Explicit versus Implicit Contracts for Dividing the Benefits of Cooperation*

Marco Casari (University of Bologna) and Timothy N. Cason (Purdue University)

5 April 2012

Abstract

Experimental evidence has accumulated highlighting the limitations of formal and explicit contracts in certain situations, and has identified environments in which informal and implicit contracts are more efficient. This paper documents the superior performance of explicit over implicit contracts in a new partnership environment in which both contracting parties must incur effort to generate a joint surplus, and one ("strong") agent controls the surplus division. In the treatment in which the strong agent makes a non-binding, cheap talk "bonus" offer to the weak agent, this unenforceable promise doubles the rate of joint high effort compared to a baseline with no promise. The strong agents most frequently offered to split the gains of the high effort equally, but actually delivered this amount only about one-quarter of the time. An explicit and enforceable contract offer performs substantially better, increasing the frequency of the most efficient outcome by over 200 percent relative to the baseline.

Keywords: Experiments; laboratory; social preferences; inequity aversion; reciprocity; trust.

JEL Classification: C70; D03

*marco.casari@unibo.it, Università di Bologna, Department of Economics, Piazza Scaravilli 2, 40126 Bologna, Italy, Fax +39 051 209 8493; cason@purdue.edu, Mailing address: Krannert School of Management, Purdue University, West Lafayette, IN 47907-2076, U.S.A. Fax: +1-765-494-9658. Funding for subject payments was provided by the Purdue University Faculty Scholar program. We thank Sukanya Chaudhuri and Jingjing Zhang for research assistance. Helpful comments on earlier versions of this work were provided by two anonymous referees and an Associate Editor, as well as Dirk Engelmann, Dan Kovenock, and presentation audiences at the Barcelona ISNIE conference, Purdue University, IUPUI, ESA conferences in Rome and Tucson, University of Bari, and the Max Plank Institute in Jena.

1. Introduction

Contract theory has been developed mostly on the domain of self-regarding preferences. While this focus has allowed researchers to address important questions in optimal contract design and other areas, the emphasis on explicit incentive contracts has been challenged in the last decade by accumulating experimental evidence on "fair-minded" agents. For example, in a laboratory labor market Fehr et al. (2007) show that unenforceable bonus contracts that reward an agent for effort can outperform explicit incentive contracts when agents have preferences for fairness. Moreover, principals recognize this and frequently choose the unenforceable contract when given a choice of contract format. In contrast, the laboratory experiment in this paper employs a different environment where two agents' combined efforts determine available surplus, and an explicit and enforceable contract performs substantially better than a promised bonus offer.

General results in contract theory could in principle be extended to many preference structures, including those based on fairness. Empirical results generated in the laboratory necessarily must focus on special cases, and so before undertaking such extensions it is important to explore a variety of environments. The present study compares performance of explicit and implicit contracts in a new economic environment that we call "partnership game." In this game two agents must cooperate to generate some joint surplus that is split between them. One agent—call her the principal or simply the "strong agent"—is responsible for dividing the surplus. We examine treatments in which the strong agent offers an unenforceable (cheap talk) "bonus" payment to the other agent, or an explicit and formal contract with an effort-contingent payment.

We make no claim that this environment with simultaneous contributions to generate the joint surplus is any better or more representative than the sequential design typically considered in the laboratory labor market literature. Rather, we simply observe that many profitable economic interactions, both in the labor market and elsewhere, require efforts of multiple individuals; and that efforts are simultaneous (from a modeling perspective) when information about others' efforts is limited. Examples from management contexts are common, such as many situations where work teams collaborate on a project from multiple locations and a manager allocates a project bonus. Firms organized as partnerships provide a good concrete example.

Many such firms have senior partners who have substantially greater power in determining annual bonuses for junior partners and associates.

With explicit contracts, efficient high effort outcomes are theoretically feasible in the partnership game. Without explicit contracts, they are not, unless agents have some type of social preferences. For example, some intermediate distributions of inequity averse social preferences yields high effort as an equilibrium. Joint high effort may not be an equilibrium if too many or too few agents have self-regarding preferences. Consistent with standard theory we document empirically that explicit contracts strongly outperform implicit (bonus) contracts, as well as a baseline treatment with no opportunity for any kind of contract offer.[1] Although the promise of an unenforceable payment doubles the rate of joint high effort relative to the baseline, the formal contract triples it. Effort also decreases with experience in the baseline and cheap talk with bonus treatments but increases with experience in the formal contract treatment, so these performance differences increase over time. In the Cheap talk treatment, the strong agents frequently offered to split the gains of high effort equally, but delivered an equal split only about one-quarter of the time. Very low and high offers helped agents coordinate on the low effort equilibrium, however. This is consistent with the interpretation that offers can signal information about different preference types, reflecting heterogeneity across individuals' other-regarding preferences.

The next section briefly places this new game in the related literature. Section 3 describes the partnership game in detail along with the experimental design and procedures. Section 4 presents some theoretical predictions for the benchmark case in which all agents have standard money-maximizing preferences, as well as some implications of social preferences. Section 5 contains the results and Section 6 concludes.

2. Related literature

Elements of the partnership game are shared also by many other games that have been studied through experiments, including the public good game, trust game, principal agent games, stag

[1] Although our subjects do not sign actual contracts in the experiment, they sometimes make fully-enforceable commitments that are analogous to explicit contracts. The subjects did not see this "contract" framing of the problem during the experiment, but we adopt it here to be consistent with the existing experimental literature.

hunt game, team production and other games. Given the extent of the related literature, this section will necessarily be selective.

One common element among the above games is that when agents cooperate they generate some joint surplus that is then split between them. Unlike most public good games (recently reviewed in Chaudhuri, 2011), here agents' strategy spaces are not symmetric as there are weak and strong roles. While in public good games the surplus is evenly split among everyone, here the strong agent can decide about the split. The partnership game has a sequential element like the trust game but requires a joint effort of two agents to generate the surplus. In labor market experiments in the laboratory typically the principal pays the agent and the agent exerts effort that benefits the principal (for a review, see Gächter and Fehr, 2001, or Frey and Osterloh, 2002). The moves are usually sequential, although payments sometimes occur before and sometimes after the effort. By contrast, in our experiment the two agents move simultaneously to generate some joint surplus that they can share. Hence we call this a "partnership" game, since the agents are more equal partners than the sequential principal-agent relationships such as Charness and Dufwenberg (2006) or Fehr et al. (2007). Nevertheless, as in a labor market the environment is also hierarchical, because one agent—labeled as the "strong agent"—is responsible for dividing the benefits of their high effort. This asymmetry also exists in the power-to-take game (Bosman and van Winden, 2002), where one of the two agents can claim any fraction of the other's income following an effort stage.

Our experiment focuses on the comparison between explicit and implicit agreements to share the surplus arising from effort, and this comparison has also been a major concern of trust and principal-agent games. Ben-Ner and Putterman (2009) show that implicit contracts in a simple trust game are effective and preferred by subjects over costly explicit contracts when pre-play communication is possible. By contrast, implicit gift exchange contracts are apparently less effective when effort is more costly and not individually observable by the experimenter (Rigdon, 2002), when payoffs are presented differently (Charness et al., 2004), or for different parametrizations (Fehr et al., 2007; Healy, 2007), and implicit gift exchange may have only a temporary impact on behavior in longer field experiments (Gneezy and List, 2006).

With an explicit contract the partnership game can be similar to a stag hunt game (e.g., Battalio et al., 2001; Rydval and Ortmann, 2011), where there exist a risk dominant and a payoff dominant equilibria. This introduces an element of coordination, and the strong agent's offer for the shared surplus determines the risk and benefit of attempted cooperation. As we discuss in Section 4, the offer can also signal the agent's intention to cooperate.

3. Experimental Design and Procedures

Each experimental session included four parts: (1) Lotteries to measure risk attitude; (2) Ultimatum game; (3) Trust game; (4) Partnership game.[2] The main focus of this study is on the partnership game, hence we describe it first. Before learning the results from parts 1-3, subjects played 10 periods of the partnership game illustrated in Table 1 where two agents independently choose between high effort (1) and low effort (2). The special aspect was that one agent had a "strong" role and another a "weak" role. Whenever the high effort outcome (1, 1) was reached, the strong agent chose how to split 60 experimental francs between herself, *a*, and the weak agent, *b*. Roles were common knowledge. We conduct three treatments in an across-subject design: Baseline, Cheap Talk and Commitment.

Table 1: The Partnership Game

		Weak agent	
		1 (high effort)	*2 (low effort)*
Strong agent	*1 (high effort)*	*a*, *b* (*a*+*b*=60)	0, 10
	2 (low effort)	10, 0	10, 10

In the Baseline treatment the strong and a weak agent made a simultaneous choice between 1 and 2. In addition, when the strong agent chose 1, she was then asked to decide how she would split the 60 francs in case the outcome (1, 1) was reached. The subjects received no

[2] Sample instructions are available in the appendix.

feedback about choices and earnings until the end of each period. When the weak agent chose 2, she learned nothing about the strong agent's planned allocation because this split decision is not payoff relevant. While this could create an information extraction incentive for the weak agent to choose 1 (high effort), we employed a perfect strangers matching protocol so the split decision of the current partner provides only limited information about future partner allocations.

In the Cheap Talk treatment the strong agent first sent "a message about the allocation" to the weak agent, "(I earn …, you earn …)" and then the procedure was the same as in the Baseline treatment. Both strong and weak agents then made a simultaneous choice between 1 and 2. In addition, when the strong agent chose 1, she had to decide on how she would split the 60 francs in case the outcome (1, 1) was reached. The actual bonus given to the weak agent could be different from the one promised.[3]

In the Commitment treatment the strong agent first decided how to split the 60 francs in the event that outcome (1, 1) was reached. This choice was binding and was immediately communicated to the weak agent in the form "(I earn …, you earn …)." Both the strong and weak agent then made a simultaneous choice between 1 and 2. Thus, while choosing her effort level, the weak agent knows the bonus amount in the Commitment treatment; she knows just a non-binding bonus promise in the Cheap Talk treatment; and she receives no information in the Baseline treatment.

To reduce any repeated game effects, we employed a perfect stranger matching protocol so that subjects could never be matched with the same person more than once in any of the games played. Half of the subjects were strong agents and kept that role throughout parts 2-4. When a participant was the proposer in the ultimatum game, she was the trustee in the trust game, and the strong agent in the partnership game. Similarly, the weak agents always remained weak agents.

[3] Although we did not design our experiment to be directly comparable to Fehr et al. (2007), it has a number of similarities with their "trust" and "bonus" treatments, both in the type of interaction as well as in the matching protocol. There are also differences in a variety of dimensions. In particular, in our design (1) agents are exogenously assigned to a contract type and do not choose between two contracts, (2) both parties must exert an effort in order to reach a high payoff outcome, (3) agents choose between just two possible effort levels, rather than 11, (4) the maximum wealth multiplier in the transaction is 3, and not 5 to 10, (5) and effort choices are simultaneous, which generates a coordination problem.

The willingness of an agent to choose action 1 in the partnership game may be related to her attitude toward risk. For this reason in part 1 we measured subjects' risk attitude with fifteen binary choices between lotteries. The size of the stakes was calibrated to the partnership game levels and the overall incentive structure was similar to that in Holt and Laury (2002).[4] We paid one of the fifteen decisions, chosen randomly at the end of the session. Random choices were all implemented through drawings from a bingo cage.

We designed the ultimatum and trust games of parts 2 and 3 as special cases of the partnership game. To minimize path dependency, participants received feedback on choices and earnings for parts 1, 2 and 3 only at the end of the session. When the strong agent always chooses action 1, the Commitment treatment is like the ultimatum game played in part 2. In the ultimatum game the responder chose with the strategy method. The proposer had 60 francs and proposed an allocation. The responder had to state the minimum amount in [0, 60] she was willing to accept, referred to later as a "demand." If the proposer allocated an amount equal to or higher than the responder's demand, the proposed allocation was implemented. Otherwise, the default allocation for the "rejection" case was asymmetric: the proposer received 0 while the responder received 10 (equivalent to outcome (1, 2) of the partnership game).

The trust game of part 3 exhibits similarities to the Baseline treatment of the partnership game. The outcomes available in the trust game were the same as the mutual high effort (1, 1) and mutual low effort (2, 2) of the partnership game. Trustor and trustee began with 10 francs each. The trustor had a binary choice between sending all 10 francs to the trustee or keeping them. If 10 francs were sent, they were multiplied by five and the trustee received 50 francs. Before learning that choice, the trustee had to state how many francs in [0, 60] she wanted to send back to the trustor, i.e. the trustee chose with the strategy method.[5] Note that the trustee could also send back her own endowment francs.

[4] Subjects chose between a "safe" Option A and a "risky" Option B. The payoff of Option A was deterministic (10 experimental francs) and the potential payoffs for Option B were either 30 or 0 francs. On the first choice the probability of the high payoff for Option B was zero. In subsequent choices, the probability of the high payoff increased by 1/20 each time. A risk neutral person would choose A in lotteries 1 through 7 and then switch to B in lottery 8. Risk averse agents may switch later than lottery 7.

[5] Casari and Cason (2009) shows that the trustee is less trustworthy when this game is conducted using the strategy method than the direct response (game method).

A total of 144 subjects participated in the experiment, all recruited from the undergraduate population of Purdue University in West Lafayette, IN, USA. Six sessions were conducted with 24 subjects in each session—two sessions (48 subjects) in each of the three treatments. We recruited subjects through announcements in classes and by inviting people to sign up online using the ExLab software. No subject participated in more than one session.

