying action. An IA Decider on the other hand, should either choose the selfish or surplus creating action when being better-off than the Receiver, but either the selfish or surplus destroying action when being worse-off than the Receiver. Finally, a CP Decider should either choose the selfish or surplus destroying action but never a surplus creating action.[9]

The experiment consists of three parts. First, subjects take actions over the sixteen decision tables. Given their decision profile, we are able to perform a within subject classification of subjects into the four different preferences-types. Second, we elicit Deciders' beliefs about other Deciders' actions in exactly the same sixteen decision tables. This allows us to identify different beliefs among the subject population and to

[8] In Andreoni and Miller (2002)'s design subjects make choices over different budgets of payoffs between themselves and another subject, with different relative prices of own-payoff and other-payoff. Our modified dictator games are similar to theirs in that they also include prices for surplus creating and surplus destroying actions. Fisman et. al. (2007)'s design replicate Andreoni and Miller (2002)'s design but they also allow for step-shaped budget sets, in which subjects can take Pareto damaging actions. Our design is similar to theirs in that it also allows for Pareto damaging behavior (our surplus destroying action). Our main difference with respect to these two studies resides in having only three available actions. Making the choice set discrete allows us to elicit beliefs and provide information on other subjects' actions in a simple and meaningful manner.

[9] As it will become clear later, for SW, IA and CP individuals, the choice between the selfish and the surplus creating/destroying action may depend on the value of s. For a detailed explanation of the identification strategy see footnote 26.

classify each individual into different belief-types. We compare the preferences-type classification with the belief-type classification in order to measure how much of the existent heterogeneity in actions is known to the subjects and also to test for correlation between their actions and beliefs. Finally, Deciders take actions over the sixteen decision tables as in the first part of the experiment, but this time, we provide them with information about the distribution of choices other Deciders previously made. This allows us to compare the preferences-types classifications in parts one and three, in order to test whether social information has any influence on their decisions.

We find a preferences-type distribution very similar to those found by Andreoni and Miller (2002) and Fisman et al. (2007). Selfish preferences-type is the most frequent (44% of the subjects), followed by Inequity Averse individuals (25%) and Social Welfare maximizers (21%). A small fraction of subjects is classified as being Competitive (10%). More importantly, we find that individuals with different interdependent preferences indeed have different beliefs about others' actions and that they are correlated with their type. Selfish individuals systematically state they believe other individuals only take selfish actions, while other preferences-types are more aware of the existent heterogeneity in actions. Social Welfare maximizers are the individuals whose beliefs are closest to the actual heterogeneity in observed behaviour. Finally, social information affects types very differently. While Selfish subjects never change their type, showing great robustness to social information, almost half of the subjects classified as having other-regarding preferences (SW, IA and CP) are more vulnerable to social information and thus, change their type, tending to behave overall more selfishly.[10]

Our results suggest that it may be problematic to assume that heterogeneity in preferences is common knowledge, as well as to assume that updating those beliefs through social information will not influence behaviour. These findings have important implications for modelling interdependent preferences, as well as for the application of interdependent preferences to both non-strategic and strategic settings. Thus, this paper contributes to the discussion of whether purely interdependent preferences, which take into account only payoff differences, capture the essence of other-regarding preferences or, on the contrary, extended models, which include others' *expected* and *actual* behaviour, are required. Notice that we chose a modified dictator game setting, that is, the simplest non-strategic setting in which other regarding preferences affect behaviour.

[10] The robustness of Selfish individuals to social information is in agreement with the work by Cason and Mui (1998) in regular dictator games.

In such a setting the explanation for non-selfish preferences relies mostly on interdependent preferences. In light of our results, other-regarding preferences, even in a simple dictator setting, are a more complicated object than the reduced form modelled by purely interdependent preferences.

Outside the laboratory, for example in charitable giving, our results would imply that individuals have different expectations about others' contributions, making predictions on final takings of a charity campaign possibly inaccurate. Furthermore, our findings suggest social information can be used to effectively influence charitable giving. In particular, those who never contribute, Selfish individuals, will not be affected by knowing others do, consistent with Fey and Meier (2004)'s findings in the field. However, those who actually contribute will be sensitive to social information and therefore the provision of the *right* information can be a useful resource to increase charitable giving. In particular, according to our results, Social Welfare and Inequity Averse individuals, two preferences-types that would contribute to charity, should never be provided with information on those who do not contribute but only on those who do contribute. This is consistent with Croson and Shang (2008), who found that manipulating the information on how much others have contributed is possible to increase charitable contributions in the field.

The rest of the paper is organized as follows. Section 2 explains the experimental design and procedures. Section 3 shows the main descriptive statistics in the three parts of the experiment. Section 4 describes the classification of subjects into four interdependent preferences-types according to their choices in the first part of the experiment. Section 5 explains the belief-type identification and classification, and studies correlation between the actions-based and beliefs-based classifications. Section 6 shows the new classification of subjects according to their actions in part three of the experiment, once they have been exposed to social information. Section 7 concludes. Figures, tables and experimental instructions are included in the Appendix.

2. **Experimental Design and Procedures**

Three experimental sessions were conducted in the Laboratori d'Economia Experimental (LEEX) at Universitat Pompeu Fabra using z-Tree experimental software (Fischbacher, (2007)) in February, 2008. A total of 120 subjects, 40 per session, were recruited using the ORSEE recruiting system (Greiner, (2004)), ensuring that subjects had not participated in similar experiments in our laboratory in the past. After arrival, subjects extracted a piece of paper from a bag which randomly determined whether they would stay in the lab or they would go to a different classroom. We will refer to the 60 subjects in the lab as "Deciders", and the 60 subjects in the classroom as "Receivers".[11] Further, the 20 Deciders in each session were divided into two groups of 10 subjects each, which will be relevant for parts two and three of the experiment. A sheet with general and identical instructions was distributed and read aloud to all subjects. Instructions for each of the subject roles were also read aloud in each room before tasks were performed. Once the experiment had concluded, subjects filled in a voluntary questionnaire while they waited to be paid.

Each experimental session lasted one and a half hours (including assignment of subjects to rooms and payment). Throughout the experiment we ensured anonymity and effective separation between Deciders and Receivers, locating them physically in different rooms, in order to minimize any interpersonal influences which could stimulate other-regarding behavior. Subjects were paid individually and in private, using a closed envelope and starting with Deciders first. After Deciders had left, we called Receivers one by one into the laboratory and paid them.

Deciders performed three tasks which determined the payoffs for both player roles. Receivers waited in a separate classroom filling in a voluntary questionnaire that had no influence on their payoffs.[12] Tasks were presented in three different parts. For all three parts, Deciders were shown the same sixteen decision tables which described the allocation of experimental units among two subjects.[13] According to any interdependent preferences model the optimal choice of actions is the same when decision tables are shown sequentially than when they are shown all at once. The order in which tables were shown to subjects was changed randomly from one task to the other, aiming to control for possible order effects and keep subjects engaged.

[11] Subjects know their role in the experimental task before they take any action (role certainty). In previous sessions, data from which is not used in this paper, we used role uncertainty in order to save costs and extract more information. We found significantly different results. We report differences when using role certainty vs. role uncertainty in Iriberri and Rey-Biel (2008b).

[12] Receivers were also read the Deciders' instructions for Part 1 and Part 3 such that they would know how their own payoffs were determined. Receivers were explicitly told that their earnings would not depend on whether they answered the voluntary questionnaire or not, although they all did. The questionnaire asked them to perform the same tasks as Deciders did, clearly stating that their decisions were hypothetical. The questionnaire is available upon request. Data from these unpaid questionnaires are not used in the current paper although we analyzed it. One important difference with respect to the results reported in the current paper is that the level of noise is significantly higher when subjects are not paid than when they are paid. Also, when decisions do not have payoff implications and therefore are hypothetical, Dictators show more generous behavior towards Receivers.

[13] An experimental unit was equal to 0.25 Euro.

We now proceed to describe the sixteen decision tables. Each table contained three options, which showed different allocations of experimental units between Deciders and Receivers, as illustrated in Figure 2. One of the options contained the highest number of experimental units for the Decider, and we will refer to such option as the *selfish* action. Another option was constructed such that the Decider would lose one experimental unit in order to *increase* the Receiver's allocation by $s>1$ units. We will refer to this option as the *surplus creating* action. The third option was constructed such that the Decider would lose again one experimental unit but this time in order to *decrease* the Receiver's allocation by $s>1$ units. We will refer to this option as the *surplus destroying* action. As shown in the tables in Figure 3, we fixed the cost of creating and destroying surplus to one and varied s, the number of units that were created and destroyed.[14] The sixteen tables, shown in Figure 3, differed on: i) the difference between the Decider's and the Receiver's allocations ($|x-y|$), ii) the Decider's relative position with respect to the Receiver, that is, whether the Decider was ahead (better-off than) or behind (worse-off than) the Receiver ($x>y$ or $x<y$) and whether this would change depending on the chosen action, i.e., if $x>y$ whether $x-1>$ or $<y+s$,[15] and iii) the number of created and destroyed experimental units, that is, on s, which varied between 2, 3, 4, 5, 6 and 7.

Deciders' tasks were as follows. In Part 1, they had to choose one of the three options in each of the sixteen tables, knowing that they were randomly and anonymously matched with a different participant in each table and that their payoffs corresponded to that of "Decider" while the "Receiver's" payoffs corresponded to a matched Receiver in another classroom.

In Part 2, we elicited Deciders' beliefs about other Deciders' actions. The 20 Deciders in each session were divided into two groups of 10 participants each. Deciders' task was to guess how many of the 10 participants in the other group of Deciders had chosen each of the three options in each of the sixteen tables.[16]

[14] We will refer to $1/s$ alternatively as the price of creating or destroying surplus. Labels for options obviously used neutral language and the order of the selfish, surplus creating and surplus destroying actions was randomly chosen for each of the sixteen tables.

[15] In six out of sixteen tables, tables 2, 3, 5, 7, 11 and 12, Deciders' payoffs were higher than Receivers' for all three available choices. In other six tables, tables 1, 6, 8, 10, 13 and 14, Deciders' payoffs were lower than Receivers' for all available choices. Finally, in four out of sixteen tables, Deciders' relative position changed depending on the chosen action. In tables 9 and 15, Decider's relative position changes from ahead to behind only when the surplus creating action is chosen. In tables 4 and 16 Decider's relative position changes from behind to ahead only when the surplus destroying action is chosen. When referring to subjects' relative position in a table, we generally refer to their position when taking the selfish action.

[16] We elicited beliefs by asking subjects about frequencies of play instead of probabilities (Costa-Gomes and Weizsäcker (in press)), following Gigerenzer's (2000, 2002) and Hoffrage et al. (2000)'s hypothesis that individuals may find frequencies more meaningful than the probability of a single event which occurs

Finally, in Part 3 Deciders had to choose again among the three options in each of the sixteen tables, although this time subjects were informed about the exact distribution of choices previously made by the 10 participants of the other group of Deciders in each of the sixteen tables in Part 1. Deciders were again matched randomly and anonymously to a Receiver in another classroom, who was different from the one in Part 1, in order to avoid possible compensations between amounts allocated in Part 1 and Part 3.

At the end of the experiment three tables were randomly chosen to determine payments for each of the three parts.[17] Deciders received the sum of a 3 Euro participation fee, plus the allocation they had chosen for "Decider" in the randomly chosen tables in Parts 1 and 3, plus the amount earned according to a quadratic scoring rule rewarding accuracy of their elicited beliefs in the randomly chosen table in Part 2.[18] Receivers earned the 3 Euro participation fee, plus the allocation for the "Receiver", chosen by their randomly matched Decider in the randomly chosen tables in Parts 1 and 3. Average total payments were 13.94 Euros for Deciders and 9.25 Euros for Receivers.

3. Descriptive Statistics

We start by exploring subjects' average behaviour over all sixteen tables in the three parts of the experiment. Table 1 reports the number of times each of the available actions, selfish, surplus creating and surplus destroying actions, were chosen in Part 1 of the experiment. We separate those tables in which the Decider has a higher payoff than the Receiver ("Ahead") from those in which Decider's payoff is lower ("Behind"). The selfish action was chosen with highest frequency, not only on average (69%), but also in

once. See the discussion in Rey-Biel (in press). Additionally, eliciting probabilities creates the problem that the experimenter does not know the real probability distribution so it cannot reward for accuracy in probabilities.

[17] Tasks in Parts 1 and 3 are identical except for the extra-information provided in Part 3. Subjects were therefore rewarded in an identical way for their decisions in these two parts. Also, we wanted to avoid any compensation effect between these two parts of the experiment. We chose to pick one game randomly in each part making sure that the Receiver in Part 3 was a different one of that from Part 1. Another alternative would have been rewarding for one decision table among all 28 decisions made in Parts 1 and 3. We considered it was simpler to communicate to subjects that they would be rewarded by one randomly chosen decision table in each of the parts.

[18] The particular quadratic scoring rule (QSR) used in the experiment is shown in the Instructions. There exists no consensus yet among experimentalists about the optimal incentive mechanism for eliciting beliefs. Huck and Weizsäcker (2001) find that QSRs yield more precise belief statements than bidding functions. However, with a finite population of subjects, QSRs have the problem that they are not necessarily incentive compatible, although expected payoff maximizers can do no better by stating different beliefs than their true beliefs. Other problems of QSRs are that incentives are flat at the maximum and that they may be difficult to understand. To avoid the latter problem, our instructions emphasized that understanding the particular QSR used was not essential and that it was important to understand that the more accurate their beliefs were the more they would be paid. Similarly, aiming for simplicity, Charness and Dufwenberg (2006) offered a fixed fee to subjects who correctly guessed the proportion of subjects choosing a single option within a five percent interval. For a discussion on QSRs see Offerman and Sonnemans (2001) and Andersen et al. (2007).

each of the sixteen tables. The selfish action was chosen slightly less frequently when Deciders were ahead (66%) than when they were behind (72%). The surplus creating action was chosen with second highest frequency overall (23%), although it was more frequently chosen when the Decider was ahead (30%) than when behind (17%). Finally, the surplus destroying action was the least chosen (8%).[19] Deciders chose to destroy surplus more frequently when behind (11%) than when ahead (5%). Although average behavior did not change much across tables, standard deviations indicate that there exists variability across subjects.[20] As we will show in the next section, we can explain this variability with the existence of different preferences-types.

Table 2 reports the average frequency subjects assigned to each of the actions, selfish, surplus creating and surplus destroying actions, taken by the other group of Deciders. We observe that subjects expected the selfish action to be chosen on average with highest frequency (75%), which as we have seen, was correct. Furthermore, on average subjects consistently believed that the selfish action was chosen with highest frequency in all sixteen tables, no matter the Decider's relative position. Surplus creating and destroying actions were expected to be chosen with lower frequencies (14% and 12% respectively). The surplus creating action was believed to be chosen with slightly higher frequency when Deciders were ahead (16%) than behind (12%). Finally, the surplus destroying action was expected to be chosen slightly more frequently when Deciders were behind (13%) than ahead (11%). Standard deviations also indicate that there exists heterogeneity in beliefs. In Section 5 we will study the sources of such heterogeneity.

Finally, Table 3 reports the frequency with which each of the available actions, selfish, surplus creating and destroying actions, were chosen in the third part of the experiment. We again observe the familiar pattern that the selfish action was chosen with highest frequency (71% when ahead and 78% when behind). The surplus creating action was more frequently chosen when ahead (24%) than when behind (14%). Finally, the surplus destroying action was chosen with lowest frequency, although more frequently when Deciders were behind (8%) than ahead (5%). Comparing average frequency of play in Tables 1 and 3, we can see the selfish action has become more

[19] The surplus creating action was also the action chosen with second highest frequency in all tables but tables 8 and 10, in which the percentages with which surplus creating and destroying actions were chosen were very similar.

[20] We performed Fisher Exact probability tests to check whether differences in the observed proportions of the three actions between each pair of tables could have been expected by chance. Under the two-tailed null hypothesis of equal probability between observed proportions and at the 5% significance level, we find that out of 120 comparisons ([(16*16)-16]/2), only 28 (23.3%) are significantly different.

prominent and surplus creating and surplus destroying action less frequent in Part 3. Standard deviations also indicate that there exists heterogeneity in chosen actions.

Our analysis in the following sections will study the sources of heterogeneity behind the average behavior reported here.

4. Results in Part 1 of the Experiment: Estimation of the Distribution of Interdependent Preferences-types

This section describes the identification strategy of different interdependent preferences-types in the first part of the experiment and presents the estimated type distribution for different econometric specifications.

Our econometric specifications follow the mixture-of-types models of Stahl and Wilson (1994, 1995), Harless and Camerer (1994), El-Gamal and Grether (1995), Costa-Gomes, Crawford, and Broseta (2001), Camerer, Ho, and Chong (2004), Costa-Gomes and Crawford (2006) and Crawford and Iriberri (2007a, 2007b).[21] As explained in the introduction, we consider four different interdependent preferences-types; Selfish (SF), Social Welfare maximizers (SW), Inequity Averse (IA) and Competitive (CP). Readers who are familiar with the application of mixture-of-type models can skip ahead to results on page 14.

The identification strategy for the preferences-types classification is based on CR's piece-wise linear preferences utility function, shown in equation (1). Deciders' utility (u_D) depends on both Decider's own payoff (π_D) and Receiver's payoff (π_R). The two key parameters are the weight on the Receiver's payoff, ρ, when the Decider is ahead the Receiver ($\pi_D > \pi_R$), and the weight, σ, when the Decider is behind the Receiver ($\pi_R > \pi_D$).

(1) $u_D(\pi_R, \pi_D) = (\rho r + \sigma s)\pi_R + (1 - \rho r - \sigma s)\pi_D$,

where $r = 1$ if $\pi_D > \pi_R$ and $r = 0$ otherwise, and $s = 1$ if $\pi_D < \pi_R$ and $s = 0$ otherwise.

Each Decider *i* at decision table *t*, has three available actions, $a=\{S,C,D\}$, referring to selfish ("*S*"), surplus creating ("*C*") and surplus destroying ("*D*") actions respectively. According to CR's utility function, Deciders would choose among the available actions after evaluating them into the utility function given in (1). Remember that SF type should always choose the Decider's payoff maximizing action. SW type should either choose the surplus creating action or the selfish action, regardless of the Decider's

[21] Our main application, individual by individual estimation and uniform errors, is closest to El-Gamal and Grether (1995) and Costa-Gomes, Crawford and Broseta (2001).

relative position. IA type should either choose the surplus creating action or the selfish action when Deciders are ahead, while they should choose either the selfish action or the surplus destroying action when behind. Finally, CP should either choose the surplus destroying action or the selfish action, regardless of their relative position. For all types except Selfish, the choice between the surplus creating (destroying) action and selfish action will depend on the price of creating (destroying) action, given by (*1/s*), where *s* is the number of created (destroyed) units in the decision tables (see footnote 27).

The utility of a given Decider at decision table *t* and when taking action *a*, is thus given by the next equation (2):

(2) $u_D(\pi_{Rta}, \pi_{Dta}) = (\rho r + \sigma s)\pi_{Rta} + (1 - \rho r - \sigma s)\pi_{Dta}$ for $t = 1,...,T$ and $a = \{S, C, D\}$.

Based on CR's piece-wise linear utility function, a preference-type *k* will be defined by the sign the parameters ρ and σ may take. For SF type, both parameters must be zero, so they are fixed and will not be estimated. For SW type, both parameters must be strictly positive. For IA, ρ must be strictly positive and σ non-positive. Finally, for CP, both parameters must be non-positive and at least one parameter strictly negative.[22] A pair (ρ_k, σ_k) defines a preferences-type and we will refer to the utility of the Decider who belongs to preferences-type *k* as $u_{Dk}(\cdot)$.

Given a specific preferences-type, individuals evaluate the three available actions and choose the action that yields the highest utility. We also introduce a uniform *iid* error across different decision tables, meaning that, with some probability, given by ε, to be estimated, individuals make a mistake and choose any of the available three actions with equal probability. Hence, according to CR's utility function and the *iid* error, the predicted choice at decision table *t* for a Decider who belongs to preferences-type *k*, is shown in equation (3).

(3) $\Pr edictedChoice(a|\rho_k, \sigma_k, \varepsilon)_{Dkt} = (1-\varepsilon)1_{a=\arg(\max_a u_{Dk}(\pi_{Rta}, \pi_{Dta}))} + \frac{\varepsilon}{3}$ for $a = \{S, C, D\}$,

$k = \{S, SW, IA, CP\}$ and $t = 1,...,T$.

The indicator function 1_a takes value 1, if action *a* yields the highest utility, and zero otherwise. With no error, ε=0, the action yielding highest utility is chosen with

[22] We considered individuals with strictly positive ρ and σ equal to zero as Inequity Averse since their behavior would always yield a more equalitarian distribution of payoffs. These subjects take surplus creating actions when ahead and behave as purely selfish when behind. Most of the subjects classified as IA are found to have these estimated parameter values (See Tables 4 and 10). Subjects with strictly negative ρ or/and σ were classified as Competitive since this would mean that they either choose the selfish action or incur in a cost to destroy Receiver's surplus.

probability one. With positive error, $1>\varepsilon>0$, the action yielding the highest utility is chosen with higher probability than other actions although it is chosen with probability smaller than one. Finally, if $\varepsilon=1$ the individual is purely random and chooses any of the available actions with equal probability.

Notice that CR's utility function is restrictive in its specific *linear* form. Therefore, the error term is capturing two types of errors. One type of error is taking both surplus creating and surplus destroying actions in tables in which the subject's relative position is kept constant. No preferences-type *k* can explain this type of error, which is not implied by the linearity restriction but by the basic consistency restriction that indifference curves should not cross. The other type of error is creating or destroying surplus for a certain price but not doing so for a lower price. This partly comes from the linearity restriction. Using a more flexible utility function, such as Constant Elasticity of Substitution, could accommodate some of this second type of errors. However, when we considered this case, only 5 out of 60 individuals improved in their log likelihood, so we will stick to CR's linear utility function for simplicity.[23]

The decision data collected in Part 1 of the experiment consisted of *T* decisions over *S*, *C* and *D* actions for each of the *N* Deciders, called in general *Choice*. The typical observation, called $Choice(a)_{Dit}$, takes value 1 if individual *i* took action *a* at decision table *t*, and 0 otherwise. Having described the predicted choice in equation (3) and Decider's actions data, we can now construct the likelihood function for the three different econometric specifications that we have considered.

The first one is an individual by individual estimation, which yields a set of estimated parameters (ρ, σ, ε) for each individual *i*. Accordingly, p_i is estimated to be equal to one for the preferences-type which explains best Decider *i* and zero for other types. The overall preferences-type distribution is obtained counting the number of subjects classified in each type. The likelihood function to be maximized is shown in expression (4).

$$(4)\quad L_{Di}(\rho_i,\sigma_i,\varepsilon_i|Choice_{Di}) = \sum_{k=S,SW,IA,CP} p_i \prod_{t=1}^{T} \prod_{a=\{S,C,D\}} \Pr edictedChoice(a|\rho_i,\sigma_i,\varepsilon_i)_{Dikt}^{Choice(a)_{Dit}}$$

[23] A constant elasticity of substitution utility function includes an extra parameter that determines the curvature of the indifference curve, allowing for linear but also Cobb Douglas or Leontief functional forms. As mentioned, only 5 out of 60 individuals were better explained by this more flexible functional form. Also and more importantly, since we are not interested in the point estimation of ρ and σ but in a categorization of individuals into different interdependent preferences-types based only on the sign of these parameter values, we report results using the CR linear utility function.