Subjects were seated at computer terminals that were visually separated by partitions. No communication among subjects was allowed. An experimenter read instructions aloud one part at a time and subjects completed a short quiz for each part. Part 1 was carried out with pen and paper, and in the other parts decisions were submitted via z-Tree applications (Fischbacher, 2007). All subjects received a hard copy of the instructions. Including instructions and payment time, sessions lasted a bit less than one hour. Experimental francs were converted to U.S. dollars at a 10 to $1 rate. The average payment was $11.63, including a $5 show up fee.

4. Predictions: Self-Regarding and Inequity-Averse Preferences

This section summarizes the Nash equilibria for self-regarding agents and for agents with simple inequity aversion. It first presents the partnership game, followed by the ultimatum game and the trust game.

Predictions for the partnership game depend on the treatment and of agents' motivations. Consider first a model where everyone is self-regarding. In the Baseline and Cheap Talk treatments, a unique subgame perfect equilibrium exists where the strong agent does not allocate any amount to the weak agent and both agents exert low effort and earn 10 francs. Since the proposed bonus is cheap talk it should be irrelevant. In the Commitment treatment, the allocation choice of the strong agent influences the equilibrium set. Consider the three intervals of possible bonuses B_1=[0, 10), B_2=[10, 50], and B_3=(50, 60]. There exists a unique subgame perfect equilibrium for a bonus in $b \in B_1 \cup B_3$ and multiple equilibria for a bonus in $b \in B_2$. A low bonus $b \in B_1$is insufficient to compensate the weak agent for her effort (opportunity) cost, hence the strong agent is better off not allocating any amount to the weak agent (b=0) and both agents exert low effort and earn 10 francs. A high bonus $b \in B_3$ makes the strong agent earn less than the amount assured by choosing low effort, hence it is more profitable for the strong agent to give no

bonus to the weak agent (b=0), so both agents exert low effort and earn 10 francs. For any allocation $b \in B_2$, however, the subgame is a stag hunt game and there exist two pure strategy equilibria (1,1) and (2,2) and a mixed strategy equilibrium where the strong agent exerts high effort with probability $10/b$ and the weak agent with probability $10/(60-b)$. The high effort equilibrium Pareto dominates the low effort equilibrium – but except for extreme proposed payoff differences of – when $b=10, 50$ – the low effort equilibrium is risk dominant. For example, the following strategy profile constitutes a subgame perfect Nash equilibrium: (i) the strong agent commits to transfer $b \in B_2$ to the weak agent and chooses high effort; (ii) the weak agent chooses high effort for a bonus of at least x, where $x \leq b$, and chooses low effort for a bonus below x. When coordinating on (2,2), earnings are $60-b$ for the strong agents and b for the weak agent, which range from 10 to 50 francs per agent.

Fairness concerns could change the equilibrium set of the partnership game in all treatments. There exists in the literature a variety of models of fairness and reciprocity ; see Sobel (2005) for a survey. We outline here the equilibria when agents' preferences are characterized by a simple model of linear inequity aversion along the lines of Fehr and Schmidt (1999).[6] We did not design our experiment to examine the relative performance of the different models of other-regarding preferences, hence this analysis has an illustrative purpose.

Consider a population with both self-regarding and "fair-minded" types of agents. For the Baseline and Cheap Talk treatments, self-regarding strong agents would, of course, keep all 60 franc surplus that becomes available if joint high effort occurs. Fair-minded strong agents would prefer a more equal split of the 60 francs because they dislike advantageous inequality. Depending on the fraction of fair-minded types in the set of players, the high effort outcome can emerge in equilibrium in the Baseline and Cheap Talk treatments.

[6] For the two-player case relevant for this game, the utility of player i over monetary payoffs x_i and x_j in the Fehr-Schmidt model is $U_i(x_i, x_j) = x_i - \alpha_i \max[x_j - x_i, 0] - \beta_i \max[x_i - x_j, 0]$, for $i \neq j$. Fehr and Schmidt assume the disutility from advantageous inequality, captured by β_i, is no more than the disutility from disadvantageous inequality, captured by α_i; that is $\beta_i \leq \alpha_i$. Furthermore, they rule out spiteful behavior and perverse incentives to destroy personal earnings with the restrictions $0 \leq \beta_i < 1$.

Based on specific assumptions concerning common knowledge beliefs over the distribution of player types, one can derive the Bayesian-Nash equilibrium (BNE).[7] If some but not too many players are fair-minded, a BNE exists in which strong agents of both types exert high effort. While fair minded strong agents give a positive bonus, those who are self-regarding give no bonus. Moreover, weak agents who are fair-minded exert low effort when they suffer severely from the nontrivial likelihood of the asymmetric payoff vector (0, 60), but weak agents who are self-regarding exert high effort. Thus, what makes the high effort outcome (2, 2) a BNE is the presence of fair-minded strong agents together with self-regarding weak agents. If the proportion of fair-minded types in the population is too high, however, then the high effort rate for weak agents falls too low for the fair-minded strong agents to exert high effort. The best response for all weak agents therefore becomes low effort, yielding low effort outcome (1, 1) as the unique BNE. Interestingly, in equilibrium as the fraction of fair-minded types increases, the overall frequency of high effort choices in the population falls.[8] . This equilibrium structure from inequity-averse preferences suggests the following patterns in the data:

(a) Strong agents have more to gain from high effort than weak agents because they control the distribution of the gains, implying a greater high effort rate for strong than weak agents;

(b) When going from the low to high effort outcome, fair-minded strong agents experience a smaller utility gain than do self-regarding strong agents, implying a greater high effort rate for self-regarding strong agents; and,

(c) Fair-minded weak agents are less likely to exert high effort than self-regarding weak agents.

When all subjects in a session are self-regarding, the availability of communication in the Cheap Talk treatment should be irrelevant. When uncertainty exists about types, however, the proposed bonus amount could serve as a signal regarding the strong agents' type or effort intention. Of course, for many beliefs and distributions, only a pooling BNE exists and so the

[7] Recall that our design features a perfect strangers matching protocol in which subjects interact only once with each partner. This eliminates repeated game complications such as reputations.

[8] The equilibrium would also change under alternative assumptions about the relationships between the β_i and α_i parameters in the inequity aversion model across players, so we do not wish to emphasize the specific predictions from the type distribution assumed here.

proposed bonus amount would be completely uninformative. In this case there would be no differences in outcomes between the Baseline and Cheap Talk treatments.

In the Commitment treatment, multiple Nash equilibria exist with fair-minded agents, as in the case with all self-regarding agents. If the strong agent's offer is below 10 francs or above 50 francs, there exists a unique equilibrium where both agents exert low effort and earn 10 francs. If the offer is sufficiently generous, the subgame takes the stag hunt form and there exist two pure strategy equilibria with agents coordinating on high or low effort. Highly asymmetric offers, such as (50, 10) and (10, 50) splits, could be part of a high effort equilibrium if all agents have self-regarding preferences and are not risk averse but would lead to a low effort equilibrium if *any* agent has inequity averse or risk averse preferences. This is because the agent who would receive the 10 francs faces a risk that the other agent exerts low effort, so it is dominated by the safe payoff of 10 francs from exerting low effort. This suggests that either asymmetrically generous or asymmetrically selfish offers may serve as a signal to both agents to play the low effort equilibrium.

In summary, the efficient, high effort outcome is an equilibrium with the explicit contracting environment of the Commitment treatment, both for other-regarding and self-regarding preferences. The high effort outcome is also possible in equilibrium for the implicit contracting environment of the Cheap Talk treatment for some distributions of inequity averse preferences, but not with all self-regarding agents. In both the Cheap Talk and Commitment treatments, very high or very low offers may be used to signal intentions to play the low effort equilibrium.

Behavior can also differ in the ultimatum and trust games across subjects who have different types of other-regarding preferences, which implies a particular within-subject correlation of choices across games. Self-regarding strong agents should be more likely to (1) offer less than half the surplus in the ultimatum game and (2) return nothing in the trust game. Self-regarding weak agents should be more likely to (1) demand less than half of the surplus in the ultimatum game and (2) send all francs in the trust game. Our analysis in the next section looks for these specific patterns in the data, and also uses the lottery choices and the strategies in

the ultimatum and trust games to provide some insights into the behavior in the main partnership game.

5. Results

5.1 Overview

This section presents the results and is articulated into four subsections. After offering an overview, it shows the aggregate performance by treatment in terms of earnings and efficiency (5.2). It then focuses on bonus offers made by strong agents in the Cheap Talk and Commitment treatments, and how these offers affected coordination (5.3). Finally, it reports the measures of social and risk preferences that were elicited in the ultimatum game, trust game and lottery choice tasks, and how they relate to subjects' choices in the partnership game (5.4).

Tables 2 and 3 summarize the results for the partnership game. Agents reached the high effort outcome in 544 of 1440 matches in all treatments (38 percent). In every treatment the strong agent exerted high effort more often than the weak agent. Over all treatments the strong agent chose high effort 72 percent of the time and the weak agent choose high effort 48 percent of the time. This difference is already significant at a 5 percent level when looking at period 1 choices.[9]

Individual high effort and joint high effort were highest in the Commitment treatment and lowest in the Baseline treatment. Figure 1 presents the evolution over time of the high effort outcome rate by treatment. In the Baseline treatment the high effort outcome started around 30-40 percent in period 1 and declined to near zero at the end of the session. The baseline results provide a good benchmark from which to evaluate the impact of the other treatments because there is convergence toward the unique Nash equilibrium of low effort. In the Cheap Talk treatment the high effort outcome started around 60-70 percent and declined as well, roughly in parallel with the Baseline treatment. By contrast, the high effort outcome in the Commitment

[9] High effort choices of strong agents is 56/72 and of weak agents is 44/72, Fisher exact probability test, one-tailed, p=0.014, N=144.

treatment rose over time from the 40-50 percent range to the 60-70 percent range by the end of the session.[10]

5.2 Earnings and Efficiency

Result 1: In all treatments, strong agents earn more on average than weak agents.

Support: Table 3 shows that over all periods the strong agents earned between 54 percent (Commitment) and 67 percent (Cheap Talk) of the total amount received by the two agents. The difference is statistically significant when pooling all treatments.[11] The share earned by the strong agent declines by the final 3 periods in the Baseline and Cheap Talk treatments, in part due to the declining rate that pairs reached the high effort outcome, but it never falls below half of the total.[12] ■

Recall that for self-regarding agents, in both the Baseline and Cheap Talk treatments a unique Nash equilibrium exists with low effort, yielding the payoff vector (10, 10). Multiple equilibria exist in the Commitment treatment, including one of high effort. The next result indicates that these predictions receive some support in the data.

Result 2: Over time subjects in the Baseline and Cheap Talk treatments move closer to the low effort outcome while subjects in the Commitment treatment move closer to the high effort outcome.

Support: Figure 1 displays the overall trends in the frequency of the high effort outcome and Table 3 indicates the frequency during the last 3 periods of a session. In the last 3 periods of the Baseline treatment the high effort outcome rate is less than 6% and in the Cheap Talk treatment it is 25%. This result is in sharp contrast with the Commitment treatment, where the high effort outcome rate in the last 3 periods is nearly 70%. Each treatment is statistically

[10] The higher rate of the high effort outcome in period 1 for the Cheap Talk treatment compared to the Commitment treatment is not statistically significant (Fisher's exact test *p*-value=0.39).

[11] We ran an OLS regression of individual subject earnings on a weak agent dummy with and without robust errors clustered by session (*N*=144). The *p*-values for the relevant *t*-tests are 0.007, 0.000, respectively. In addition we ran a Kolmogorov Smirnov test on period 1 earnings (N=144, p-value 0.008). When looking at single treatment comparisons, the results are mixed. The p-values for the three statistical procedures described above are 0.16, 0.01, 0.67 for Baseline, 0.11, 0.00, 0.07 for Cheap Talk, and 0.05, 0.11, 0.08 for Commitment.

[12] In the Cheap Talk treatment the payoff distribution is particularly favorable to the strong agent (Table 3). Fehr et al. (2007) finds a similar result in a principal-agent setting with a promised bonus.

different at a 5 percent level from any other. As a comparison, consider the behavior recorded in a stag hunt game by Rydval and Ortmann (2011) with payoffs similar to our Commitment treatment in terms of attractiveness of high effort. They report 80% of choices for high effort given payoffs (80, 80) under high effort outcome, (30,30) under low effort outcome, and (10,30), (30,10) in the mixed cases. The corresponding figure in our game is 76% (Table 3, all periods) but one has to consider that in our design the average payoff for weak agent exerting high effort was 21 (and not 30).[13] ■

Overall efficiency parallels the high effort outcome rates (Table 3). We measure efficiency using actual earnings in a pair in comparison to the maximum possible earnings of 60 francs. The low effort outcome yields a 33.3% efficiency and the high effort outcome yields a 100% efficiency. This index reaches a minimum of 16.7% in the case of a miscoordination outcomes (10, 0) or (0, 10), which occurred to some extent in all treatments.

Result 3: Miscoordination occurred in about half the pairs in the Baseline and Cheap Talk treatments, and about one-third of the pairs in the Commitment treatment. While the proposed allocation in the Cheap Talk treatment doubles the rate of the high effort outcome relative to the Baseline, it does not substantially reduce miscoordination rates.