The other two specifications refer to population level estimations. Here, we consider two different specifications. Both estimate ρ and σ for each preferences-type *k*, as well as p_k, the frequency for each type *k*. The difference between the two specifications is that while the former estimates a type specific error term the latter estimates one unique error term for all types. The type-specific error and the one-error likelihood functions are given by equations (5) and (6) respectively.[24]

(5)

$$L(p_k,\rho_k,\sigma_k,\varepsilon_k|Choice)=\prod_{i=1}^{N}\sum_{k=S,SW,IA,CP}p_k\prod_{t=1}^{T}\prod_{a=\{S,C,D\}}\Pr edictedChoice(a|\rho_k,\sigma_k,\varepsilon_k)_{Dkt}^{Choice(a)_{Dit}}$$

(6) $$L(p_k,\rho_k,\sigma_k,\varepsilon|Choice)=\prod_{i=1}^{N}\sum_{k=S,SW,IA,CP}p_k\prod_{t=1}^{T}\prod_{a=\{S,C,D\}}\Pr edictedChoice(a|\rho_k,\sigma_k,\varepsilon)_{Dkt}^{Choice(a)_{Dit}}$$

The estimation results are summarized in Tables 4 to 6.

We will start with the most flexible specification, the individual by individual estimation, which estimates a set of parameters (ρ, σ, ε) for each Decider *i*. 37% of the subjects, 22 out of 60, are estimated without any error and their preferences-types are readable directly from their actions, which are summarized in the first 6 columns of Table 4. They show the number of decision tables in which each Decider takes the selfish, surplus creating and surplus destroying actions, separating for Deciders' relative position. There is at least one subject which can be classified into each preferences-type without error. Subject 4, among many others, is classified as SF because consistently chose the selfish action in all decision tables. Subject 37 is classified as SW because she consistently chose the surplus creating action in all decision tables. We classified subject 52 as IA because she chose the surplus creating action once when ahead but never when behind.[25] Finally, subject 44 is classified as CP since she consistently chose the surplus destroying action in all decision tables. Furthermore, almost 87% of the subjects, 52 out of 60, are estimated as having a particular preferences-type with an error level equal to or less than 0.38.[26] Apart from the error level, Table 4 also suggests

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[24] Notice that the predicted choice will have subscript *i* only when we allow for an individual specific error term and an individual specific ρ and σ, that is, in the first specification. In the population level estimations the predicted choice will be the same for two subjects who belong to the same type *k*.

[25] Notice that none of the subjects who took mostly surplus creating actions when ahead and surplus destroying actions when behind was classified without error. Subjects 17, 26 and 40 exhibited this behavior but were classified as IA with an error level of 28% (ε=0.28).

[26] The 8 individuals estimated with a higher error level (ε>0.38) require such error to be classified into one of the four categories. Some of these subjects are just noisy, such as subjects 12, 13, 18, 32, 57 and 59. But subjects 54 and 60 are furthermore more difficult to classify. For example, subject 54 is estimated to have a ρ equal to zero and a strictly positive σ, which can not be accommodated by any of the interdependent preferences-types assumed by the CR model. Subject 60, given the high error rate, is

that there is considerable individual variation in the parameter values ρ and σ. For example, among those individuals classified as SW, there are some, such as subject 37, who always choose the surplus creating action, regardless of the price of such action, which yields the highest possible value of 0.34 for ρ and σ. However, there are also other subjects, such as subject 49, who require a lower price for creating surplus when they are ahead than when behind, which yields a higher ρ than σ (ρ=0.34, σ=0.26). Also, among those individuals who are estimated to be IA, some Deciders, such as subject 29, never chose to destroy surplus when behind, which yields an estimate of σ equal to zero, but others, such as subject 17, choose to actively destroy surplus when behind, which yields a negative estimate of σ (ρ=0.34, σ= -0.51).[27]

Based on the individual by individual estimation, Table 5 reports the average frequency of play of the three available actions, $a=\{S, C, D\}$, separately for subjects classified in each of the preferences-types. This table clearly shows the idea behind our identification strategy for different preferences-types. Subjects classified as SF almost always chose the selfish action (98% of the time). Subjects classified as SW chose the surplus creating action with highest frequency (60% of the time) and very rarely decided to destroy surplus (2% of the time). Subjects classified as IA chose the Selfish action with highest frequency, but also took the surplus creating and destroying actions with non-trivial frequency (27% and 9% of the time respectively). As expected, subjects classified as IA created surplus much more when ahead (50%) than when behind (6%) and they destroyed surplus more when behind (15%) than when ahead (4%). Subjects

estimated to have a σ equal to zero but allows for a value of ρ which can be positive or zero, which makes its classification difficult, since both Selfish and Inequity Averse preferences can be behind those parameter values.

[27] The decision of choosing to create surplus over being selfish identifies a positive ρ and σ such that ρ,σ> $1/(1-s)$. Thus, if a Decider chooses to create at s, both when she is ahead and behind, then ρ and σ will be estimated to be strictly higher than $1/(1-s)$. Since s takes values of 2,3,4,5, 6 and 7 then ρ and σ can be estimated to take values strictly higher than 0.33, 0.25, 0.20, 0.16, 0.1428 and 0.125 respectively. In those cases, for simplicity we will write estimates of 0.34, 0.26, 0.21, 0.17, 0.15 and 0.13 in a way that for example an estimate equal to 0.21 means that when $s\geq4$ Decider chooses to create surplus but when $s<4$ the Decider chooses the selfish action. Notice that the highest ρ and σ we can identify is therefore 0.34, which is slightly lower than it has been found in the literature. In a similar way, the decision of choosing to destroy surplus over being selfish identifies a negative ρ and σ such that, ρ,σ< $1/(1-s)$. If Decider chooses to destroy at s, both when she is ahead and behind, then ρ and σ will be estimated strictly lower than $1/(1-s)$. Since s takes values of 1,2,3, 4, 5, 6 and 7 the negative ρ can be estimated to take values strictly lower than -1, -0.5, -0.33, -0.25, 0.20, -0.16. In those cases, we will write -1.1, -0.51, -0.34, -0.26, -0.21, -0.17 in a way that for example an estimate equal to -0.26 means that when $s\geq5$ the Decider chooses to destroy surplus but when $s<5$ then she will favour the selfish action.

classified as CP were, as expected, the ones taking the surplus destroying action with highest frequency (44% of the time).

Results in Tables 4 and 5 suggest that the identification strategy was successful in classifying individuals into different preferences-types. Notice that had a subject chosen her actions randomly, the estimated error term in the individual by individual estimation would have been equal to one (ε=1). Given that the preferences-type classification is going to be crucial for the analysis of the second and third parts of the experiment, we decided to continue the analysis only with those subjects whose type is estimated within the reasonable noise level mentioned above (ε≤0.38). For the population level estimation, as well as for the second and third parts, we thus limit our sample of 60 to 52 subjects.[28]

Table 6 summarizes the preferences-type distribution for each of the three specifications. The first four columns refer to the summary of the individual by individual estimation discussed above, where ρ, σ and ε are averaged across individuals classified as belonging to each preferences-type. The second block shows the population level estimation where the error level is allowed to depend on the preferences-type. Finally, the third block shows the most aggregated population level estimation, in which the error term is restricted to be equal for all types. The three different specifications, from left to right, are ordered from the least to the most restrictive in terms of allowed flexibility and the number of parameters. From the individual by individual estimation we can see that SF individuals are the least noisy, followed by the rest of the types. This suggests that the one-error specification is quite restrictive, as it distorts the most the preferences-type distribution. Overall, the estimated type distribution is fairly robust across the three specifications. SF is the most frequent type and its frequency varies between the 44% and 63% of the distribution, depending on the level of aggregation in the estimation. It is followed by SW and IA types, whose frequencies vary from 21% to 9% and from 32% to 22% respectively. The least frequent type is CP, whose frequency varies between 10% and 6%. This preferences-type distribution is fairly similar to the ones previously found in the literature by Andreoni and Miller (2002) and Fisman et al (2007).[29]

[28] Our analysis with the complete sample offers the same qualitative results. This analysis is available upon request.

[29] Andreoni and Miller's (2002) design cannot distinguish between Selfish and Competitive preferences. They find the following distribution for Selfish, Social Welfare and Inequity Averse respectively, 44%, 21%, and 35%. Fisman et al.'s (2007) design can further identify what they call Lexicographic Self while we cannot, so if we add up their Lexicographic Self and Selfish frequencies, their type distribution for

For the rest of the analysis, we will use the individual by individual type classification of the sub-sample of 52 subjects. Under such classification, 44% of the subjects are classified as being Selfish (SF), 21% as Social Welfare maximizers (SW), 25% as Inequity Averse (IA) and finally 10% as Competitive (CP).

5. Results in Part 2 of the Experiment: Belief-type Identification and Correlation Between the Interdependent Preferences-types and Belief-types

This section describes the belief-type identification strategy and presents the estimated belief-types with different econometric specifications. We also look for correlations between the identified belief-types and the interdependent preferences-types already estimated in the previous section.

We will start commenting on overall belief accuracy. We calculate the average square error (ASE) between subjects' beliefs and the real distribution of actions, averaging across all subjects. The ASE over all sixteen tables was 20.07, i.e., around a 10% of the maximum error subjects could have made.[30] Although this ASE seems to indicate that subjects were reasonably accurate, averaging across subjects gives a misleading idea of the knowledge subjects had about the heterogeneity in actions. As it will become clear later, there exist significant differences in beliefs across subjects.

Our objective is to identify the belief-types present in the subject population and measure the level of heterogeneity in their beliefs. After we have identified them, we will be able to classify each subject into different classes of beliefs in order to relate the two classifications, one based on their actions and thus on preferences and the other based on their beliefs.

One simple way to identify beliefs and look for differences among different preferences-types consists of averaging elicited beliefs across individuals who were classified into the same preferences-type according to their choice in Part 1 of the experiment. Table 7 shows the average frequency of play expected by those subjects classified as belonging to each of the preferences-types. All types of subjects assign highest frequency to others choosing the selfish action, which as Table 1 showed, is right. However, Table 7 also suggests that different preferences-types may have

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Selfish, Social Welfare, Inequity Averse and Competitive is 62%, 13%, 19%, and 5%, respectively. Both distributions are quite similar to ours.

[30] The minimum possible ASE is obviously 0, while the maximum possible ASE is 200, corresponding for example to stating beliefs (10, 0, 0) while the frequency of actions taken were (0, 10, 0). Looking at the average square error in each of the sixteen tables we do not observe clear differences. Subjects on average were most accurate in table 3 (ASE=13.47) while they were most imprecise in table 11 (ASE=31.11).

different beliefs. In particular, SF subjects assign much higher frequency (92%) to others subjects taking the selfish action than other types (61%, 71% and 66% for SW, IA and CP types, respectively). Additionally, SW subjects are the ones assigning highest frequency (28%) to the surplus creating action, while CP subjects are the ones assigning highest frequency (25%) to the surplus destroying action. This result also points on the direction of the existence of "false-consensus bias". This is a regularity found in the psychological literature as well as in Economics, which describes the fact that individuals tend to believe others are more likely to be like themselves, i.e. in our experiment, they would assign high frequency to other subjects taking the same actions as they themselves took.[31]

However, averaging beliefs of those individuals classified into a preferences-type can be misleading since it imposes the assumption that all individuals belonging to a type according to their actions should have similar beliefs. Since this is in fact one of the questions we are interested in addressing, we opted for a different strategy. We take a purely empirical strategy in identifying experimental subjects' beliefs about the actions of other individuals. Furthermore, we empirically test whether individuals classified as belonging to different preferences-types actually have different beliefs about others' actions.

We follow a mixture-of-types model, using the elicited belief data, to identify belief-types, as well as the frequencies associated with each of the belief-types. The elicited belief data consists of a probability distribution over the three available actions, $a=\{S, C, D\}$, for each of the T decision tables and each of the N individuals. The typical elicited belief observation is given by (Seb_{it}, Ceb_{it}), where Seb_{it} and Ceb_{it} represent the frequencies Decider i associates to observing the selfish and surplus creating actions at decision table t. Notice that the belief about the surplus destroying action is given by one minus the beliefs about selfish and surplus creating actions. For example, if Decider i states that half of the ten participants in the other group of Deciders chose the selfish

[31] False consensus bias was first mentioned by psychologists (Ross (1977) and Mullen et al. (1985)). Economists have also found evidence of it, see Selten and Ockenfels (1993) and Charness and Grosskpof (2001). Engelmann and Strobel (2000) define *real* false consensus effect as weighting own decisions more heavily than those of a randomly selected person from the same population. We look at the average frequency subjects classified under each type assign to the action they take in each of the tables. This is not strictly a measure of the self-consensus bias since it is affected by the frequency with which actions are actually taken. In any case, SF subjects assign highest frequency (0.91) to others taking their own action. SW subjects assign a frequency of 0.45 to their own action being taken, while IA subjects assign a frequency of 0.59 to their own action. Finally, CP subjects assign a frequency of 0.64 to their own action.

action and the other half the surplus creating action, then the elicited belief observation will take the values (0.5, 0.5).[32]

When applying a mixture-of-types model to the analysis of beliefs we have to make some specification decisions. First, we need to address what the specification of a belief-type is. We consider two different belief-type specifications, depending on whether the relative position of a subject matters (or not) for belief statements. Our unrestricted specification defines a belief-type as two different probability distributions over selfish, surplus creating and surplus destroying actions; one when the Decider is better-off than the Receiver and another when the Decider is worse-off. This specification thus separates the elicited beliefs about others' actions into two different sets depending on the Decider's relative position (*rp*), *rp*={*A,B*}, which we name *A* and *B* referring to ahead and behind respectively. The typical belief-type *k* will then be given by ($SbA_k, CbA_k, SbB_k, CbB_k$). The restricted specification defines a belief-type as a distribution over selfish, surplus creating and surplus destroying actions, without differentiating for the Decider's relative position. The typical belief-type is then given by (Sb_k, Cb_k). The decision about whether the data fits one specification better than the other will be taken using a likelihood ratio test.

The second question we need to address is how many belief-types we should consider. We took a conservative position and started allowing for only one belief-type, which yields exactly the average beliefs in the subject population. We then added types one by one until the explanatory power of adding one more type was offset by the increased number of parameters to be estimated. For the decision over the number of belief-types, we again used likelihood ratio tests. The restricted model refers to the specification with (*k-1*) belief-types and the unrestricted model the specification with (*k*) belief-types.

The likelihood functions for the *k* different belief-types in the specification where the Decider's relative position matters, are shown in equation (7). A belief-type is given by $(SbA_k, CbA_k, SbB_k, CbB_k)$ and p_k refers to the frequency of the *k*th belief-type. Observations are counted separately when the Decider is ahead and behind the Receiver. That is, the sixteen decision tables will be divided into two sets of eight depending on the Decider's relative position represented by *rp*.

[32] Remember that beliefs were elicited as frequencies. The task involved distributing 10 subjects into three different actions (*S*, *C* and *D*), rather than assigning probabilities of observing each of the available actions. The elicited belief data was divided by 10 to obtain the probability distribution over the three actions so that the elicited belief about the surplus destroying action is given by ($1 - Seb_{it} - Ceb_{it}$).

(7)

$$L(p_k, SbA_k, CbA_k, SbB_k, CbB_k | Seb, Ceb) = \prod_{i=1}^{N} \sum_{k=1}^{K} p_k \prod_{rp \in \{A,B\}} \prod_{t=1}^{T/2} Sbrp_k^{Sebrp_{it}} Cbrp_k^{Cebrp_{it}} (1 - Sbrp_k - Cbrp_k)^{(1-Sebrp_{it}-Cebrp_{it})}$$

The likelihood function for the *k* different belief-types in the restricted belief-type specification, where the Decider's relative position does not matter, is shown in equation (8). Now, the belief-type is given by (Sb_k, Cb_k) and, as before, p_k refers to the frequency of the *k*th belief-type. Also, the actual elicited beliefs are given by (Seb_{it}, Ceb_{it}) but now the observations will not be separated for when the Decider is ahead or behind the Receiver.

(8) $$L(p_k, Sb_k, Cb_k | Seb, Ceb) = \prod_{i=1}^{N} \sum_{k=1}^{K} p_k \prod_{t=1}^{T} Sb_k^{Seb_{it}} Cb_k^{Ceb_{it}} (1 - Sb_k - Cb_k)^{(1-Seb_{it}-Ceb_{it})}$$

The estimated belief-types are summarized in Table 8. The first block of columns, models (1) to (4), shows the simpler belief-type specification when the Decider's relative position does not matter while the second block of columns, models (5) to (8), shows the belief-type specification when the Decider's relative position matters. The difference between models (1), (2), (3) and (4), as well as the difference between models (5), (6), (7) and (8), is the number of allowed belief-types, which changes from one to up to four belief-types. Therefore, horizontally we can compare the two different specifications of belief-types keeping the number of types fixed, while vertically we can compare what we gain when we allow for heterogeneity within each belief-type specification. Likelihood ratio tests are our guide to decide over the two different specifications, as well as over the number of types. As it becomes clear in Table 8, likelihood ratio tests persistently favor the belief-type specification where the Decider's relative position is not taken into account. When models (1) and (5), (2) and (6), (3) and (7), and finally (4) and (8) are compared, the likelihood ratio tests cannot reject the restricted model, the simpler belief-type specification, with *p*-values of 0.19, 0.37, 0.57 and 0.67 respectively. Also, when deciding about how much heterogeneity to allow for, i.e., about the number of belief-types to consider, likelihood ratio tests favor including up to three different belief-types but not the fourth one.[33] That is, the likelihood ratio test favors model (3), which will be our focus (in bold in Table 8).

According to model (3), the most frequent belief-type in the subject population, held by 55% of the subjects, represents an almost mass-point distribution concentrated on the

[33] When models (2) and (3) are compared, the unrestricted model is favored (*p*-value 0.0000028), suggesting it is worth considering a third type, but when models (3) and (4) are compared, the restricted model is favored (*p*-value 0.12), suggesting it is not worth allowing for a fourth belief-type.

selfish action. These Deciders believe that the vast majority of other Deciders, 93% of them, will choose the selfish action. A second belief-type, held by 20% of the subjects, assigns highest frequency to the selfish action (64%) but also assigns a high weight to the surplus creating action (32%), while it does not assign hardly any weight to the surplus destroying action (4%). Finally, a third belief type, held by 25% of the subjects, distributes the probabilities more evenly among the three actions. Most of the weight is again on the selfish action (54%), but subjects holding these beliefs assign high frequency to others taking the surplus destroying action (31%) and the surplus creating action (14%).

These three belief-types represent different views about what others do. Given the actual frequencies of actions observed in Part 1 of the experiment (72% of selfish actions, 24% surplus creating and 8% surplus destroying), subjects believing most actions would be selfish and surplus creating (but almost no surplus destroying) were most accurate. That is, the second belief-type is the most accurate one.[34]

Once we have selected model (3), where there are three belief-types, we can classify each individual into different identified belief-types. This can be done with a likelihood function or even following a mean square error criterion so that each individual is classified into the belief-type from which her elicited beliefs deviate the least. Both methods give us the same classification. We can therefore proceed with a direct comparison between the classification of subjects by their actions (preferences-type classification in Part 1) and the classification of subjects by their beliefs.

Results are shown in Table 9. This contingency table shows the preferences-type classification by rows and the beliefs-type classification by columns. Each cell of the table contains the number of individuals classified as belonging to the preferences-type represented by that particular row, who have the belief-type represented by that particular column. We observe dependency between the row and column classifications.[35] Subjects classified as SF are clearly behind the first belief-type. As

[34] Calculating the ASE for each of the three beliefs types, we find that subjects holding the Belief-Type 1 incurred in a 56.41% ASE of the maximum they could have made. Belief-Type 2 subjects made an ASE of 13.35% of the maximum while Belief-Type 3 subjects made an ASE of 49.50% of the maximum. Notice that ASE-s here are calculated slightly differently than the average ASE calculated at the beginning of this section. The reason is that we are here imposing that individuals classified under a particular belief-type, hold the same beliefs in all sixteen tables.

[35] Association measure tests such as Goodman and Kruskal's Tau and Uncertainty Coefficients both yield (asymptotic) *p*-values lower than 0.001. A Chi-square test allows us to conclude that rows are not independent (*p*-value=0.002). Pair-wise Fisher Exact tests inform us that the distribution of beliefs-types of subjects classified as SF and SW and of subjects classified as SF and IA are significantly different (*p*-values of 0.001 and 0.019 respectively). Other pair-wise comparisons are not significantly different partially due to the sample size.

such, SF subjects can hardly conceive any other action but the selfish one. Other types of subjects have more disperse beliefs. Most subjects classified as SW, six out of eleven, are behind the second belief-type. They believe the selfish action is chosen with highest frequency (64%) but assign high frequency (32%) to the surplus creating action, and almost none (4%) to the surplus destroying action. Subjects classified as CP either have the third type of beliefs, i.e., they conceive the selfish and surplus destroying actions are taken with highest probability or they have the first belief type, only conceiving the selfish action as being taken by other Deciders. Finally, subjects classified as IA hold all three belief-types.

Overall, Table 9 can be summarized as showing that while everyone believes the selfish action is taken with highest frequency, SF and CP types can hardly believe others may take the surplus creating action. Furthermore, SW and IA types believe a significant part of other Deciders create surplus, as themselves do, but they can still conceive selfish and surplus destroying actions being chosen by others.

We conclude that individuals do not have a homogeneous and accurate perception of the existent heterogeneity in actions and therefore in preferences. Furthermore, given the dependence found between preferences-type and belief-type classifications, different preferences-types hold different beliefs about the heterogeneity in actions. While all subjects are affected by self-consensus bias, Selfish subjects cannot conceive any heterogeneity in actions. Other preferences-types are partially affected by false-consensus bias but believe others may take different actions than the ones they take. The preferences type that has the most accurate beliefs about others' actions is the SW type.

6. Results in Part 3 of the Experiment: Estimation of the Distribution of Interdependent Preferences-types after Elicitation of Beliefs and Observation of other Participants' Actions

In Part 3 of the experiment, subjects make their choices over the three available actions in the sixteen decision tables again, after having had their beliefs elicited and after having observed what the ten participants of the other group of Deciders in their same session actually chose in Part 1 of the experiment. We aim to compare how the elicited beliefs and the observation of others' actions influence subjects' actions and preferences-types. We also look at how many subjects actually change preferences-type from Part 1 to Part 3, toward which preferences-type switches occurred and finally, how the observed information influences the changes.

The social influence literature suggests that people rely on social information to infer what the appropriate behaviour is in ambiguous situations, and then conform to the norm (Akerlof (1982), Jones (1984) and Bernheim (1994)). Cason and Mui (1998) also study the effect of social information on behaviour using a regular dictator game design. They test the "social influence hypothesis", where an individual's perception of what constitutes socially appropriate behaviour may depend on her estimate of others' beliefs regarding what constitutes socially appropriate behaviour.[36] We aim to extend the analysis of the effect of social information to our modified dictator game setting, where we show that such effect does not affect equally to the four interdependent preferences-types previously identified.

We start by re-classifying subjects according to their actions in the third part of the experiment. We re-do the interdependent preferences-type estimation, as explained in Section 4, for the third part of the experiment and we present the estimated type distribution for different econometric specifications. Table 10 presents the individual by individual estimation and Table 12 summarizes the two population level estimations. The first thing to notice in Tables 10 and 12, compared to the estimation in Part 1 shown in Tables 4 and 6, is that the noise level decreases considerably. In Part 3, 58% of subjects, 35 out of 60, are estimated to belong to a preferences-type without any error in contrast to the 37% of subjects in Part 1. These noiseless subjects' preferences-types are readable directly from their actions, which are summarized in the first 6 columns of Table 10. The second important thing to notice is that the preferences-type distribution changes slightly towards a distribution where the SF preferences-type is even more prominent. Notice that most of the reduction in noise is coming from the higher frequency of SF types, who are on average the least noisy.[37]

[36] Notice that although their explanation seems to include second-order beliefs, in practical terms their design only elicits first-order beliefs.