Support: Figure 2 displays the time series of miscoordination rates, and Table 2 reports miscoordination rates in the off-diagonal (Low effort, High effort) and (High effort, Low effort) cells, which were 51, 47 and 33 percent in the Baseline, Cheap Talk and Commitment treatments, respectively. The high frequency of miscoordination may be the effect of the stranger matching protocol, where subjects knew that they would change partner in the following period. The high effort outcome rate is 18 percent in the Baseline treatment and 36 percent in the Cheap Talk treatment. Most of this increase comes from a reduction in the frequency of the low effort outcomes and not from a reduction in the frequency of miscoordination.[14] ■

---

[13] For each treatment pair we ran a probit regression of high effort choices on a treatment dummy with individual random effects (N=960). The p-values for the relevant t-tests are 0.010 for Baseline compared to Cheap Talk, 0.006 for Cheap Talk compared to Commitment, and 0.000 for Baseline compared to Commitment.

[14] Statistical tests for *overall* miscoordination rates are not significant. For each pair of treatments we run a probit regression of miscoordination on a treatment dummy with robust errors clustered by session (N=480). The p-values for the t-tests are 0.564 for Baseline compared to Cheap Talk, 0.114 for Cheap Talk compared to Commitment, and 0.108 for Baseline compared to Commitment. Donald and Lang (2007) show that clustering standard errors by session may not be an ideal way to account for our panel data structure with a small number of clusters.

5.3 Cheap Talk and Commitment Contract Offers

The results summarized thus far indicate that the high effort outcome was more frequent in the Cheap Talk and Commitment treatments where the strong agent could communicate with the weak agent. We now analyze how the contract offers influenced behavior in the two treatments.

Result 4: In the Cheap Talk treatment, the strong agent most frequently proposed to equally split the earnings, but actually delivered this amount only about one-quarter of the time.

Support: Figure 3 displays a bubble chart indicating the frequency of different amounts of bonuses proposed and actually paid in the Cheap Talk treatment. By far the most common bonus proposal is to equally split earnings, 30/30, which is promised 60 percent of the time (145/240). The proposal was to split earnings equally in 31 of the 66 times that the strong agent chose high effort. The actual amount paid was often less than the amount promised in this implicit contract offer, however, as shown by the large and frequent bubbles below the diagonal 45-degree line in Figure 3. Only 43 out of 174 proposed bonuses (25 percent) were fulfilled exactly. The strong agent only paid more than the proposed bonus in 3 out of 174 cases, and paid less than promised in 128 out of 174 promises. When failing to pay as much as promised, the strong agent gave no bonus in 77 cases and "partially filled" the bonus with a positive amount the other 51 times. The data suggest a low level of guilt aversion as motivation of subjects, as many promises of bonus where later reneged.■

Result 5: In the Cheap Talk treatment, coordination on the low effort outcome is more frequent when proposed allocations are very high or very low.

Support: High effort rates in Panel A of Table 4 were greatest for intermediate bonus proposals. The first column indicates that the weak agent exerted high effort about half the time when the strong agent proposed a bonus of less than 50 but more than or equal to 30 of the 60 total francs available in the high effort outcome. The second column shows that in the above situations, the strong agent exerted high effort even more frequently. Both agents choose high effort at lower rates when the strong agent proposes no bonus or a bonus above 50 francs. In this treatment the strong agent appeared to employ the bonus amounts to signal to the weak agent whether they should coordinate on low effort or high effort (Figure 4). Miscoordination, which

occurs when only one agent exerts high effort, is considerably lower for very high and very low bonuses. Average bonuses changed little over time, however, displaying only a slight increase from 26-29 francs in early periods, to 30-33 francs in later periods. This may be one reason why miscoordination does not decline over time in the Cheap Talk treatment (Figure 2). ■

Result 6: In the Commitment treatment the bonus payment provided an effective tool to coordinate actions. Explicit commitment led to much better coordination on high effort than the nonbinding proposal in the Cheap Talk treatment.

Support: Panel B of Table 4 displays the high effort and coordination rates for various bonus amounts. The weak agent almost never exerts high effort when the strong agent commits to pay no bonus or a bonus above 50 francs, and the strong agent exerts high effort infrequently after indicating a bonus payment above 30 francs. When the strong agent commits to a bonus of 30 out of the 60 francs, both agents typically choose high effort and this leads to effective coordination on the high effort outcome. This is the main source of the increased efficiency in the Commitment treatment. The comparison of Figures 4 and 5 conveys how much stronger of a signal the explicit contract offer is compared to the implicit contract offer. ■

5.4 Using Measured Preferences to Understand Effort Choices

Prior to playing the partnership game, subjects made three decisions without receiving any feedback. These decisions are employed as measurements of subjects' characteristics in terms of risk attitudes, reciprocal tendencies, trusting, and trustworthy behavior, which are then applied to understand better the behavior in the partnership game. Strong agents (a) made 15 binary lottery choices, (b) made an offer to split 60 francs in an ultimatum game, and (c) decided what fraction of 60 francs to return to a first-mover in a trust game. Weak agents (a) made 15 binary lottery choices, (b) selected a minimum offer (of 60 total francs) that would be acceptable in an ultimatum game, and (c) made a binary decision whether to keep 10 francs or send all 10 francs (which was increased to 50 francs) to a second-mover in a trust game.

Lottery results are reported in Figure 6. As illustrated by the dotted line, a risk neutral agent would choose the safe option A in lotteries 1 through 7, and then switch to option B in

lottery 8. Most subjects—122 out of 144—made consistent, monotonic choices that switched from the risky to the safe option no more than once across the 15 lotteries.[15]

In the ultimatum game the strong agents made proposals that were consistent with previous research. The modal proposal was 30, half the total surplus of 60 francs. Fifty-one out of the 72 strong agents offered 25 or 30 francs, and another 8 offered 20 of the 60 francs. The mean proposed offer was 28.2 francs. Weak agents submitted demands in the form of minimum acceptable offers. The modal demand, submitted by 29 of the 72 weak agents, was 30. Another 16 weak agents demanded 20 to 29 francs, and 15 demanded less than 20 francs. The mean demand by the weak agents was 27.0 francs. A few, possibly confused subjects demanded most of the surplus (i.e., 3 of the 72 weak agents demanded 59 or 60 francs). This partly explains the higher rejection rate—16 out of 72 pairs (22 percent)—than is typically observed. Bahry and Wilson (2006) provide a discussion of ultimatum rejection rates using the strategy method, including the possible influence of confusion.

In the trust game 45 of the 72 weak agents (63 percent) chose to send the 10 francs to the other agent. These 10 francs were converted to 50 francs, which were combined with the strong agents' 10 franc endowment. All 72 strong agents chose an allocation of these 60 francs, which was carried out if their paired weak agent trusted them. A large fraction of strong agents, 43 out of 72 (60 percent) were not trustworthy and kept all 60 francs. Another 9 kept 50 francs and returned only 10. Only 6 of the 72 strong agents (8 percent) returned 30 francs, and 10 strong agents returned 20 francs. Strictly positive returns would have been earned by only 19 of the 72 weak agents (26 percent), and the average amount returned was 7.4 francs. The high level of trust exhibited by the weak agents is therefore surprising, and is perhaps due to inaccurate beliefs regarding the trustworthiness of the strong agents. This lack of trustworthiness differs from other binary trust games such as Eckel and Wilson (2004) who find that almost no second movers kept the entire surplus. This could be due to our use of the strategy method to elicit the return decision, if the *act* of being trusted generates stronger reciprocal feelings than what the decision-maker feels when specifying a strategy indicating an amount returned *if* he is trusted. Consistent

[15] For nonmonotonic subjects we approximated their risk attitude using the average among the lowest and the highest points of their switch.

with this conjecture, Casari and Cason (2009) show that second movers are significantly more trustworthy when this trust game is played using the game method.

Result 7: Weak agents who trusted in the trust game were more likely to choose high effort in the Baseline and Cheap Talk treatments of the partnership game. Strong agents who were not trustworthy were more likely to choose high effort in the Commitment treatment, and were more likely to pay low actual bonuses and make bonus offers that exceed bonus amounts actually paid in the Cheap Talk treatment.

Support: Tables 5 and 6 provide support for Result 7. Table 5 reports the results of a random effect probit model of subjects' (risky) high effort decision in the partnership game, separately for each treatment and for the strong and weak agent roles.[16] Table 6 presents random effects estimates of models of the bonus proposed by the strong agent in the Cheap Talk treatment (columns 1 and 2) and in the Commitment treatment (column 4). Weak agents were trustors and their choices in the two domains were correlated, which suggest a consistent behavior across partnership and trust games. Those subjects who sent all the money as trustors chose high effort significantly more as weak agents (columns 2 and 4). No such correlation exists in the Commitment treatment (column 6), suggesting that explicit contracts were perceived in a different way from implicit bonus contracts. Strong agents that were less trustworthy (gave back nothing in the trust game) chose high effort with greater frequency in the Commitment treatment (column 5), which is an environment that requires less trust. By contrast, columns 2 and 3 of Table 6 show that in the Cheap Talk treatment that requires substantial trust, untrustworthy strong agents paid lower actual bonuses on average and failed to deliver on positive promised bonuses.

We also assess the impact of risk attitude on effort choices and on bonus amounts in Tables 5 and 6. Based on their answers to the lottery questions, participants are placed in three

[16] In the Partnership game with Cheap Talk or Commitment, the strong agent first proposes an amount to keep for herself and then both strong and weak agents choose effort levels. The promised amount is an endogenous choice variable and it most likely influenced the subjects' propensity to choose a high effort. For this reason, we follow an instrumental variables approach to model the strong agents effort decision in the Cheap Talk and Commitment treatments. In a first-stage regression the dependent variable is the proposed amount (columns 1 and 4 of Table 6) and in a second-stage regression the dependent variable is the choice of exerting high effort where one of the regressors is the proposed amount predicted by the first-stage regression model (instead of the actual amount, see columns 3, 4, 5, and 6 of Table 5).

categories (1) risk seeking (21 percent of subjects), (2) risk neutral and moderately risk averse (49 percent of subjects), and (3) strongly risk averse who switched from option A to B in lottery 12 or after (30 percent of subjects). Category (2) is the base case in Tables 5 and 6 (omitted dummy variable). In the partnership game, high effort rates tend to decline with increases in subjects' degree of risk aversion. In three out of six columns of Table 5 the strongly risk averse dummy coefficient is negative and significant at least at the 10 percent level. This suggests a lower propensity to choose high effort for strongly risk averse agents, relative to the omitted case of moderate risk aversion. In the Cheap Talk treatment, risk seeking strong agents generally give less generous bonuses. This effect is not always statistically significant, however (Table 6). ■

Table 7 provides additional evidence on the correlation of behavior across games. Panel A shows that while a majority of strong agents gave back nothing in the trust game, those who offered less than 30 francs in the ultimatum game were significantly more likely to give nothing (Fisher's Exact Test one-tailed p-value<0.05). The 16 (out of the total 72) strong agents who both kept all 60 francs in the trust game and offered less than 30 francs in the ultimatum game most clearly exhibit self-regarding preferences and apparently have more optimistic beliefs that a substantial number of weak agents are self-regarding and would accept unequal offers in the ultimatum game. As discussed in Section 3, this is the strong agent type that should be most likely to exert high effort in the partnership game in the Baseline and Cheap Talk treatments. Contrary to this prediction, however, these subjects choose high effort at exactly the same rate in those treatments (64 percent) as the subjects who do not exhibit such preferences and beliefs.[17]

Panel B of Table 7 shows that the pattern of weak agent behavior in the ultimatum and trust games is not consistent with the expectation based on other-regarding preference types hypothesized at the end of Section 3. Because inequity averse agents suffer from disadvantageous inequality so much, unless they have very optimistic beliefs about the trustworthiness of the strong agents they should not send the 10 francs in the trust game. These inequity averse agents should also demand a large fraction of the 60 francs in the ultimatum game. Contrary to this prediction, however, 32 out of the 47 weak agents who demand at least 25

[17] Blanco et al. (2011) also do not find substantial consistency of individual fair behavior across games. In particular, individual β_i coefficients estimated from choices in a modified dictator game fail to predict behavior in the proposal role of an ultimatum game or voluntary contributions to a public good.

out of the 60 francs in the ultimatum game trusted in the trust game (68 percent), while 13 out of the 25 weak agents who demand less than 25 francs in the ultimatum game trusted in the trust game (52 percent). This difference is not statistically significant, but it is not even in the hypothesized direction since the apparently more fair-minded agents who demand more in the ultimatum game also trust more and risk the highly inequitable (0, 60) payoff split. One possible explanation for this finding is that subjects with different preference types have different beliefs, such as inequity averse agents who believe that most others are inequity averse (Blanco et al., 2009). It is also possible that this simplified inequity aversion model is a poor approximation in the current context. For example, the fair-minded weak agents may also have preference for efficiency and value the *potential* Pareto improvement of trusting.

6. Conclusions

Other-regarding preferences have been well-documented both within and outside the laboratory for a variety of forms of economic interactions. Empirical evidence for such preferences is now circulating back to inform and guide positive economic theory. The goal of this paper is to provide some laboratory evidence that explores the efficacy of implicit contracts compared to explicit contracts in a new partnership game environment, in order to further the research agenda "to identify the strengths and limits of the standard approach in contract theory by isolating conditions under which the model's contract choice predictions are met and conditions under which these predictions fail" (Fehr et al., 2007, p. 124). In this partnership game, other-regarding preferences such as inequity aversion can result in large high effort rates even with implicit contracts for certain distributions of fair-minded types. Multiple equilibria also exist in this game with explicit contracts, including both low and high effort outcomes. This underscores the importance of new data to provide a foundation for more empirically-accurate positive theory.

Some of our results support the need for behavioral models with other-regarding preferences, while others are consistent with more standard models. The greater high-effort rates among strong agents compared to weak agents, as well as the greater high effort with implicit (cheap talk) contract offers relative to the baseline with no offers, indicate the influence of other-regarding preferences. Choices by individual subjects are also somewhat consistent across

games. For example, trustworthy strong agents in the trust game were more likely to make generous offers in the ultimatum game, and trusting weak agents in the trust game were more likely to exert high effort in the partnership game. Considerable evidence here is consistent with standard, self-regarding preferences, however, most notably the substantially greater high effort levels when moving to explicit contracts that grow over time. Strong agents also frequently pay small or no bonuses after making generous unenforceable bonus offers. Implicit contracts do not perform nearly as well as explicit contracts in this partnership environment, which is an implication of standard preferences.

Our main result contrasts with Fehr et al.'s (2007) result that bonus (implicit) contracts can outperform explicit contracts. This could be due to several differences in the underlying environments, such as the requirement in the present study that the strong agent must exert effort or the restriction to two (rather than ten) possible effort choices. Our experiment is not designed to explore the source of these differences, and it may be possible to improve the relative performance of implicit contracts in a variety of ways. For example, one could make explicit agreements more costly, choose environments such that optimal explicit incentive contracts generate zero surplus to one party, or enhance the social connectedness of parties with rich communications. Although our experiment does not seek to explore all of the possible factors affecting the performance of explicit and implicit contracts, it does highlight an additional environment where explicit contracts perform better, consistent with standard theory. We think that it is wise to explore further the boundaries of the domain where standard theory based on the approximation of self-regarding preferences works reasonably well before advocating a major revision of contract theory.

References:

Bahry, Donna and Rick Wilson (2006). "Confusion or Fairness in the Field? Rejections in the Ultimatum Game under the Strategy Method," *Journal of Economic Behavior and Organization*, 60, 37-54.

Battalio, Raymond, Larry Samuelson and John Van Huyck (2001), "Optimization Incentives and Coordination Failure in Laboratory Stag Hunt Games," *Econometrica*, 69, 749-764.

Ben-Ner, Avner and Louis Putterman (2009). "Trust, Communication and Contracts: An Experiment," *Journal of Economic Behavior and Organization*, 70, 106-121.

Blanco, Mariana, Dirk Engelmann, Alexander Koch and Hans-Theo Normann (2009), "Preferences and Beliefs in a Sequential Social Dilemma: A Within-Subjects Analysis," IZA Discussion Paper 4624.

Blanco, Mariana, Dirk Engelmann and Hans-Theo Normann (2011). "A Within-Subject Analysis of Other-Regarding Preferences," *Games and Economic Behavior*, 74, 321-338.

Bosman, Ronald and Frans van Winden (2002), "Emotional Hazard in a Power-to-Take Experiment," *Economic Journal*, 112, 147-169.

Casari, Marco and Timothy Cason (2009). "The Strategy Method Lowers Measured Trustworthy Behavior," *Economics Letters*, 103, 157-159.

Chaudhuri, Ananish (2011), "Sustaining Cooperation in Laboratory Public Goods Experiments: A Selective Survey of the Literature," *Experimental Economics*, 14, 47-83.

Charness, Gary, Guillaume Frechette and John Kagel (2004). "How Robust is Laboratory Gift Exchange?" *Experimental Economics*, 7, 189-205.

Charness, Gary and Martin Dufwenberg (2006). "Promises and Partnership," *Econometrica*, 74, 1579-1601.

Donald, Stephen and Kevin Lang (2007), "Inference with Difference-in-Differences and Other Panel Data," *Review of Economics and Statistics*, 89, 221-233.

Eckel, Catherine and Rick Wilson (2004). "Is Trust a Risky Decision?" *Journal of Economic Behavior and Organization*, 55, 447-465.

Fehr, Ernst and Armin Falk (2002). "Psychological foundations of incentives," Joseph Schumpeter Lecture, *European Economic Review*, 46, 687-724.

Fehr, Ernst, Alexander Klein and Klaus Schmidt (2007). "Fairness and Contract Design," *Econometrica*, 75, 121-154.

Fehr, Ernst and Klaus Schmidt (1999). "A Theory of Fairness, Competition and Cooperation," *Quarterly Journal of Economics*, 114, 817-868.

Fischbacher, Urs (2007). "z-Tree: Zurich Toolbox for Ready-Made Economic Experiments," *Experimental Economics*, 10, 171-178.

Frey, Bruno and Margit Osterloh (eds.) (2002). *Successful Management by Motivation – Balancing Intrinsic and Extrinsic Incentives*. Springer Verlag, Berlin, Heidelberg, New York.

Gächter, Simon and Ernst Fehr (2001). "Fairness in the Labour Market–A Survey of Experimental Results," in: Friedel Bolle and Marco Lehmann-Waffenschmidt (eds.), *Surveys in Experimental Economics. Bargaining, Cooperation and Election Stock Markets*. Physica Verlag.

Gneezy, Uri and John List (2006). "Putting Behavioral Economics to Work: Testing for Gift Exchange in Labor Markets using Field Experiments," *Econometrica*, 74, 1365-1384.

Healy, Paul J. (2007). "Group Reputations, Stereotypes, and Cooperation in a Repeated Labor Market," *American Economic Review*, 97, 1751-1773.

Holt, Charles and Susan Laury (2002). "Risk Aversion and Incentive Effects in Lottery Choices," *American Economic Review*, 92, 1644-1655.

Rigdon, Mary (2002). "Efficiency Wages in an Experimental Labor Market," *Proceedings of the National Academy of Sciences*, 99, 13348-13351.

Rydval, O. and Ortmann, Andreas (2011), "Loss avoidance as selection principle: evidence from simple stag-hunt games," Charles University, Center for Economic Research and Graduate Education.

Sobel, Joel (2005). "Interdependent Preferences and Reciprocity," *Journal of Economic Literature*, 43, 392-436.

Table 2: Effort levels and outcomes in the Partnership game

Panel A: Baseline

		WEAK AGENT		
STRONG AGENT		High effort	Low effort	Totals
	High effort	17.9%	36.7%	54.6%
	Low effort	14.6%	30.8%	45.4%
	Totals	32.5%	67.5%	100.0% N=480

Panel B: Cheap Talk

		WEAK AGENT		
STRONG AGENT		High effort	Low effort	Totals
	High effort	35.8%	36.7%	72.5%
	Low effort	10.4%	17.1%	27.5%
	Totals	46.3%	53.8%	100.0% N=480

Panel C: Commitment

		WEAK AGENT		
STRONG AGENT		High effort	Low effort	Totals
	High effort	59.6%	28.3%	87.9%
	Low effort	5.0%	7.1%	12.1%
	Totals	64.6%	35.4%	100.0% N=480

Table 3: Results overview of the Partnership game

	Baseline		Cheap Talk		Commitment	
	All periods	Last 3 periods	All periods	Last 3 periods	All periods	Last 3 periods
Overall frequency of high effort choices	43.5%	25.0%	59.4%	47.9%	76.3%	81.3%
Frequency of mutual high effort outcome	17.9%	5.6%	35.8%	25.0%	59.6%	68.1%
Actual bonus paid by strong agents choosing high effort (max 60 francs)	10.8		11.9		21.4	
Average earnings strong agent	13.6	9.4	19.8	15.8	21.8	24.5
Average earnings weak agent	8.4	9.0	9.9	9.7	18.7	20.1
Share of earnings of strong agent	61.8%	51.1%	66.7%	62.0%	53.8%	54.9%
Efficiency (possible range from 16.7% to 100%)	36.7%	30.7%	49.5%	42.5%	67.5%	74.3%

Note: the efficiency of the low effort outcome is 33.3%

Table 4: Contract offers, Effort Choices and Miscoordination in the Cheap Talk and Commitment treatments: Frequencies by level of proposed bonus

Panel A: Cheap Talk Treatment

	No. of obs.	Weak agent high effort (percent)	Strong agent high effort (percent)	high effort outcome	low effort outcome	Miscoor-dination
Bonus, $b \geq 50$	10	10%	20%	0.0%	70%	30%
30 < bonus, $b < 50$	33	48%	64%	30%	18%	52%
bonus, $b = 30$	145	53%	79%	43%	12%	45%
30 < bonus, $b < 0$	41	41%	88%	32%	2%	66%
zero bonus, b	11	0%	9%	0%	91%	9%

Panel B: Commitment Treatment

	No. of obs.	Weak agent high effort (percent)	Strong agent high effort (percent)	high effort outcome	low effort outcome	Miscoor-dination
bonus, $b \geq 50$	5	0%	20%	0%	80%	20%
30 < bonus, $b < 50$	4	100%	25%	25%	0%	75%
bonus, $b = 30$	75	99%	95%	93%	0%	7%
30 < bonus, $b < 0$	127	60%	94%	56%	2%	42%
zero bonus, b	29	3%	66%[a]	3%	35%	62%

[a] This high rate of strong agents who choose high effort after offering low bonuses is mostly due to two individual subjects (out of the 24 strong agents in this treatment). These two subjects are responsible for 80 percent of these observations.

Table 5: Explaining high effort in the Partnership game, all treatments

Dependent variable: 1=high effort and 0=low effort	(1) Baseline, Strong agent	(2) Baseline, Weak agent	(3) Cheap Talk, Strong agent	(4) Cheap Talk, Weak agent	(5) Commitment, Strong agent	(6) Commitment, Weak agent
Risk seeking or neutral (switch at or before lottery 7)	1.691	0.483	-0.989	0.251	0.061	0.471
	(1.341)	(0.600)	(0.786)	(0.593)	(0.497)	(0.694)
Strongly risk averse (switch at or after lottery 12)	-2.985**	-0.399	-0.218	0.011	-1.203*	-1.132*
	(1.412)	(0.377)	(0.659)	(0.578)	(0.701)	(0.609)
Average high effort rate of all your previous opponents (fictitious play beliefs)	8.858***	1.031**	5.009***	-0.747	3.309***	0.431
	(2.034)	(0.479)	(1.141)	(0.699)	(0.786)	(0.921)
1/ln(period)	3.594***	1.578***	-2.131**	1.419***	0.867	-0.735*
	(0.874)	(0.350)	(0.866)	(0.388)	(0.537)	(0.444)
Proposer in ultimatum game wants to give < 30 francs	-1.278		-0.277		0.185	
	(1.208)		(0.820)		(0.447)	
Trustee gives back nothing in trust game	-1.008		-0.328		1.204***	
	(1.007)		(0.620)		(0.374)	
Responder in ultimatum game demands ≤25 francs		0.309		0.259		0.118
		(0.322)		(0.388)		(0.499)
Responder in ultimatum game demands ≥35 francs		-0.599		-0.029		0.132
		(0.656)		(0.641)		(0.744)
Trustor passes all the money in trust game		1.185***		1.440**		0.307
		(0.338)		(0.560)		(0.717)
(Cheap Talk) Bonus the strong agent actually gave minus proposed bonus (zero if strong agent chose low effort)			0.010	0.008		
			(0.011)	(0.008)		
Strong agent proposes bonus above 25 but less than or equal to 30 francs (#)			1.422***	0.426	0.428	2.772***
			(0.424)	(0.278)	(0.345)	(0.790)
Strong agent proposes bonus between 15 and 25 francs included (#)			1.264*	0.016	-0.019	0.342
			(0.685)	(0.375)	(0.374)	(0.610)
Strong agent proposes bonus of less than 15 francs (#)				-8.578	7.195	-2.402***
				(5122)	(1025263)	(0.761)
Constant	-4.424***	-2.743***	0.047	-1.121	-1.835**	0.205
	(1.404)	(0.593)	(0.788)	(0.874)	(0.734)	(1.271)
Observations, Subjects	216, 24	216, 24	216, 24	216, 24	216, 24	216, 24

Notes: Random effect probit, standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions include session dummies, not reported in the table. Period 1 not included because some regressors are lagged (216 obs. instead of 240). The strong agent is the proposer in the ultimatum game, the trustee in the trust game and the dominant agent in the partnership game. The weak agent is the responder in the ultimatum game, the trustor in the trust game and the weak agent in the partnership game.(#) Instrumental variables for columns (3) and (5); the dummies were constructed using the fitted values from columns (1) and (4), respectively, of Table 6.

Table 6: Explaining division of benefits in the Partnership game, Cheap Talk and Commitment treatments

	(1) Bonus promised by strong agent (Cheap Talk treatment)	(2) Bonus actually given by strong agent (Cheap Talk treatment)	(3) Bonus promised by strong agent minus bonus actually given (Cheap Talk treatment)	(4) Bonus promised and given by strong agent (Commitment treatment)
Risk seeking or neutral (switch at or	-2.932	-11.337*	7.543	4.834
before lottery 7)	(3.423)	(6.167)	(7.885)	(4.095)
Strongly risk averse (switch at or after	0.441	-5.731	8.955	8.938*
lottery 12)	(2.643)	(4.768)	(6.109)	(4.623)
Average high effort rate of all your	-1.667	-4.518*	6.618	-4.672
previous opponents (fictitious play belief)	(3.371)	(2.728)	(4.209)	(2.940)
Proposer in ultimatum game offers	-5.383	4.405	-3.551	0.710
strictly less than 30 francs	(3.344)	(6.006)	(7.677)	(3.503)
Proposer in ultimatum game offers	-9.875**	5.017	-10.381	1.534
more than 31 francs	(4.522)	(8.131)	(10.426)	(5.248)
Trustee gives back nothing in trust	0.603	-14.487***	18.578***	-2.734
Game	(2.568)	(4.628)	(5.929)	(3.430)
Constant	29.459***	31.025***	-9.462	17.199***
	(4.555)	(5.926)	(7.983)	(3.944)
Observations, Subjects	216, 24	155, 24	155, 24	216, 24
R-squared	0.162	0.449	0.384	0.186

Notes: Random effect regressions, standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions include session dummies, not reported in the table. Period 1 not included because some regressors are lagged (216 obs. instead of 240). In columns (2) and (3) we considered only observations when the strong agent chose high effort. The strong agent is the proposer in the ultimatum game, the trustee in the trust game and the dominant agent in the partnership game.