[37] Although in Table 10 we show the individual by individual estimation for the 60 subjects, as stated in Section 4, for Tables 11-15, we will concentrate on the sub-sample of 52 subjects estimated within a reasonable error level of 0.38 in Part 1 (see footnote 24). Among those 52 subjects there are some subjects estimated with an error level lower or equal to 0.38 in Part 1 but higher than 0.38 in Part 3 of the experiment. These are subjects 2, 20, 50 and 51. Moreover, two other subjects out of the 52 do not have a clear interdependent preferences-type specification according to their actions in Part 3 so we will have to take a subjective decision about their types. Subject 15, with a noise level of 0.38 is estimated to have a ρ parameter between 0 and 0.34 and σ equal to -0.26. This subject allows for both IA and CP preferences. We classify this subject as CP, as we did according to his actions in Part 1. In a similar way, subject 50 with an error level of 0.47 is estimated in Part 3 as having a ρ equal to 0 and a σ in the interval between 0 and 0.13, which are not allowed by any type included in the CR model. We classify this subject as SF and consider the few times she creates surplus as an error. Finally, subject 59 also allows for a range of values in σ so she could be classified as either SW or IA. However, since this subject does not belong to the sub-sample of 52 subjects from Part 1, we do not need to take a decision on her type.

Table 11 shows, as Table 5 did for Part 1, the frequency of actions taken by each preferences-type. Comparing Table 5 and Table 11, we observe that the distribution of average frequencies with which overall the three actions were played (the last row in both tables) is practically identical to that of Part 1. However, when we look in Table 11 at the average frequency with which each preferences-type took each of the three actions, we observe that preferences-types are now more clearly separated. Again we find that SF type barely took any but the selfish action, no matter their relative position (93%). The SW type now took the surplus creating action with highest frequency (76%) and while they sometimes (24%) took the selfish action, they never took the surplus destroying action. The IA type mainly took selfish (48%) and surplus creating actions when ahead but they choose most frequently (80%) the selfish action and much less frequently (8%) the surplus destroying action when behind. Finally, the CP type almost never created surplus (9% when ahead, 0% when behind) and chose selfish and surplus destroying actions in similar percentages (52% and 42%, respectively).

In Table 12, we find that the preferences-type distribution is robust across different specifications. SF preferences are the most frequent, with a frequency varying from 58% to 74%. SW preferences appear in a proportion varying from 13% to 10% of the subjects. IA preferences appear with a frequency varying from 26% to 9%, of the subjects. Finally, CP preferences' frequencies vary from 13% to 5%. Again, SF types are classified with the least noise (ε=0.03) while IA and CP subjects are classified with highest level of noise (ε=0.23). For the rest of the analysis we focus on the individual by individual specification where 58% of subjects are estimated to have SF preferences, 15% of the subjects are estimated to have IA preferences and SW and CP preferences are estimated to have a frequency of 13% each in the population.

We now check whether actions and preferences-types were consistent between Part 1 and Part 3 of the experiment. As a first approximation, we find that subjects changed their action from Part 1 to Part 3 on average in 1.31 tables out of 16 decision tables (8.2% of the time). Subjects classified as SF according to their actions in Part 1, were actually the ones who changed their actions the least (2.7% of the time). SW and IA subjects changed their actions more often on average, in 4 and 5 out of 16 decision tables (25% and 32% of the time, respectively). CP subjects changed their action in 3.20 tables on average (20%).

More precisely, Table 13 presents an overall contingency table where rows refer to the preferences-type classification in Part 1 and columns refer to the preferences-type classification in Part 3. The diagonal cells of this table show the number of subjects who did not change preferences-type from Part 1 to Part 3 of the experiment. Off-diagonal cells present the number of subjects who changed type from row's preferences-type to column's preferences-type. The majority of subjects (69.23%, 36 out of 52), did not change their preferences-type from Part 1 to Part 3.[38] The number in the diagonal cells is always higher than in any other cell. Consistently, subjects who changed type changed an average of 2.65 actions from Part 1 to Part 3 (16.6%), while subjects who did not changed type changed an average of 0.70 actions (4.4%).

Moreover, there are significant differences if we compare the likelihood of changing types across different rows, and therefore, across different preferences-types. Consistent with the finding in changes on actions, subjects estimated as having SF preferences are the ones who changed the least their preferences-type from Part 1 to Part 3. Only 1 subject out of 23 actually switched type. On the other hand, almost half of the subjects estimated as having SW preferences in Part 1 actually switched type. Also, most subjects estimated as having IA preferences, 8 out of 13, switched type from Part 1 to Part 3. Finally, 2 out of 5 subjects estimated as having CP preferences switched to a different type. We can conclude that while SF preference-type is very stable, SW, IA and CP preferences-types show less stability.[39] If we order preferences-types with respect to a decreasing level of altruism (SW- IA- SF- CP), Table 13 shows that the majority of the subjects who changed type (13 out of 16) moved from a more altruistic type to a less altruistic one. Also, as a measure of stability in the classification, subjects did not change their type dramatically. For example, no subject classified as SW in Part 1 was classified as CP in Part 3 and vice versa.

The switch in actions and in preferences-types might come as a result of purification of those confused or noisy subjects. That is, since it is the second time subjects go over the same decision tables, now they may have a better idea of what their preferred choice is and therefore, there may be less confusion.[40] It is important to look at the noise level in Part 1 of those who switched preferences-types in comparison to the noise level of

[38] The Kappa test, a chance-corrected measured of agreement between two classifications, yields a value of 0.5372. Therefore, we conclude that there exists agreement between both classifications. In any case, this value partially comes from the high proportion of subjects which were consistently classified as SF both in Part 1 and Part 3 of the experiment.

[39] Pair-wise Fisher Exact tests comparing the classification in Part 3 of the experiment of subjects classified under the four types in Part 1, allows us to conclude that there exists significant differences between the SF type and SW, IA and CP types (p-values of $1.05e^{-06}$, $3.34e^{-05}$ and 0.01, respectively). Fisher tests also show significant difference between SW and CP types (p-value=0.008).

[40] The best test for this hypothesis is to repeat the experiments with the same design with a treatment in which no information was provided in the third part of the experiment. As an alternative approximation we compare the noise levels of those who change and do not change preferences-types.

those who did not. The sixteen subjects who changed type were actually identified in the first part of the experiment with a higher level of noise than those who did not change type. Using the individual by individual classification, subjects who changed type were identified with an average level of noise of ε=0.19, while subjects who did not were identified with an average level of noise of ε=0.05. However, the main reason behind this result is the existence of a majority of SF type subjects who do not change type and whose noise level is the lowest (ε=0.02). SW, IA and CP type subjects who changed and who did not change type are estimated with similar levels of noise in Part 1.[41] This suggests that the substantive change in actions and therefore in preferences-types is not totally explained by simple purification of those noisy or confused subjects, but that it is at least partly due to the information provided.

We can further aim to investigate the effect of providing information about other subjects' actions on the classification of subjects from Part 1 to Part 3. Notice that the actions observed by subjects differed for the different groups of ten participants, A and B, in each of the three experimental sessions. Therefore, we have six independent observations of other Deciders' actions. Our analysis is limited to these six different sets of information and to the relative variability in observations which naturally occurred. Without differentiating for the Decider's relative position or for different decision tables, the 6 different aggregated observed actions are given in Table 14, where the numbers refer to the Session and the letter to groups A and B.

A Chi-Square test rejects the hypothesis that these 6 different distributions of other participants' actions are equal (*p*-value 4.72E-11), and therefore, they cannot be pooled. However, a pair-wise Fisher's Exact test shows that observed data in 1-A cannot be rejected to be equal to that in 2-A (*p*-value 0.62), also data in 1-B cannot be rejected to be equal to that in 3-A (*p*-value 0.40), and finally that data in 2-B cannot be rejected to be equal to that in 3-B (*p*-value 0.57)[42]. These three different observations of Deciders' actions show that most of Deciders are taking the selfish action but apart from that they offer a different view of what Deciders are doing in the decision tables. Set 1-A and 2-A show relatively few Deciders taking the surplus creating and even fewer taking the surplus destroying action. The second set of observations, consisting of 1-B and 3-A,

[41] Noise levels for SW type who change and do not change type are ε=0.23 and ε=0.14, respectively. For IA subjects, noise levels are ε=0.17 and ε=0.19 for individuals who change and do not change type respectively. Finally for CP subjects, noise levels are ε=0.09 and ε=0.09 for those who change and do not change type respectively.

[42] Fisher Exact test cannot either reject that 1-A is equal to 3-B but since this *p*-value (0.34) is lower than the *p*-value (0.57) when 2-B and 3-B are compared, we decided to pool 2-B and 3-B.

shows that almost equal number of Deciders are taking the surplus creating and destroying actions. Finally, the third set, given by 2-B and 3-B, shows a fair amount of Deciders taking the surplus creating action and almost no-one taking the surplus destroying action.

We can therefore replicate the contingency Table 13, separately for these three subgroups of different observations described above.[43] Most SW subjects happened to observe a distribution of actions given by 1-A and 2-A, which shows a higher frequency of selfish action than in any other observation, as shown in Table 15. Out of 5 subjects classified as SW, two subjects switched to SF preferences-type and another one switched to IA preferences. Most IA subjects happened to observe a fair amount of surplus creating action but very little of surplus destroying action, as shown in Table 17. Out of 6 subjects classified as IA, two subjects switched to Selfish preferences and other two switched to SW preferences. Tables 15 and 17 show that the observed distribution of actions over the sixteen tables did have an impact on the actions, and therefore, in the type classification of SW and IA types, but had no impact on SF types.[44]

Overall, we conclude that almost 70% of subjects did not change preferences-type. Therefore, interdependent preferences-types seem to show robustness to belief elicitation and provision of social information. This robustness is compatible with previous evidence by Brandts and Fatás (2001), who observe little indication of social influence in a public good game and thus, in a strategic environment. However, in our non-strategic setting there are important differences across different preferences-types. While Selfish subjects never change type, other preferences-types show much less stability. Our results are consistent with Cason and Mui (1998), where they show, in a twice-repeated regular dictator game in which dictators are informed of a previous choice by another single dictator, that subjects who are more self-regarding on their first decisions are less likely to change choices between their first and second decisions. Notice that this result seems intuitive up to some extend: SF individuals who do not care

[43] This is done in Tables 15, 16 and 17. Kappa tests measuring agreement between row and column classifications yield values 0.502, 0.781 and 0.304 for Tables 15, 16 and 17 respectively. Therefore, we can reject the independence hypothesis between rows and columns. Furthermore, pair-wise Fisher Exact tests comparing the classification in Part 3 of the experiment of subjects classified under the four different preferences-types in Part 1, allows us to conclude that there are significant differences across types. In particular in Table 15, the SF type is significantly different from SW type (p-value of 0.037) and also from the IA type (p-value of 0.015). In Table 16, SF type is significantly different from SW (p-value of 0.006). Finally, in Table 17, SF type is significantly different from IA type (p-value of 0.025).

[44] Disaggregating this data into the three different observations of information limits the number of individuals to 20 subjects each time, reducing dramatically the number of observations of subjects classified as SW, IA and CP. This caveat could be partly solved at the cost of having more subjects or complicating the design (or incurring in deception). Further research on this topic, using a specific design to study the effect of information on the stability of interdependent preferences will follow.

about others' payoffs are not affected by others' actions, while other' regarding individuals (SW, IA or CP) are more affected by others' choices.