Table 7: Correlation behavior in ultimatum and trust games

Panel A: Strong Agents

		When Proposer in Ultimatum Game	
		Offered 30 out of 60 or more	Offered less than 30 out of 60
When Trustee in Trust Game	Gave back more than 20	15	2
	Gave back nothing	27	16

Notes: Twelve subjects who gave back a positive amount but less than 20 francs in the Trust Game are not shown. Fisher's Exact Test one-tailed *p*-value=0.047 (*N*=60).

Panel B: Weak Agents

		When Responder in Ultimatum Game	
		Demanded at least 25 out of 60	Demanded less than 25 out of 60
When Trustor in Trust Game	Sends nothing	15	12
	Sends all 10 francs	32	13

Notes: Fisher's Exact Test one-tailed *p*-value=0.14 (*N*=72).

Figure 1: Frequency of the high effort outcome over time

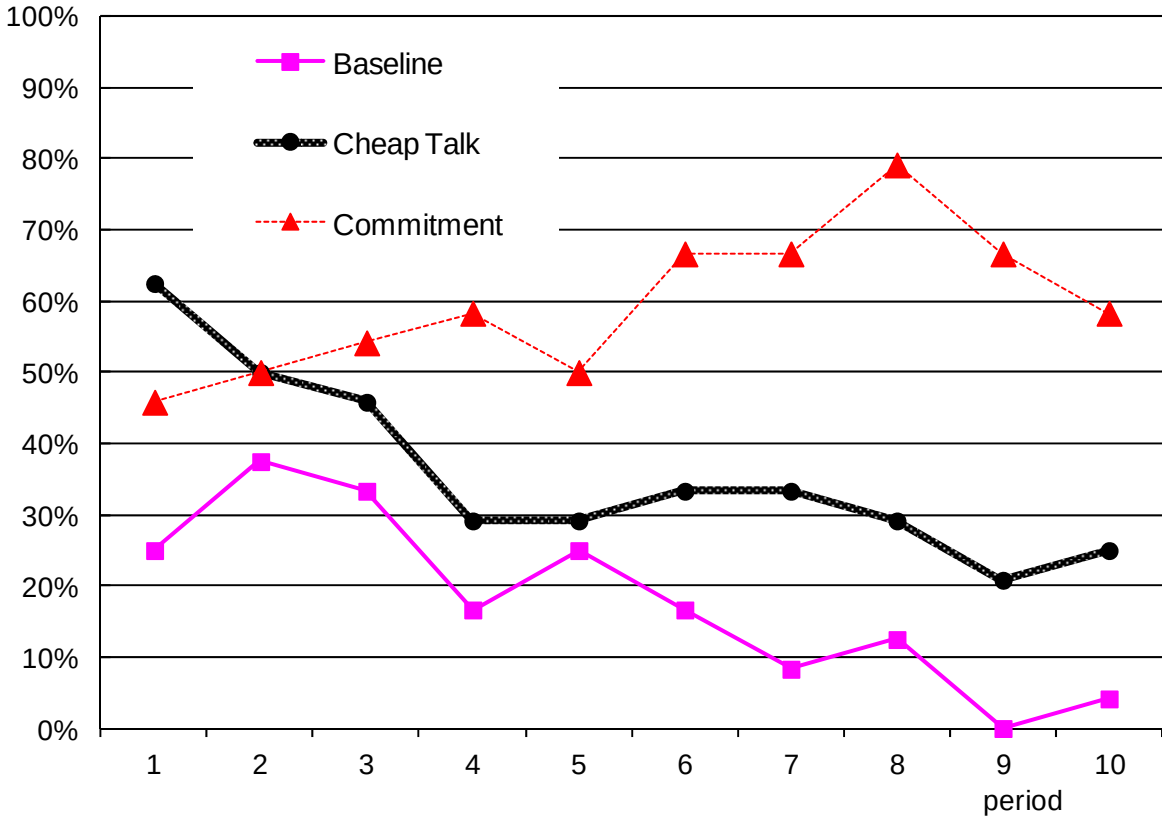


Figure 2: Frequency of miscoordination over time

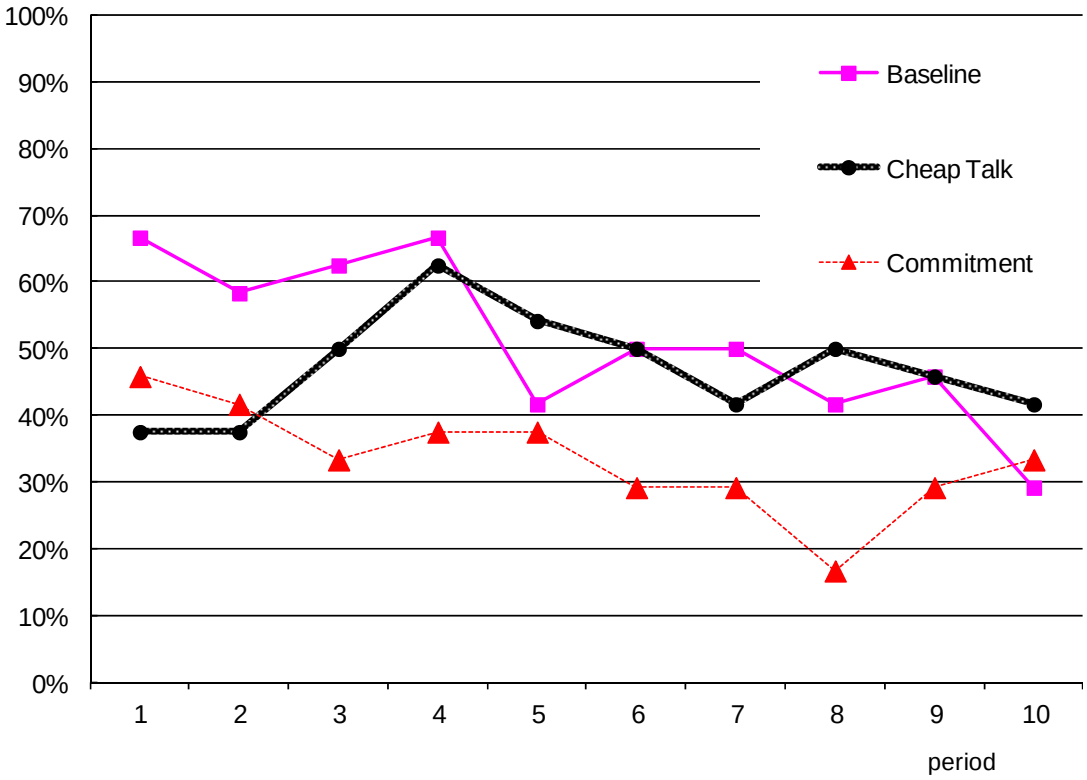
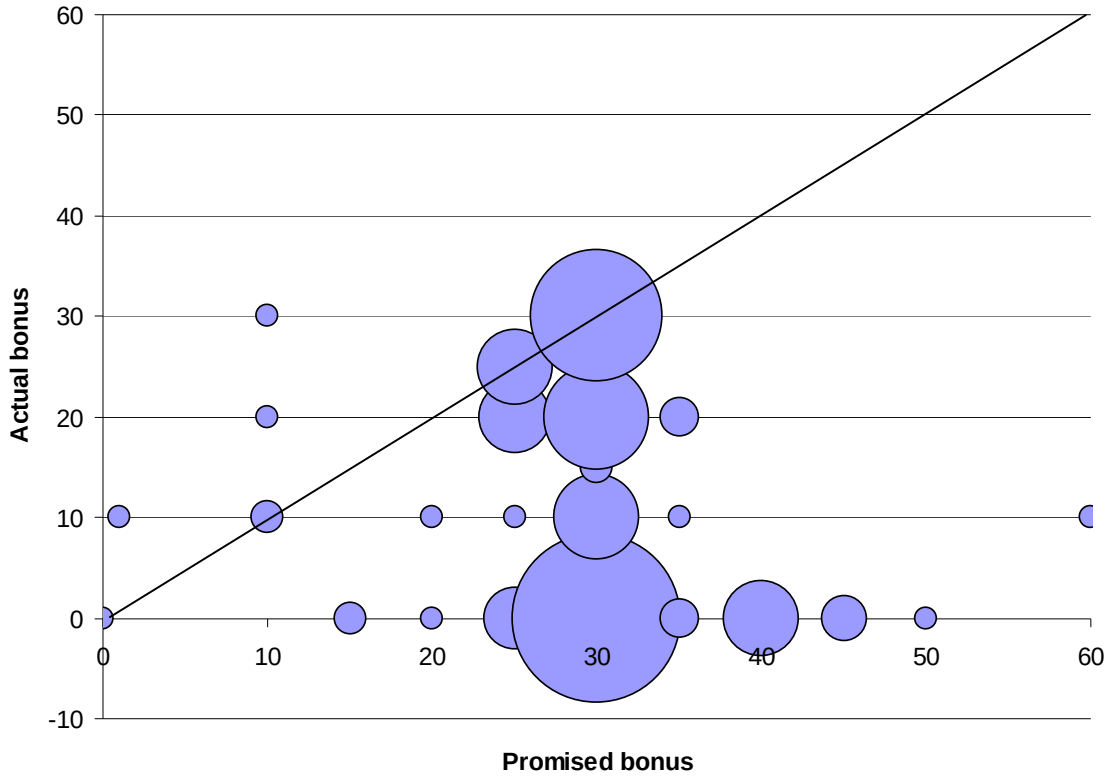


Figure 3: Promised and actual bonus (Cheap Talk treatment)



Notes: Larger circles indicate more frequent outcomes. There were 240 bonus proposals. This chart displays only 174 observations, because strong agents only made an actual bonus choice when they chose high effort. Mean promised bonus: 29.6 / 60; Mean actual bonus: 11.9 /60; Frequency of promise delivered exactly or in excess: 26.4%.

Figure 4: Implicit contract offer as a coordination device (Cheap Talk treatment)

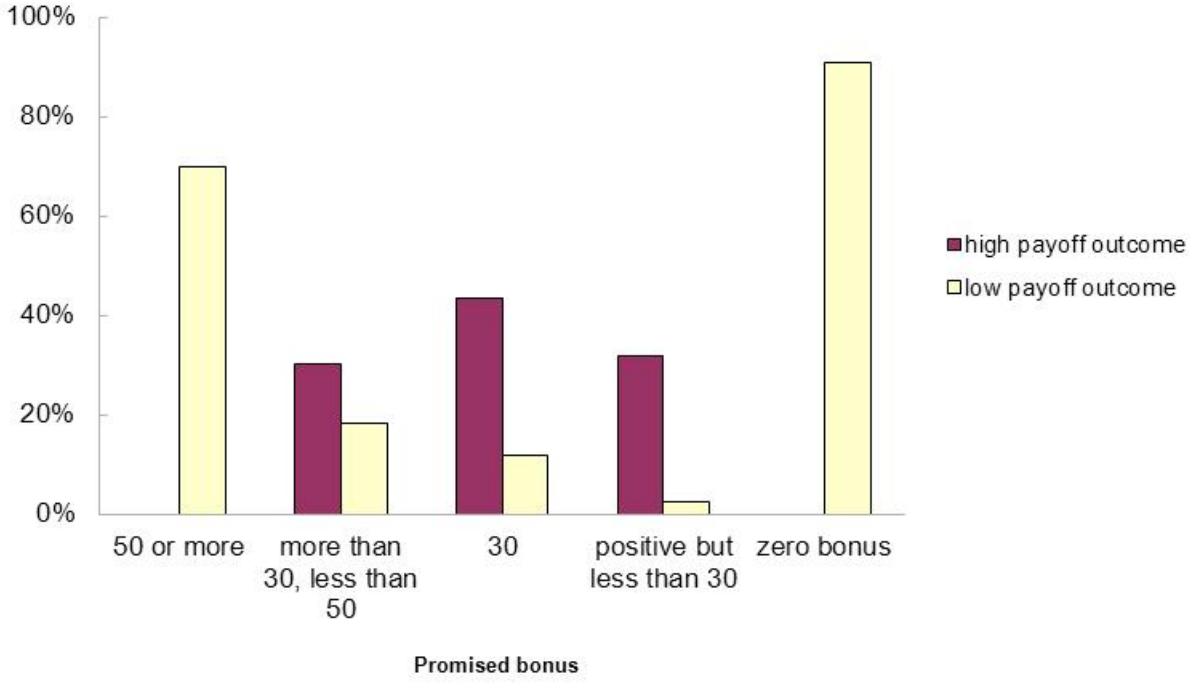


Figure 5: Explicit contract offer as a coordination device (Commitment treatment)