7. **Conclusions**

We have designed a modified dictator game experiment which allows us to classify subjects into four different interdependent preferences-types. We have elicited beliefs Deciders hold about other Deciders' actions, and we have provided Deciders with information regarding other Deciders' actions. Our analysis shows that while some individuals may be aware of the existence of heterogeneity in actions and therefore interdependent preferences, it is wrong to assume that they all hold the same beliefs. The most prominent interdependent preferences-type is Selfish, and all existent preferences-types are aware of this. However, while Selfish individuals do not believe others incur in personal costs to create or destroy surplus, individuals with interdependent preferences are aware that there may exist others taking different actions. Social Welfare maximizers hold the most accurate beliefs about the heterogeneity in actions. We also show that different types of individuals are affected differently by social information. When providing information about others' previous choices, Selfish types barely change their choices, while Social Welfare maximizers, Inequity Averse and Competitive individuals show to be sensitive to this information. In particular, we show that those individuals with interdependent preferences, who are affected by social information, tend to behave more selfishly.

Our empirical analysis has been carried out in a decision making (non-strategic) setting due to two reasons. First, we aimed to identify purely distributional or interdependent preferences. Second, we aimed to study the role beliefs play, as well as the effect social information has, in purely distributional or interdependent preferences. Our results have important implications for modeling and interpreting behavior both in non-strategic and strategic interactions between individuals with heterogeneous preferences. The experimental results reported in this paper show that interdependent preferences that only include payoff differences among players might be too limited to capture other-regarding preferences because beliefs and knowledge about what others choose, despite not affecting directly own payoffs, might actually play an important role determining behavior.

In charitable giving or public good settings, heterogeneous beliefs about others' contributions may affect contributions. Moreover, providing information on what other decision makers have contributed might be an effective and powerful tool, if used appropriately, on increasing contributions. Fundraisers should carefully design what information should be provided keeping always in mind the target donor. We aim to develop these ideas in future research.

8. **References**

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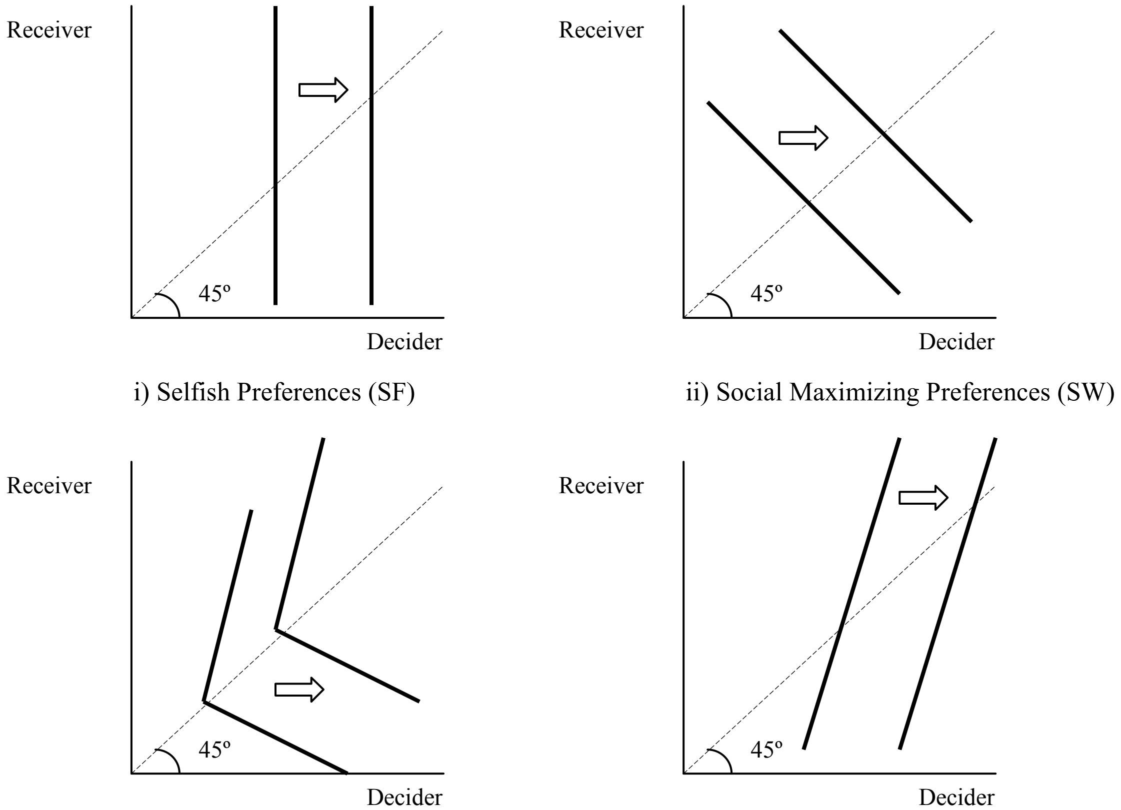
9. Appendix

Figure 1. Indifference Curves for Different Interdependent Preferences-Types



i) Selfish Preferences (SF)

ii) Social Maximizing Preferences (SW)

iii) Inequity Averse Preferences (IA)

iv) Competitive Preferences (CP)

Figure 2. Decision Table

	S (Selfish Action)	C (Surplus Creating Action)	D (Surplus Destroying Action)
Decider	*x*	*x-1*	*x-1*
Receiver	*y*	*y+s*	*y-s*

Figure 3. The Sixteen Distribution Tables

Table 1 (*s*=7)	Option 1	Option 2	Option 3
Decider	7	7	8
Receiver	10	24	17

Table 2 (*s*=5)	Option 1	Option 2	Option 3
Decider	16	17	16
Receiver	3	8	13

Table 3 (*s*=2)	Option 1	Option 2	Option 3
Decider	20	19	19
Receiver	5	7	3

Table 4 (*s*=7)	Option 1	Option 2	Option 3
Decider	10	10	11
Receiver	21	7	14

Table 5 (*s*=4)	Option 1	Option 2	Option 3
Decider	17	16	16
Receiver	8	12	4

Table 6 (*s*=3)	Option 1	Option 2	Option 3
Decider	8	7	7
Receiver	17	14	20

Table 7 (*s*=3)	Option 1	Option 2	Option 3
Decider	17	16	16
Receiver	8	11	5

Table 8 (*s*=5)	Option 1	Option 2	Option 3
Decider	8	7	7
Receiver	17	12	22

Table 9 (s=6)	Option 1	Option 2	Option 3
Decider	13	14	13
Receiver	5	11	17

Table 10 (s=4)	Option 1	Option 2	Option 3
Decider	4	5	4
Receiver	24	20	16

Table 11 (s=7)	Option 1	Option 2	Option 3
Decider	16	16	17
Receiver	1	15	8

Table 12 (s=4)	Option 1	Option 2	Option 3
Decider	20	19	19
Receiver	5	1	9

Table 13 (s=2)	Option 1	Option 2	Option 3
Decider	4	4	5
Receiver	22	18	20

Table 14 (s=6)	Option 1	Option 2	Option 3
Decider	7	7	8
Receiver	23	11	17

Table 15 (s=3)	Option 1	Option 2	Option 3
Decider	13	13	14
Receiver	8	14	11

Table 16 (s=5)	Option 1	Option 2	Option 3
Decider	10	10	11
Receiver	19	9	14

Table 1. Actions in Part 1 of the Experiment

	Decider's Position: Ahead			Decider's Position: Behind			
	Selfish Action	Surplus Creating Action	Surplus Destroying Action	Selfish Action	Surplus Creating Action	Surplus Destroying Action	TOTAL
Number of Actions	316	142	22	346	80	54	960
Average by subject	5.27	2.37	0.37	5.77	1.33	0.90	16
Stand. Dev.	(2.79)	(2.65)	(1.13)	(2.54)	(2.17)	(1.90)	
Frequency of Play	0.66	0.30	0.05	0.72	0.17	0.11	

Table 2. Elicited Beliefs

	Decider's Position: Ahead				Decider's Position: Behind			
	Selfish Action	Surplus Creating Action	Surplus Destroying Action	TOTAL	Selfish Action	Surplus Creating Action	Surplus Destroying Action	TOTAL
Average	0.73	0.16	0.11	1	0.76	0.12	0.13	1
Stand. Dev.	(0.23)	(0.17)	(0.13)		(0.22)	(0.15)	(0.16)	

Table 3. Actions in Part 3 of the Experiment

	Decider's Position: Ahead			Decider's Position: Behind			
	Selfish Action	Surplus Creating Action	Surplus Destroying Action	Selfish Action	Surplus Creating Action	Surplus Destroying Action	TOTAL
Number of Actions	342	114	24	374	69	37	960
Average	5.7	1.9	0.4	6.23	1.15	0.62	16
Stand. Dev.	(2.8)	(2.7)	(1.29)	(2.59)	(2.33)	(1.63)	
Frequency of Play	0.71	0.24	0.05	0.78	0.14	0.08	

Table 4. Individual by Individual Estimation (Part 1)											
	Decider's Position: Ahead			Decider's Position: Behind			Estimation				
Subject	Selfish Action	Surplus Creating Action	Surplus Destroying Action	Selfish Action	Surplus Creating Action	Surplus Destroying Action	ρ_i	σ_i	ε_i	LL	Type
1	1	5	2	2	0	6	0.34	-1.01	0.38	11.77	IA
2	5	3	0	5	2	1	0.17	0.14	0.28	9.80	SW
3	8	0	0	7	1	0	0	0	0.09	4.43	SF
4	8	0	0	8	0	0	0	0	0	0	SF
5	8	0	0	6	0	2	0	0	0.19	7.41	SF
6	8	0	0	8	0	0	0	0	0	0	SF
7	8	0	0	8	0	0	0	0	0	0	SF
8	0	8	0	2	6	0	0.34	0.34	0.19	7.41	SW
9	8	0	0	8	0	0	0	0	0	0	SF
10	8	0	0	8	0	0	0	0	0	0	SF
11	8	0	0	8	0	0	0	0	0	0	SF
12	4	4	0	4	4	0	0.30	0.16	0.56	14.74	SW*
13	3	4	1	5	3	0	0.26	[-0.15,0]	0.47	13.40	IA*
14	8	0	0	8	0	0	0	0	0	0	SF
15	6	2	0	1	0	7	0	-0.51	0.19	7.41	CP
16	8	0	0	8	0	0	0	0	0	0	SF
17	2	6	0	3	0	5	0.34	-0.51	0.28	9.80	IA
18	5	2	1	4	0	4	-0.2	-0.51	0.47	13.40	CP*
19	4	4	0	4	4	0	0.17	0.17	0.19	7.41	SW
20	6	0	2	2	0	6	-0.2	-0.51	0.09	4.43	CP
21	1	7	0	4	2	2	0.34	0.13	0.38	11.77	SW
22	8	0	0	8	0	0	0	0	0	0	SF
23	7	0	1	7	1	0	0	0	0.19	7.41	SF
24	8	0	0	8	0	0	0	0	0	0	SF
25	4	4	0	6	2	0	0.26	0.13	0.19	7.41	SW
26	5	3	0	7	0	1	0.21	0	0.19	7.41	IA
27	8	0	0	8	0	0	0	0	0	0	SF
28	2	5	1	8	0	0	0.26	[-0.15,0]	0.09	4.43	IA
29	0	8	0	7	1	0	0.34	0	0.09	4.43	IA
30	8	0	0	8	0	0	0	0	0	0	SF
31	2	6	0	5	3	0	[0.25, 0.27]	0.17	0.19	7.41	SW
32	3	4	1	1	6	1	0.26	0.34	0.47	13.40	SW*
33	7	0	1	6	0	2	0	-0.21	0.09	4.43	CP
34	8	0	0	8	0	0	0	0	0	0	SF
35	8	0	0	8	0	0	0	0	0	0	SF
36	4	4	0	8	0	0	0.34	[-0.16,0]	0.19	7.41	IA
37	0	8	0	0	8	0	0.34	0.34	0	0	SW
38	6	2	0	5	3	0	[0,0.13]	[0.13, 0.17]	0.38	11.77	SW
39	3	5	0	6	2	0	0.26	0	0.38	11.77	IA
40	7	1	0	4	0	4	[0.03, 0.13]	-0.34	0.28	9.80	IA
41	6	2	0	6	2	0	0.13	0.13	0.09	4.43	SW
42	1	7	0	0	8	0	0.34	0.34	0.09	4.43	SW
43	7	1	0	7	0	1	0	-0.17	0.09	4.43	CP
44	0	0	8	0	0	8	-1.01	-1.01	0	0	CP
45	8	0	0	8	0	0	0	0	0	0	SF
46	4	4	0	8	0	0	0.26	0	0.09	4.43	IA
47	8	0	0	8	0	0	0	0	0	0	SF
48	7	1	0	7	1	0	0.13	0	0.09	4.43	IA
49	0	8	0	1	7	0	0.34	0.26	0	0	SW
50	4	3	1	7	1	0	0.21	0	0.38	11.77	IA
51	2	6	0	7	1	0	0.21	0	0.28	9.80	IA
52	7	1	0	8	0	0	0.13	0	0	0	IA
53	8	0	0	7	0	1	0	0	0.09	4.43	SF
54	5	3	0	2	6	0	-0.13	0.34	0.47	13.40	*
55	8	0	0	8	0	0	0	0	0	0	SF
56	8	0	0	8	0	0	0	0	0	0	SF
57	2	5	1	5	2	1	[0.3, 0.34]	[0.01, 0.11]	0.47	13.40	SW*
58	8	0	0	7	1	0	0	0	0.09	4.43	SF
59	4	4	0	4	3	1	[0.17, 0.21]	[-0.33,-0.26]	0.47	13.40	IA*
60	4	2	2	7	0	1	[0, 0.26]	0	0.47	13.40	SF or IA?*

* Subjects estimated to have an error higher than 0.38 and thus, not considered in the subsequent analysis with 52 subjects.

Table 5. Frequency of Play Separately for Preferences-types (Part 1) (N=52 Subjects)

	Overall			Decider's Position: Ahead			Decider's Position: Behind		
	S	*C*	*D*	*S*	*C*	*D*	*S*	*C*	*D*
SF	0.98	0.01	0.01	0.99	--	--	0.97	0.02	0.01
SW	0.38	0.60	0.02	0.32	0.67	0.00	0.43	0.53	0.03
IA	0.62	0.27	0.09	0.46	0.50	0.04	0.78	0.06	0.15
CP	0.525	0.04	0.44	0.65	0.07	0.27	0.4	--	0.6
TOTAL	**0.72**	**0.20**	**0.07**	**0.69**	**0.27**	**0.04**	**0.75**	**0.13**	**0.11**

Table 6. Interdependent Preferences-Type Estimation for Different Specifications (Part 1)

	Individual by Individual Estimation (Summary)				Population Estimation: Type-Dependent Error				Population Estimation: One Error			
	p_k	$\bar{\rho}_k$	$\bar{\sigma}_k$	$\bar{\varepsilon}_k$	p_k	ρ_k	σ_k	ε_k	p_k	ρ_k	σ_k	ε
SF	0.44	--	--	0.03	0.52	--	--	0.05	0.63	--	--	0.21
SW	0.21	0.25	0.21	0.18	0.08	0.34	0.34	0.09	0.09	0.34	0.33	0.21
IA	0.25	0.24	-0.16	0.21	0.32	0.29	-0.01	0.44	0.22	0.33	-0.04	0.21
CP	0.10	-0.34	-0.38	0.07	0.09	-0.22	-0.76	0.47	0.06	-0.21	-0.99	0.21
LL	-217.99				-423,72				-464.32			

Table 7. Expected Frequency of Play Separately for Preferences-types

	Selfish Action	Surplus Creating Action	Surplus Destroying Action
SF	0.92	0.04	0.04
SW	0.61	0.28	0.11
IA	0.71	0.14	0.15
CP	0.66	0.08	0.25
Average	**0.78**	**0.12**	**0.10**

Table 8: Belief-Type Identification for Different Specifications

	Specification 1						Specification 2								
# of Types	Model	p_k	Sb_k	Cb_k	Db_k	LL		p_k	SbA_k	CbA_k	DbA_k	SbB_k	CbB_k	DbB_k	LL
K=1	(1)	--	0.78	0.12	0.10	-571.89	(5)	--	0.76	0.14	0.10	0.79	0.10	0.11	-570.24
							Restricted: (1) Unrestricted: (5) *p*-value=0.19								
K=2	(2)	0.53	0.94	0.04	0.03	-526.85	(6)	0.52	0.93	0.04	0,03	0.95	0.03	0.02	-524.71
		0.47	0.59	0.22	0.19			0.48	0.58	0.25	0.17	0.61	0.18	0.21	
	Restricted: (1) Unrestricted: (2) *p*-value=0.21*E18						Restricted: (2) Unrestricted: (6) *p*-value=0.37								
K=3	**(3)**	**0.55**	**0.93**	**0.04**	**0.03**	-512,61	(7)	0.55	0.92	0.05	0.03	0.94	0.03	0.03	-510.22
		0,20	**0.64**	**0.32**	**0.04**			0.20	0.5935	0.36	0.05	0.679	0.28	0.04	
		0.25	**0.54**	**0.14**	**0.31**			0.25	0.5506	0.18	0.27	0.542	0.11	0.35	
	Restricted: (2) Unrestricted: (3) *p*-value=0.000003						Restricted: (3) Unrestricted: (7) *p*-value=0.57								
K=4	(4)	0.49	0.94	0.03	0.03	-509.65	(8)	0.48	0.94	0.03	0.03	0.96	0.02	0.02	-506.78
		0.25	0.72	0.23	0.05			0.27	0.68	0.27	0.05	0.76	0.18	0.06	
		0.24	0.53	0.15	0.32			0.24	0.54	0.17	0.28	0.53	0.11	0.36	
		0.02	0.27	0.70	0.03			0.02	0.30	0.65	0.05	0.23	0.76	0.01	
	Restricted: (3) Unrestricted: (4) *p*-value=0.12						Restricted: (4) Unrestricted: (8) *p*-value=0.67								

Table 9. Frequency Table for Interdependent Preferences-Types and Belief-Types

Preferences Types	Belief-Types			
	Belief-Type 1 (0.93, 0.04, 0.03)	Belief-Type 2 (0.64, 0.32, 0.04)	Belief-Type 3 (0.54, 0.14, 0.31)	TOTAL
SF	**19**	2	2	23
SW	2	**6**	3	11
IA	**5**	3	**5**	13
CP	**2**	--	**3**	5
TOTAL	28	11	13	52

Table 10. Individual by Individual Estimation (Part 3)										
	Decider's Position: Ahead			Decider's Position: Behind			Estimation			
Subject	Selfish Action	Surplus Creating Action	Surplus Destroying Action	Selfish Action	Surplus Creating Action	Surplus Destroying Action	ρ_i	σ_i	ε_i	LL	Type
1	5	0	3	1	0	7	-0.17	-1.01	0.28	9.80	CP
2	5	1	2	5	1	2	[0.13, 0.17]	0	0.47	13.4	IA++
3	8	0	0	8	0	0	0	0	0	0	SF
4	8	0	0	8	0	0	0	0	0	0	SF
5	6	0	2	8	0	0	-0.17	0	0.09	4.43	CP
6	8	0	0	8	0	0	0	0	0	0	SF
7	8	0	0	8	0	0	0	0	0	0	SF
8	0	8	0	0	8	0	0.34	0.34	0	0	SW
9	8	0	0	8	0	0	0	0	0	0	SF
10	8	0	0	8	0	0	0	0	0	0	SF
11	8	0	0	8	0	0	0	0	0	0	SF
12	4	4	0	7	1	0	0.34	[-0.16, 0]	0.28	9.80	IA*
13	2	6	0	4	0	4	0.34	-0.34	0.19	7.41	IA*
14	8	0	0	8	0	0	0	0	0	0	SF
15	5	3	0	6	0	2	[0, 0.34]	-0.26	0.38	11.77	IA or CP+
16	8	0	0	8	0	0	0	0	0	0	SF
17	6	1	1	5	0	3	0	[-0.34, 0.17]	0.38	11.77	CP
18	7	1	0	7	1	0	0	0	0.19	7.41	SF*
19	4	4	0	5	3	0	0.17	0.17	0.28	9.80	SW
20	4	0	4	3	0	5	[-1, -0.51]	[-0.51, -0.26]	0.47	13.40	CP++
21	1	7	0	4	2	2	0.34	0	0.09	4.43	IA
22	8	0	0	8	0	0	0	0	0	0	SF
23	7	0	1	7	1	0	0	0	0	0	SF
24	8	0	0	8	0	0	0	0	0	0	SF
25	4	4	0	6	2	0	0	0	0	0	SF
26	5	3	0	7	0	1	[0.17, 0.21]	0	0.19	7.41	IA
27	8	0	0	8	0	0	0	0	0.09	4.43	SF
28	2	5	1	8	0	0	0	0	0	0	SF
29	0	8	0	7	1	0	0.34	0.17	0.19	7.41	SW
30	8	0	0	8	0	0	0	0	0	0	SF
31	2	6	0	5	3	0	0	0	0.38	11.77	SF
32	3	4	1	1	6	1	[0.13, 0.17]	[0.143, 0.17]	0.47	13.40	SW*,++
33	7	0	1	6	0	2	0	0	0	0	SF
34	8	0	0	8	0	0	0	0	0	0	SF
35	8	0	0	8	0	0	0	0	0	0	SF
36	4	4	0	8	0	0	0.13	0	0.19	7.41	IA
37	0	8	0	0	8	0	0.34	0.34	0	0	SW
38	6	2	0	5	3	0	0.26	0.26	0.09	4.43	SW
39	3	5	0	6	2	0	0.34	[-0.16, 0]	0.38	11.77	IA
40	7	1	0	4	0	4	0	-0.17	0	0	CP
41	6	2	0	8	0	0	0.13	0	0.09	4.43	IA
42	0	8	0	0	8	0	0.34	0.34	0	0	SW
43	8	0	0	8	0	0	0	0	0	0	SF
44	0	0	8	0	0	8	-1.01	-1.01	0	0	CP
45	8	0	0	8	0	0	0	0	0	0	SF
46	3	5	0	8	0	0	0.26	0	0	0	IA
47	8	0	0	8	0	0	0	0	0	0	SF
48	8	0	0	8	0	0	0	0	0	0	SF
49	0	8	0	0	8	0	0.34	0.34	0	0	SW
50	6	2	0	5	3	0	0	[0, 0.13]	0.47	13.40	SF ?+,++
51	4	4	0	5	3	0	0.21	0	0.47	13.40	IA++
52	8	0	0	8	0	0	0	0	0	0	SF
53	8	0	0	8	0	0	0	0	0	0	SF
54	5	3	0	3	5	0	0.13	0.13	0.47	13.40	SW*,++
55	8	0	0	8	0	0	0	0	0	0	SF
56	8	0	0	8	0	0	0	0	0	0	SF
57	2	3	3	7	0	1	[0.26, 0.34]	0	0.56	14.74	IA*
58	8	0	0	8	0	0	0	0	0	0	SF
59	3	5	0	5	3	0	0.34	[-0.19, 0.13]	0.38	11.77	SW or IA?*
60	8	0	0	8	0	0	0	0	0	0	SF*

* Subjects estimated in Part 1 with an error higher than 0.38 and thus, eliminated not considered in from the sub-sample of 52 subjects.
+ Subjects that allow for different type classifications in Part 3 and for which a subjective classification was used (see footnote 36).
++ Subjects estimated in Part 3 with an error higher than 0.38.