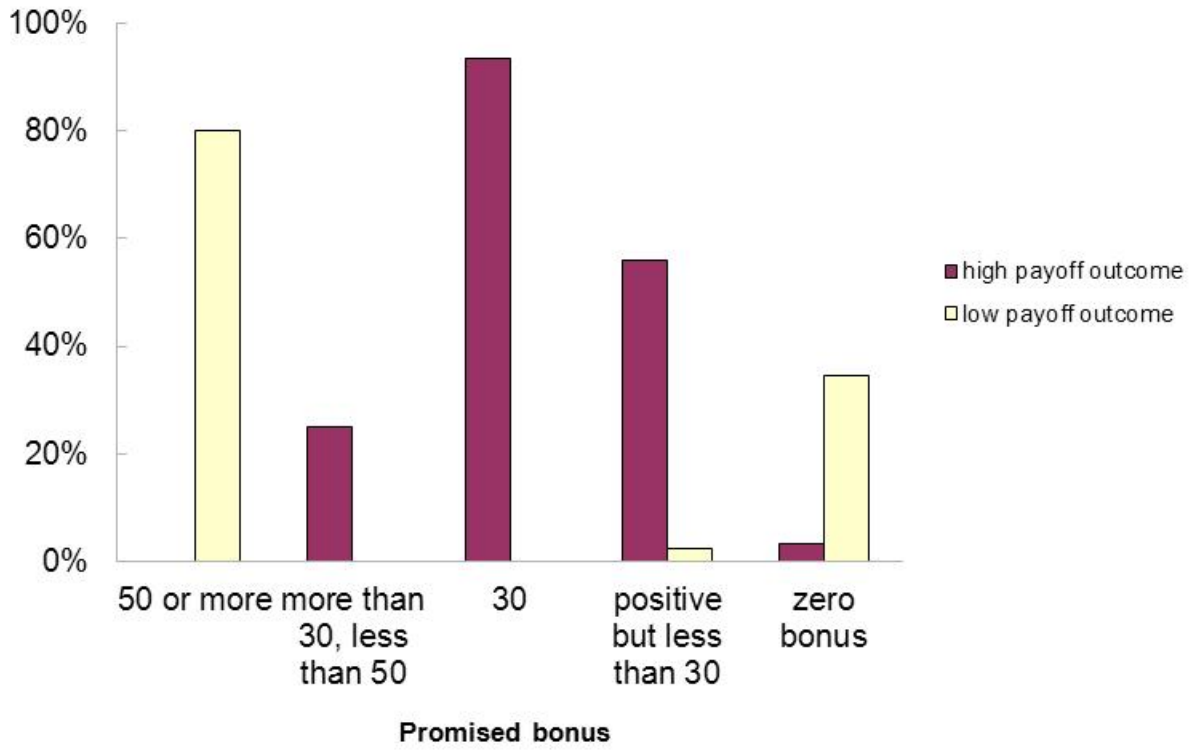
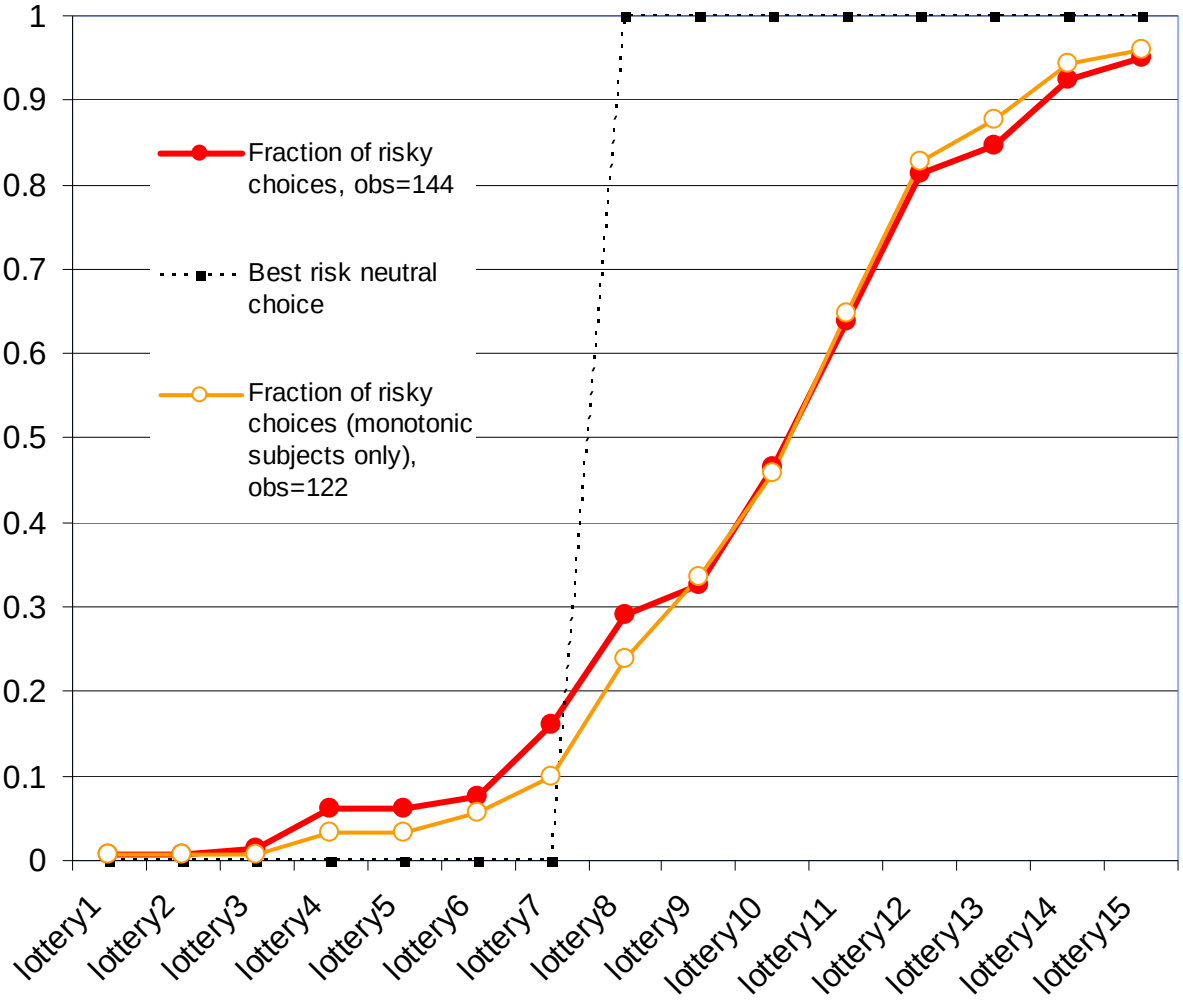


Figure 6: Risk attitude of participants, cumulative distribution



Instructions [CHEAP TALK TREATMENT. The other treatments differed only in part four. In the Baseline treatment the allocator does not send a message to the non-allocator while in the Commitment treatment a message is sent and it becomes a binding commitment for the allocator]

This is an experiment in the economics of multi-person strategic decision making. Purdue University has provided funds for this research. If you follow the instructions and make appropriate decisions, you can earn an appreciable amount of money. The currency used in the experiment is francs. Your francs will be converted to U.S. Dollars at a rate of _____ francs to one dollar. At the end of today's session, you will be paid in private and in cash. You will also receive a $5.00 participation payment regardless of what happens in the experiment.

It is important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. If you talk, laugh, exclaim out loud, etc., you will be asked to leave and you will not be paid. We expect and appreciate your cooperation.

This experiment is composed of four parts. Now are we are reading the instructions for part one.

Instructions– Part one

For each line in the table in the next page, please state whether you prefer option A or option B.

Notice that there are a total of 15 lines in the table but just one line will be randomly selected for payment. You ignore which line will be paid when you make your choices. Hence you should pay attention to the choice you make in every line. After you have completed all your choices a token will be randomly drawn out of a bingo cage containing tokens numbered from 1 to 15. The token number determines which line is going to be paid.

Your earnings for the selected line depends on which option you chose:
If you chose option A in that line, you will receive 10 experimental francs.
If you chose option B in that line, you will receive either 30 francs or 0 francs. To determine your earnings in the case you chose option B there will be second random draw. A token will be randomly drawn out of the bingo cage now containing twenty tokens numbered from 1 to 20. The token number is then compared with the numbers in the line selected (see the table). If the token number shows up in the left column you earn 30 francs. If the token number shows up in the right column you earn 0 francs.

Now it is time for clarifications. Are there any questions?

Participant ID: _

Decision no.	**Option A**	**Option B**		Please choose A or B
1	**10** francs	**30** francs never	**0** francs if 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20	
2	**10** francs	**30** francs if 1 comes out of the bingo cage	**0** francs if 2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20	
3	**10** francs	**30** francs if 1 and 2	**0** francs if 3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20	
4	**10** francs	**30** francs if 1,2 and 3	**0** francs if 4,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20	
5	**10** francs	**30** francs if 1,2,3,4	**0** francs if 5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20	
6	**10** francs	**30** francs if 1,2,3,4,5	**0** francs if 6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20	
7	**10** francs	**30** francs if 1,2,3,4,5,6	**0** francs if 7,8,9,10,11,12,13,14,15, 16,17,18,19,20	
8	**10** francs	**30** francs if 1,2,3,4,5,6,7	**0** francs if 8,9,10,11,12,13,14,15, 16,17,18,19,20	

9	**10** francs	**30** francs if 1,2,3,4,5,6,7,8	**0** francs if 9,10,11,12,13,14,15, 16,17,18,19,20	
10	**10** francs	**30** francs if 1,2,3,4,5,6,7,8,9	**0** francs if 10,11,12,13,14,15, 16,17,18,19,20	
11	**10** francs	**30** francs if 1,2, 3,4,5,6,7,8,9,10	**0** francs if 11,12,13,14,15, 16,17,18,19,20	
12	**10** francs	**30** francs if 1,2, 3,4,5,6,7,8,9,10,11	**0** francs if 12,13,14,15, 16,17,18,19,20	
13	**10** francs	**30** francs if 1,2, 3,4,5,6,7,8,9,10,11,12	**0** francs if 13,14,15, 16,17,18,19,20	
14	**10** francs	**30** francs if 1,2, 3,4,5,6,7,8,9,10,11,12,13	**0** francs if 14,15, 16,17,18,19,20	
15	**10** francs	**30** francs if 1,2, 3,4,5,6,7,8,9,10,11,12,13,14	**0** francs if 15, 16,17,18,19,20	

Questionnaire

1. If at the end of the experiment the experimenter first draws token number 2 and then draws token number 1 what are your earnings?

   In case my choice for line 2 was A _____francs

   In case my choice for line 2 was B _____francs

2. If at the end of the experiment the experimenter first draws token number 14 and then draws token number 14 again what are your earnings?

   In case my choice for line 14 was A _____francs

   In case my choice for line 14 was B _____francs

Instructions – Part two

You will participate in 12 decision making periods in the remaining 3 parts of the experiment. You will interact with another person in each of these 12 periods. You will never interact with the same person more than once, so you will interact with 12 different people.

This part of the experiment consists of one decision making period. The participants in this part of the experiment will be randomly placed into two-person groups.

Your Choices

In each group, one of you has been randomly selected to be the first mover and the other to be the second mover. You will learn which person in the group is the **first-mover** at the start of the period. Each person will make one decision.

There is a sum of 60 francs available. The first mover has the opportunity to decide how many francs to allocate to himself/herself and how many to the other person in his/her group (the second mover). See Figure 1 below. Up to two decimal points are allowed.

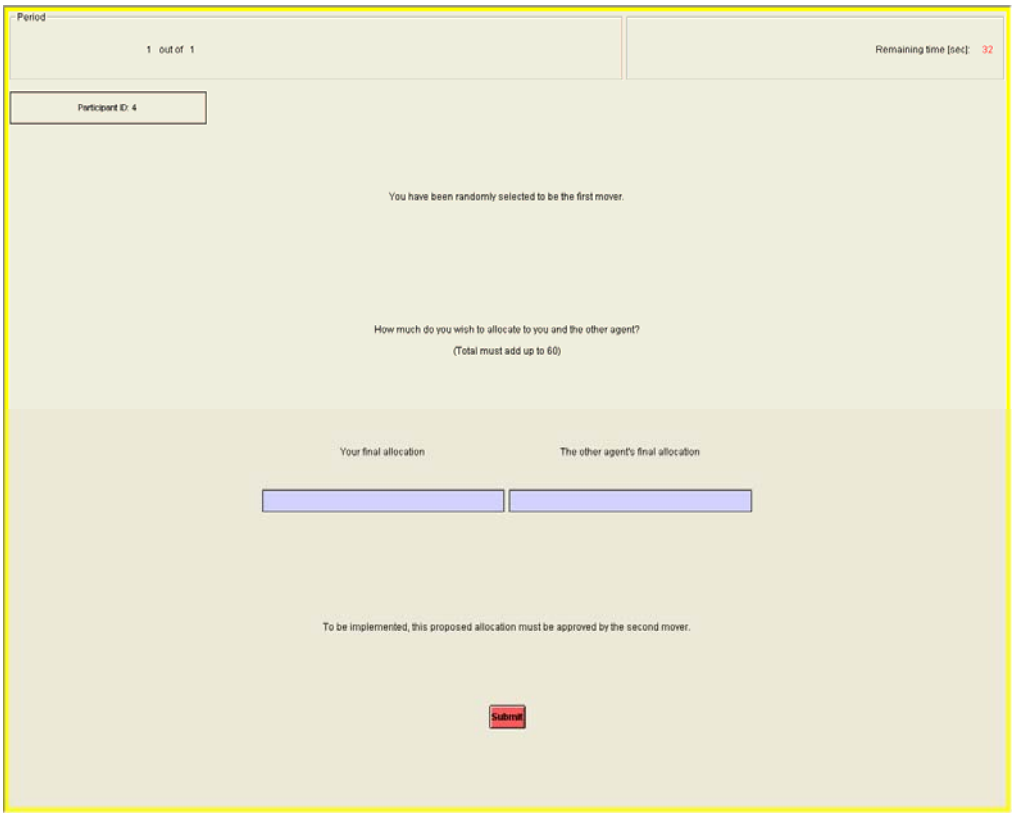


Figure 1: First Mover Decision Screen

The first mover allocation is just a proposal and the **second mover** decides whether it is implemented. The second mover can choose either **X** or **Y**:

If the second mover chooses **X:** earnings are distributed according to the allocation proposed by the first mover.