Table 11. Frequency of Play Separately for Preferences-types (Part 3) (N=52 Subjects)									
	Overall			Decider's Position: Ahead			Decider's Position: Behind		
	S	*C*	*D*	*S*	*C*	*D*	*S*	*C*	*D*
SF	0.93	0.05	0.01	0.92	0.07	0.01	0.95	0.04	0.01
SW	0.24	0.76	--	0.18	0.82	--	0.30	0.69	--
IA	0.64	0.30	0.05	0.48	0.48	0.03	0.80	0.12	0.08
CP	0.53	0.04	0.42	0.59	0.09	0.32	0.48	--	0.52
TOTAL	**0.74**	**0.19**	**0.07**	**0.71**	**0.24**	**0.05**	**0.78**	**0.13**	**0.09**

Table 12. Interdependent Preferences-Type Estimation for Different Specifications (Part 3)												
	Individual by Individual Estimation (Summary)				Population Estimation: Type-Dependent Error				Population Estimation: One Error			
	p_k	$\bar{\rho}_k$	$\bar{\sigma}_k$	$\bar{\varepsilon}_k$	p_k	ρ_k	σ_k	ε_k	p_k	ρ_k	σ_k	ε
SF	0.58	--	--	0.03	0.59	--	--	0.01	0.74	--	--	0.14
SW	0.13	0.30	0.28	0.08	0.10	0.33	0.33	0.06	0.11	0.34	0.33	0.14
IA	0.15	0.22	-0.01	0.23	0.26	0.25	-0.06	0.45	0.09	0.34	-0.03	0.14
CP	0.13	-0.28	-0.44	0.23	0.05	-0.70	-0.66	0.41	0.06	-0.75	-0.81	0.14
LL	-164.71				-315.68				-352.04			

Table 13. Interdependent Preferences-Type Classification in Parts 1 and 3					
	Preferences-Types Part 3				
Preferences-Types Part 1	SF	SW	IA	CP	TOTAL
SF	**22**	--	--	1	23
SW	2	**6**	3	--	11
IA	4	1	**5**	3	13
CP	2	--	--	**3**	5
TOTAL	30	7	8	7	52

Table 14. Different Observations of Other Participants' Actions				
Session and Group	Observed number of Selfish Action	Observed number of Surplus Creating Action	Observed number of Surplus Destroying Action	Total
1-A	122	24	14	160
1-B	103	34	23	160
2-A	126	25	9	160
2-B	95	60	5	160
3-A	113	25	22	160
3-B	103	54	3	160

Table 15. Interdependent Preferences-Type Classification in Parts 1 and 3 (1-A and 2-A)

	Preferences-Types Part 3				
Preferences-Types Part 1	SF	SW	IA	CP	TOTAL
SF	**6**	**--**	**--**	**1**	7
SW	**2**	**2**	**2**	**--**	6
IA	**--**	**--**	**2**	**2**	4
CP	**--**	**--**	**--**	**2**	2
TOTAL	8	2	4	5	19

Table 16. Interdependent Preferences-Type Classification in Parts 1 and 3 (3-A and 1-B)

	Preferences-Types Part 3				
Preferences-Types Part 1	SF	SW	IA	CP	TOTAL
SF	**8**	**--**	**--**	**--**	8
SW	**--**	**2**	**1**	**--**	3
IA	**1**	**--**	**2**	**--**	3
CP	**--**	**--**	**--**	**1**	1
TOTAL	9	2	3	1	15

Table 17. Interdependent Preferences-Type Classification in Parts 1 and 3 (2-B and 3-B)

	Preferences-Types Part 3				
Preferences-Types Part 1	SF	SW	IA	CP	TOTAL
SF	**8**	**--**	**--**	**--**	8
SW	**--**	**--**	**--**	**--**	--
IA	**3**	**2**	**1**	**1**	7
CP	**2**	**--**	**--**	**1**	3
TOTAL	13	2	1	2	18

Experimental Instructions

Below you can find a translation of the experimental instructions which were handed to Deciders sequentially and read aloud before each part. A summary of these instructions appeared on subjects' screens before each part.

Instructions read to all subjects ("Deciders" and "Receivers").

THANK YOU FOR PARTICIPATING IN OUR EXPERIMENT!

This is an experiment and thus, no talking, looking-around or walking is allowed. If you have any question or need help please raise your hand and one of the researchers will assist you. If you do not follow the indicated rules, WE WILL ASK YOU TO LEAVE THE EXPERIMENT AND YOU WILL NOT RECEIVE ANY PAYMENT. Thank you.

This experiment is about individual decisions. Both Pompeu Fabra and Autònoma de Barcelona universities have provided funds to carry it out. **You will receive 3 euros for having arrived on time.** Additionally, if you follow the instructions correctly you may earn more money.

The experiment has three parts. Before each part, we will let you know about the tasks you have to do and how your decisions will affect your payments. Everything you earn will be for you and paid in cash inside a closed envelope in a strictly private way at the end of the experimental session.

Each participant has a strictly confidential "Experiment Code" to guarantee that no participant can identify another one by his/her decisions nor earnings. Researchers will observe each participant's earnings at the end of the experiment but we will not associate your decisions with any participants' names.

Your Experiment Code is: XXXXX

The experiment consists of three parts. Your final payment will be the sum of a participation fee of the 3 euros plus whatever you earn in the three parts of the experiment.

Each experimental point corresponds to 25 Euro cents.

Thus, if you obtain a total of 32 points, you will receive a total of 11 euros (3 for participating and 8 from converting 32 experimental points into euros at a rate of 4 experimental point * 0.25 = 1 Euro).

If, for example, you obtain 10 experimental points, you will receive 5.5 Euros (10*0.25=2.5 + 3 =5.5).

If, for example, you obtain 70 experimental points, you will receive 20.5 Euros (70*0.25=17.5 + 3 = 20.5).

There are 40 participants in this experiment, 20 in the laboratory to whom we refer to as "Deciders" and 20 in a classroom to whom we refer to as "Receivers".

As you have observed, who is a "Decider" (and stayed in the laboratory) and who is a "Receiver" (and went to the classroom) has been randomly decided by extracting a paper from a bag.

"Deciders" take decisions which affect their payments and the payments of other participants in the experiment. "Receivers" do not take any decision, which affect neither their payments nor those of other participants in the experiment. When the experiment concludes, we will first pay "Deciders" in private. Once "Deciders" have left, "Receivers" will come to the laboratory and will be paid in private.

The 20 "Deciders" have been divided in two groups of 10 subjects each: "group A" and "group B". You belong to Group A (B). If you are a "Receiver" you do not belong to any group.

PART 1 is about to start. Please wait until everyone has read the instructions for PART 1.

Instructions for Deciders' Task 1

PART 1
In this part of the experiment we are going to show you 16 tables. The 16 tables the computer will show you will look as follows:

	Option 1	Option 2	Option 3
Decider	8	7	11
Receiver	17	19	13

In each of the tables you must choose between "Option 1", "Option 2" and "Option 3". Each of these 3 options describes how many experimental points a participant ("Decider") receives and how many another randomly matched participant ("Receiver") gets.

At no time a participant will know who they are matched with in any table.

When the experiment is over, the computer will randomly choose one of the 16 tables to determine the payments for PART 1.

You will receive the amount of experimental points corresponding to "Decider" in the chosen table and your matched participant will receive the number of experimental points corresponding to "Receiver" in the same table.

For example, if the chosen table was the one that appears above and you had chosen "Option 2", you would obtain 7 experimental points while your matched participant would obtain 19 experimental points.

Notice that the numbers in the example are just for illustrative purposes. They DO NOT intend to suggest how anyone may choose among the different options.

Participants in the other classroom ("Receivers") can not take any decision which may affect your payments or their payments.

What you earn and what your matched participant ("Receiver") earns depends only on your decisions and on the randomly chosen table.

Once you have chosen your option in a particular table, please press "OK" and wait for the other participants to make their choice before moving to the next table.

Instructions for Deciders' Task 2

PART 2

In this part of the experiment the computer will show you the same 16 tables you saw in PART 1, although the tables may appear in a different order than before.

Remember that we have divided the 20 participants in the experiment in two groups of 10 people ("group A" and "group B"). In the first part of the experiment all "Deciders" have chosen among the three options having as a matched participant another subject from the other room ("Receivers").

Now you will have to guess how many out of the 10 "Deciders" from the other group ("group A"/"group B") have chosen each option ("Option 1", "Option 2" and "Option 3") in each of the 16 tables in PART 1 of the experiment.

For example, in one of the tables you may write:

Option 1: 6
Option 2: 3
Option 3: 1

This would mean that you think that in this particular table, 6 out of the 10 participants in Group B (A), chose "Option 1", 3 chose "Option 2 and 1 chose "Option 3".

Notice that the numbers in the example are just for illustrative purposes. They DO NOT intend to suggest how anyone may choose among the different options.

When the experiment is over, the computer will randomly choose one of the 16 tables to make payments for PART 2. You will receive more money the closer your guesses are to what participants from Group B (A) actually chose in PART 1.

You will be paid according to the mathematical formula which appears below. Do not worry if you do not understand the formula exactly. What is important is that you understand that the closer the numbers you write to the number of participants who actually chose each option the more money you will receive.

For example, if you write that 6 participants choose "Option 1" and actually 6 participants chose "Option 1", you will receive more money than if 5 or 7 participants chose "Option 1".

Notice that in this part of the experiment your answer can only affect your payments, and not those of any other participant, either from your group or the other group.

Here is the formula:

Experimental Points in PART 2 = $20 - 0.01 * [(a-X)^2+(b-Y)^2+(c-Z)^2]$, where:

a: Number of participants you think choose "Option 1"
b: Number of participants you think choose "Option 2"
c: Number of participants you think choose "Option 3"
X: Number of participants who actually chose "Option 1"
Y: Number of participants who actually chose "Option 2"
Z: Number of participants who actually chose "Option 3"

Please read the following examples to see how the formula works:

- In one table, you write that 6 participants choose "Option 1", 3 participants "Option 2" and 1 participant "Option 3". If, in fact 6 participants chose "Option 1", 3 participants "Option 2" and 1 participant "Option 3" you will obtain:
Experimental Points in PART 2 = $20 - 0.01 * [(6-6)^2+(3-3)^2+(1-1)^2]= 20$.

- In one table, you write that 2 participants choose "Option 1", 4 participants "Option 2" and 4 participants "Option 3". If, in fact in that table 8 participants chose "Option 1", 2 participants "Option 2" and 0 participants "Option 3" you will obtain:
Experimental Points in PART 2 = $20 - 0.01 * [(2-8)^2+(4-2)^2+(4-0)^2]= 14.4$.

- In one table, you write that 0 participants choose "Option 1", 10 participants "Option 2" and 0 participants "Option 3". If, in fact in that table 10 participants chose "Option 1", 0 participants "Option 2" and 0 participants "Option 3" you will obtain:
Experimental Points in PART 2 = $20 - 0.01 * [(0-10)^2+(10-0)^2+(0-0)^2]= 0$.

Notice that the numbers in the example are just for illustrative purposes. They DO NOT intend to suggest how anyone may choose among the different options.

Examples show that with this formula you will never lose experimental points in PART 2, and that you can obtain up to 20 experimental points in PART 2. You will earn more money the closer your guesses are to the number of participants who actually chose each option.

Once you have entered your guess in a particular table, you should press "OK" and wait for the other participants to make their guesses before moving to the next table.

Instructions for Deciders' Task 3

PART 3

In this final part of the experiment the computer will show you for the last time the 16 tables you have already seen, although they might be in a different order. For each table, you are matched with a participant from the other classroom ("Receiver") randomly chosen and different from the one in PART 1.

Your task will consist once again in deciding between the three options ("Option 1", "Option2" and "Option 3") as you did in PART 1.

The way you ("Decider") and your matched participant ("Receiver") will earn experimental points is the same as in PART 1 of the experiment. Your payments only depend on your decisions and on the randomly chosen table by the computer at the end of the experiment.

The only novelty you will find is that when you now observe each of the tables you will see how many of the other group of "Deciders" actually chose each option ("Option 1", "Option2" and "Option 3") in PART 1 of the experiment.

Once you have chosen your option in a particular table, please press "OK" and wait for the other participants to make their choice before moving to the next table.

Thank you very much for your participation.

Anonymous Questionnaire filled by all participants

My Experiment Code is: ___________

1. ¿What do you think about the experiment?
2. How did you make your choices in each part of the experiment?
3. How do you think others made their choices in each part of the experiment?
4. Are you satisfied with your earnings in the experiment?
5. Gender:
6: Age.
7. What do you study?
8. Would you like to add any other comment?