If the second mover chooses **Y**: the first mover earns ***0*** francs and the second mover earns ***10*** francs.

When the second mover chooses, however, he/she will not know the allocation proposed by the first mover. Hence, the actual format of the decision is the one shown in Figure 2 below. The second mover chooses an amount **K** between zero and 60:

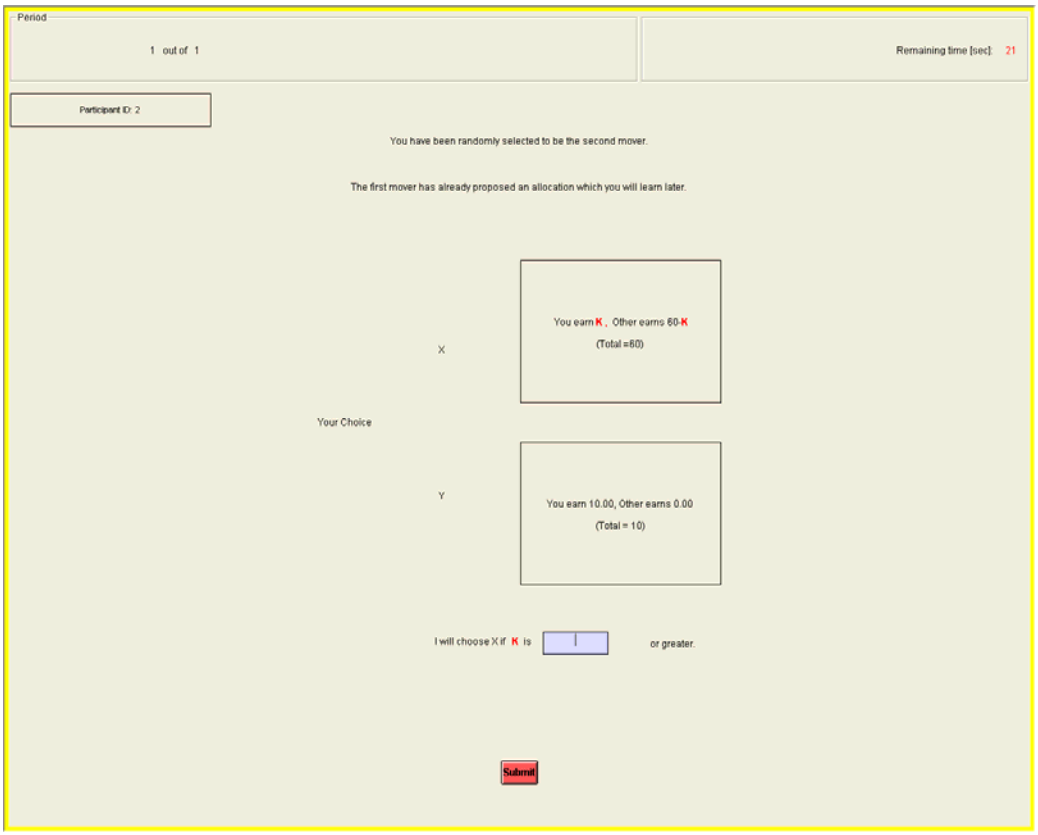


Figure 2: Second Mover Decision Screen

Then, the earnings in the proposed allocation are going to be compared with **K**. If the proposed allocation gives to the second mover **K or more** francs, the choice will automatically be **X.** Hence, the first mover proposed allocation is implemented. If the proposed allocation gives to the second mover **less than K** francs, the choice will automatically be **Y.** Hence, the first mover earns ***0*** francs and the second mover earns ***10*** francs.

The results and earnings for this part will be communicated at the end of the experiment.

Questionnaire

3. For which of the value(s) of K listed below is a proposed allocation of (21 to the first mover and 39 to the second mover) going to be implemented? (check the appropriate boxes):

☐	0.99	☐	2
☐	10	☐	12.20
☐	35	☐	60

4. How much does the first mover earn if the second mover chooses Y and the proposed allocation is not implemented? _____

5. How much does the second mover earn if the second mover chooses Y and the proposed allocation is not implemented? _____

6. Which proposed allocation(s) listed below would be implemented if K is set at 49 francs? (check the appropriate boxes):

☐ (10 first mover, 50 second mover) ☐ (20 first mover, 40 second mover)
☐ (30 first mover, 30 second mover) ☐ (40 first mover, 20 second mover)
☐ (50 first mover, 10 second mover) ☐ (60 first mover, 0 second mover)

Part two results
Participant ID:_____
Your Choice: _____
Your earnings for part two: _____ francs
Other agent's earnings for part two: _____ francs

Part two results
Participant ID:_____
Other Agent's Choice: _____
Your earnings for part two: _____ francs
Other agent's earnings for part two: _____ francs

Instructions – Part three

This part of the experiment consists of one decision making period. The participants in this part of the experiment will be randomly placed into two-person groups. The person currently placed in your group is different from the previous one. Remember, you will never interact again with this new person in the remainder of today's experiment.

Your Choices

In each group, one of you has been randomly selected to be the allocator. The other is the non-allocator. Each person will make one decision. First, the non-allocator chooses either **X** or **Y**. As the payoff table in Figure 1 indicates:

If the non-allocator chooses **Y**: there is a sum of 20 francs available; both individuals earn ***10*** francs.

If the non-allocator chooses **X:** there is a sum of 60 francs available. The person selected to be the **allocator** in the group will determine how many francs to allocate to himself/herself and how many to the other person in his/her group (the non-allocator). The allocator must choose numbers from zero to 60.

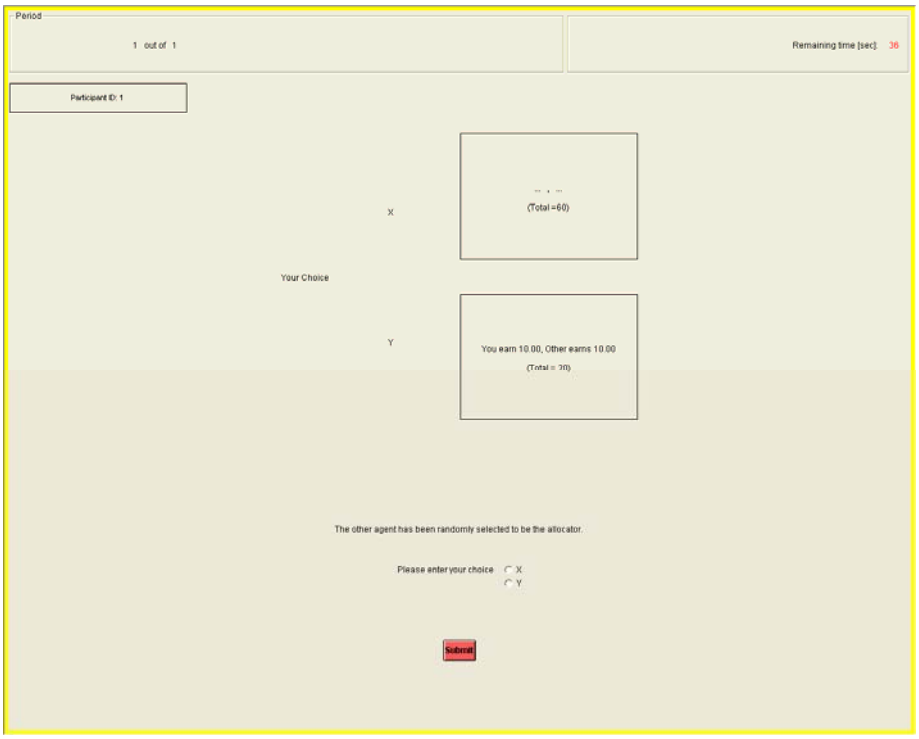


Figure 1: Initial Choice X or Y Decision Screen for the non-Allocator

You will learn which person in the group is the **allocator** at the start of the period, as shown in Figure 1 above. An example allocation screen is shown in Figure 2 below.

Figure 2: Decision Screen for the Allocator

The allocator will make a decision without knowing if the non-allocator has chosen **X** or **Y**. If the non-allocator has chosen **Y,** the allocator decision will be ignored and her/his earnings are going to be 10 francs. If the non-allocator has chosen **X,** the allocator decision will determine the earnings of both persons. The results and earnings for this part will be communicated at the end of the experiment.

Questionnaire

1. The first decision is made by the allocator (circle one): TRUE FALSE
2. If the non-allocator chooses Y, does the allocator decision influence the earnings? (circle one): YES NO
3. How much does the allocator earn if the non-allocator chooses Y? _____
4. How much does the non-allocator earn if the non-allocator chooses Y? _____

Part three results
Participant ID:_____
Your Choice: _____
Your earnings for part three: _____ francs
Other agent's earnings for part three: _____ francs

Part three results
Participant ID:_____
Other Agent's Choice: _____
Your earnings for part three: _____ francs
Other agent's earnings for part three: _____ francs

Instructions – Part four

This part of the experiment consists of 10 separate decision making periods. The participants in this part of the experiment will be randomly assigned to the role of either "allocator" or "non-allocator" and will keep this role for all 10 periods. Moreover, participants will be placed into two-person groups. After every period each participant will be randomly and anonymously re-matched with another participant. As explained at the start of the experiment, participants are never matched with the same participant for more than one decision period.

Your Choices

During each period, you and the other person in your group will make one, two, or three decisions. First, the allocator sends a message to the other agent regarding the allocation of a sum of 60 francs. As shown in Figure 1 below, the message is composed of the amount of his/her allocation and the other agent allocation. The two numbers must sum up to 60. The non-allocator will be waiting.

Figure 1: Decision Screen for Message to non-allocator

This message is then sent to the non-allocator and it is displayed on the non-allocator's screen as "Message from the allocator in case both choose X: (you earn …, other earns …)" See Figure 2 below.

Second, each person has to choose either **X** or **Y**. As the payoff table in Figure 2 indicates:

If both of you choose **Y** this period: you both earn ***10*** francs.

If you choose **Y** and the other person chooses **X**: you earn ***10*** francs and the other person earns ***0*** francs.

If you choose **X** and the other person chooses **Y**: you earn ***0*** francs and the other person earns ***10*** francs.

If you both choose **X:** the person selected to be the **allocator** in the group will make a third decision. No further decision is necessary for the other person in the group.

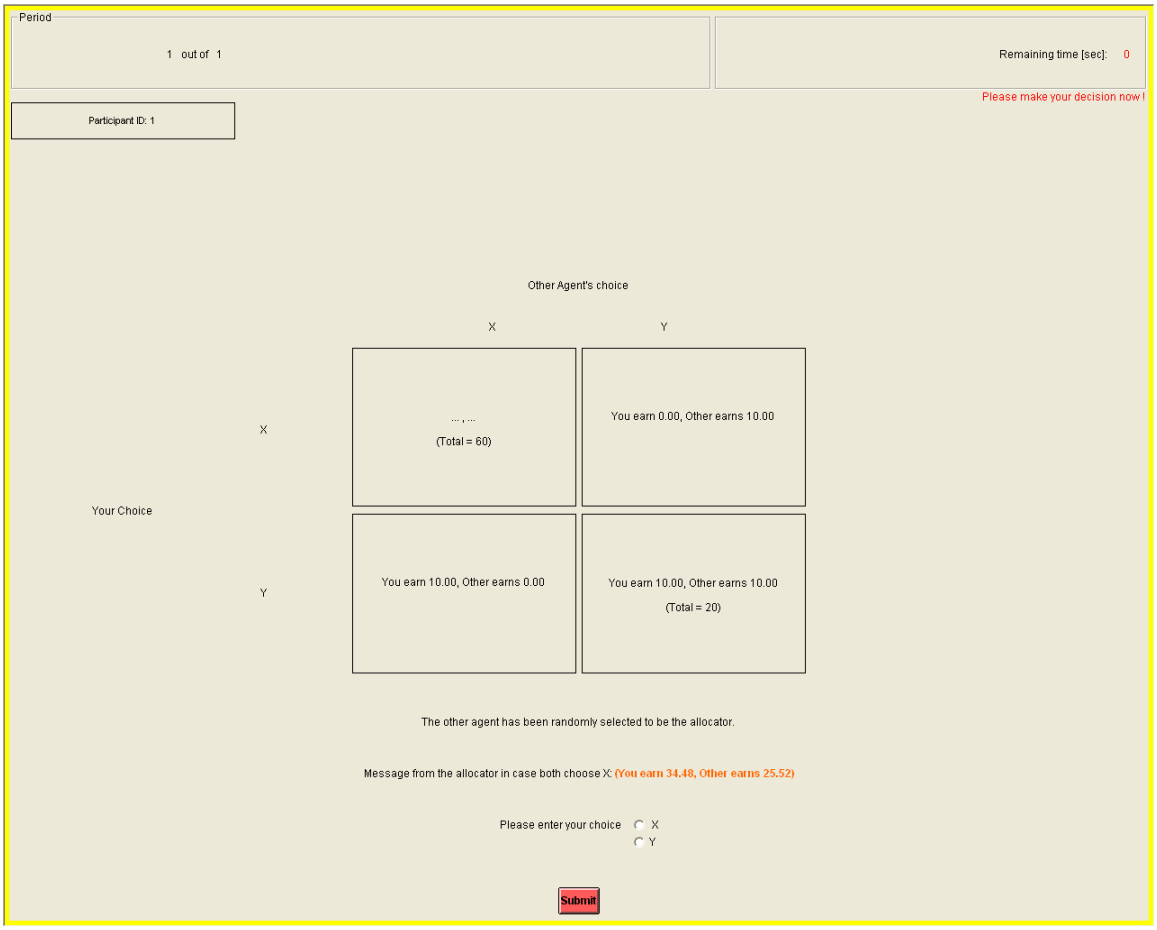


Figure 2: Decision Screen for Initial Choice X or Y

If you are the allocator and have chosen **Y**, no further choice is required. If you are the allocator and have chosen **X** you are asked to choose how many francs to allocate to you and how many to the other person in your group. The non-allocator will be waiting. The sum of the two amounts must be **60** francs. *The allocator is free to choose an allocation identical to the message sent to the non-allocator or a different one.* An example allocation screen is shown in Figure 3. The allocator's choice will be implemented when both people in the group choose **X** and ignored otherwise. Nobody will learn about this third choice unless both people in your group choose **X**.

One person in each group will be the **allocator**. You will learn which person in the group is the allocator at the start of the period, as shown in Figure 1. If you are an allocator in the first period, you will always remain an allocator for all 10 periods in this part of the experiment. Likewise, if you are not an allocator in this first period, you will never be an allocator in this part of the experiment.

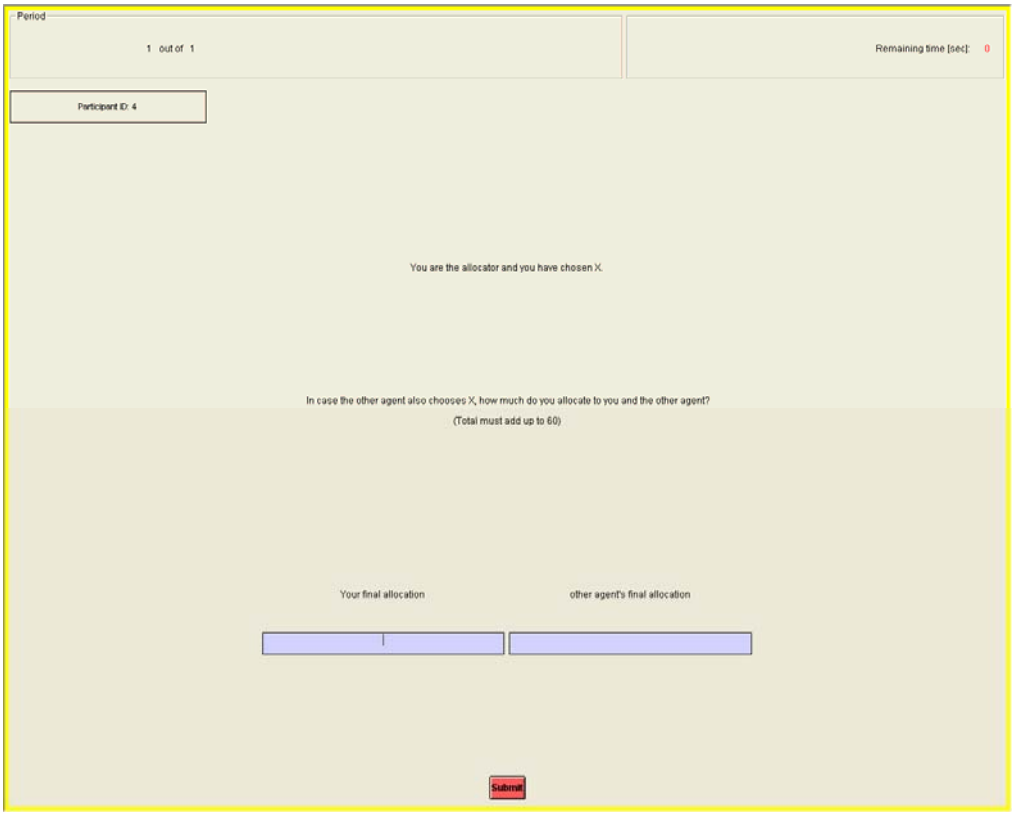


Figure 3: Decision Screen for the Allocator

<u>The End of the Period</u>

After everyone has made choices for the current period you will be automatically switched to the outcome screen, as shown in Figure 3 below. This screen displays your choice(s) as well as the choice(s) of the person you are grouped with for the current decision making period. It also shows your earnings for this period.

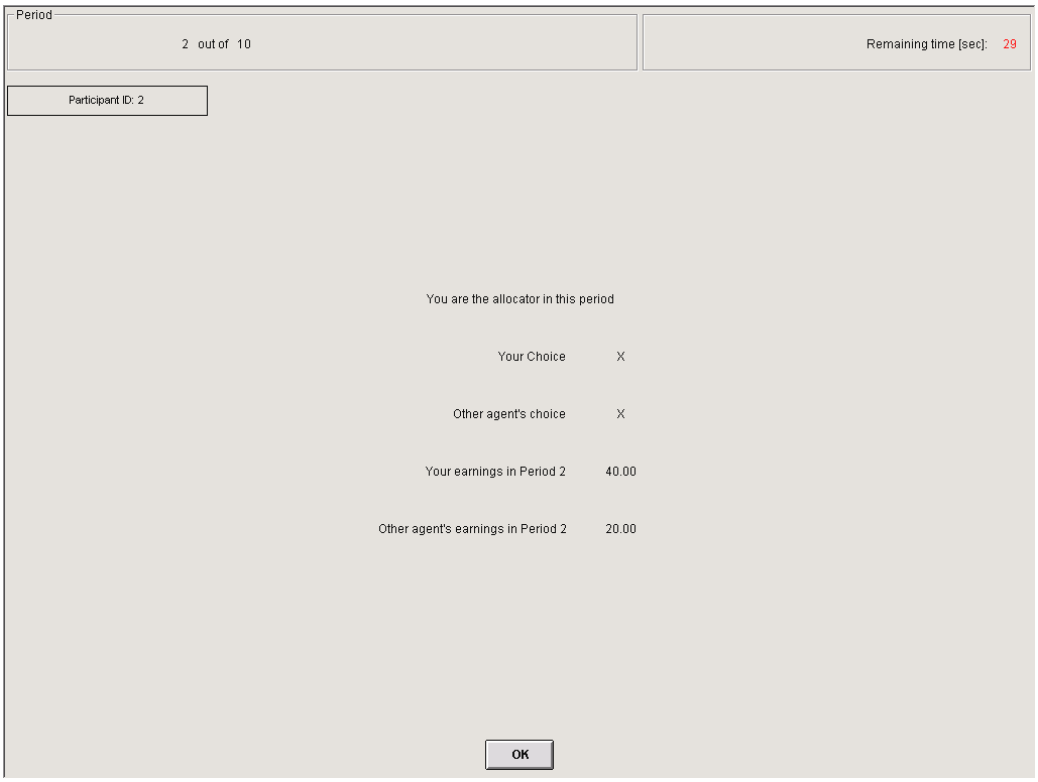


Figure 3: Example Outcome Screen

Once the outcome screen is displayed you should record your choice and the choice of the other agent in your group on your Personal Record Sheet. Also record your current period earnings. Then click on the *OK* button on the bottom of your screen. Remember, at the start of each and every period of the experiment all participants are randomly re-grouped with new participants that they have not interacted with in any previous period.

After the tenth period in this part of the experiment is completed, we will randomly draw one and only one period out of these 10 periods, and you will be paid the amount that you earned for that one period only. For example, as illustrated in Figure 4, if we randomly draw period 7 as the payment period, then you and everyone in today's experiment receive only your earnings for period 7 (for this part of the experiment), and you do not receive the earnings for the other nine periods.

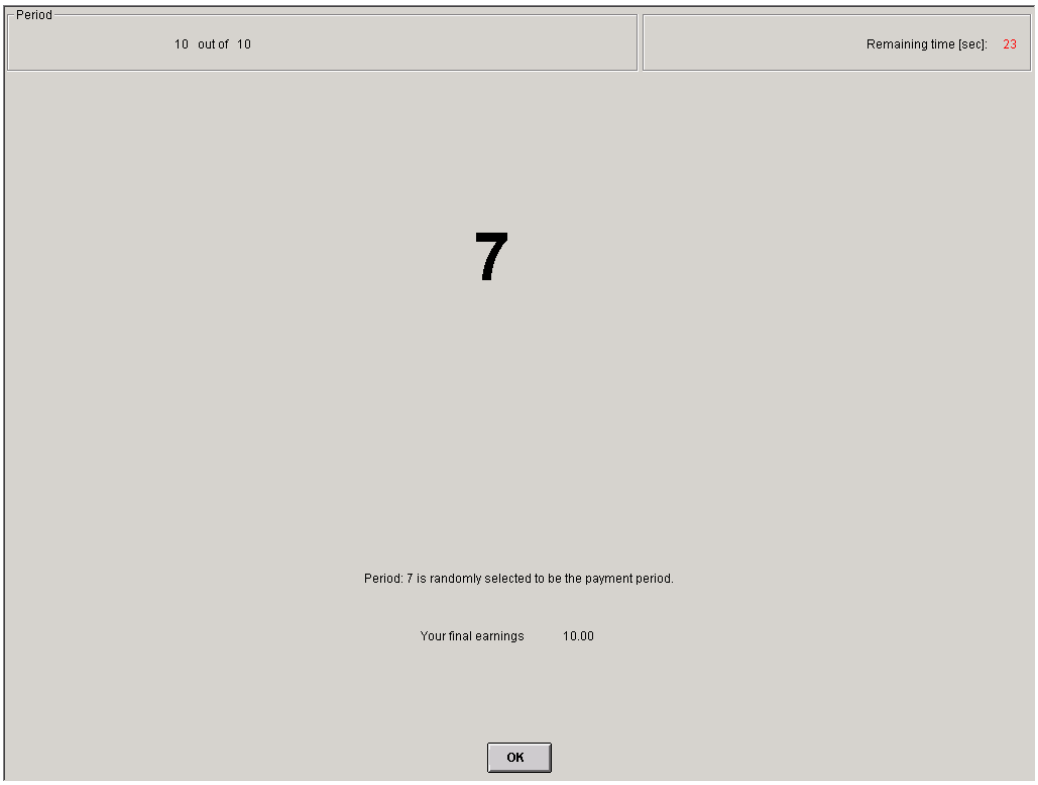


Figure 4: Random Round Selection for Payment Screen

Now it is time for clarifications. Is there any question about these instructions?

Questionnaire

1. If **You** choose **Y** and the **Other Agent** chooses **Y**, then **You** earn _____, and the **Other Agent** earns ____
2. If **You** choose **Y** and the **Other Agent** chooses **X**, then **You** earn _____, and the **Other Agent** earns ____
3. If **You** choose **X** and the **Other Agent** chooses **Y**, then **You** earn _____, and the **Other Agent** earns ____
4. As you are re-matched with another person after each period, there is a small probability that you will meet the same person again (circle one): TRUE FALSE
5. You will always maintain the same role (either allocator or non-allocator) for all 10 decision making periods (circle one): TRUE FALSE
6. Within a period you interact with just one other person (circle one)

   TRUE FALSE
7. You will be paid the sum of the earnings from all 10 periods (circle one)

   TRUE FALSE
8. The non-allocator always makes one decision each period (circle one)

   TRUE FALSE
9. The allocator always makes two decisions each period (circle one)

TRUE FALSE

10. The allocation decision for the 60 francs is implemented only if both participants in the group choose **X** (circle one):

    TRUE FALSE

11. The allocator must choose a final allocation that is identical to the message sent at the start of the period (circle one):

    TRUE FALSE

Personal Record Sheet

Period	I am the allocator this period (circle one)	My choice (circle one)	Other Agent's choice (circle one)	My earnings this period	Other Agent's earnings this period
1	Yes No	X Y	X Y		
2	Yes No	X Y	X Y		
3	Yes No	X Y	X Y		
4	Yes No	X Y	X Y		
5	Yes No	X Y	X Y		
6	Yes No	X Y	X Y		
7	Yes No	X Y	X Y		
8	Yes No	X Y	X Y		
9	Yes No	X Y	X Y		
10	Yes No	X Y	X Y		

Divide my earnings in selected period by conversion rate: ÷_____

Total earnings in for this set of periods in dollars: $_____

Earnings Record Sheet

Part 0: Initial Participation Payment Received by Everyone, in dollars: $ 5.00
Part 1: Earnings in Experimental Francs:_____. Converted to dollars: $
Part 2: Earnings in Experimental Francs:_____. Converted to dollars: $
Part 3: Earnings in Experimental Francs:_____. Converted to dollars: $
Part 4: Earnings in Experimental Francs:_____. Converted to dollars: $

Total earnings accumulated through all parts of the experiment: $_____