Explicit versus Implicit Contracts for Dividing the Benefits of Cooperation*

Marco Casari and Timothy N. Cason

Purdue University

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Abstract

Explicit contracts are used most frequently by theorists to model many relationships, ranging from labor markets to investment projects. Experimental evidence has accumulated recently highlighting the limitations of formal and explicit contracts in certain situations, and has documented environments in which informal and implicit contracts are more efficient. This paper compares the performance of explicit and 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 "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 a bonus to split the gains of the high effort equally, but actually delivered this bonus amount only about one-quarter of the time. An explicit and enforceable contract offer performs substantially better, raising the rate of the most efficient outcome by over 200 percent relative to the baseline. Interestingly, the initial bonus offer helped agents to coordinate their effort choices.

Keywords: Trust, contracting, laboratory, experiments, social preferences, inequity aversion, reciprocity

*casari@purdue.edu; 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 Dirk Engelmann, Dan Kovenock, and presentation audiences at the Barcelona ISNIE conference, Purdue University, IUPUI, and ESA conferences in Rome and Tucson.

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 laboratory evidence on "fair-minded" agents. For example, in a laboratory labor market Fehr et al. (2007) show that unenforceable bonus contracts can outperform explicit incentive contracts when agents have preferences for fairness. Moreover, their principals recognize this and frequently choose the unenforceable contract when given a choice of contract format.

General results in contract theory could in principle be extended to many preference structures, including those based on fairness. The challenging 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 to identify where explicit contracts perform worse and better than implicit contracts. Ben-Ner and Putterman (2007) 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, forthcoming). Other research has found that implicit gift exchange contracts that work well in the laboratory may have only a temporary impact on behavior in longer field experiments (Gneezy and List, 2006). The present study's objective is to compare the performance of explicit and implicit contracts in a new alternative economic environment.

As in most of the extensive literature on experimental labor markets (for a review, see Gächter and Fehr, 2001, or Frey and Osterloh, 2002), in our experiment two agents must cooperate to generate some joint surplus that is split between them. In the standard environment the principal pays the agent and the agent exerts effort that benefits the principal. The moves are typically 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—call her the principal or simply the "strong agent"—is responsible for dividing the benefits of their high effort. We examine treatments in which the strong agent offers an unenforceable "bonus" payment to the other agent, or an explicit and formal contract with an effort-contingent payment. The environment is also simplified in some dimensions (e.g., only two effort choices are feasible) but is rich in others (e.g., the strong agent can divide the surplus between the two agents in virtually any way desired).

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 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.

We find that in this environment, efficient high effort outcomes are feasible in theory even without explicit contracts for some intermediate distributions of inequity averse social preferences. Joint high effort is not an equilibrium if too many or too few agents have self-regarding preferences. Empirically, we document that explicit contracts considerably 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 increases this rate by 233 percent. Effort also decreases with experience in the baseline and bonus treatments but increases with experience in the formal contract treatment, so these performance differences increase over time. In the Bonus treatment, the strong agents most frequently offered to split the gains of high effort equally, but actually delivered an equal split only about one-quarter of the time. Very low and high offers did help agents coordinate on the low effort equilibrium, however. This is consistent with the

[1] Although our subjects do not sign actual contracts in the experiment, they sometimes make fully-enforcable 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.

interpretation that offers can signal information about different preference types, reflecting heterogeneity across individuals' other-regarding preferences.

The next section describes the partnership game along with the experimental design and procedures. Section 3 presents some theoretical predictions for the benchmark case in which all agents have standard money-maximizing preferences, as well as a simple version of inequity averse social preferences. Section 4 contains the results and Section 5 concludes.

2. Experimental Design and Procedures

An 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. 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 A and B(onus) and thus was the dictator in splitting the 60-franc gain. Roles were common knowledge. We conduct three treatments in an across-subject design: Baseline, Bonus and Explicit 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 a strong and a weak agent made a simultaneous choice between 1 and 2. When the strong agent chose 1, she was then asked, in addition, to decide on how she would split the 60 francs in case the outcome (1, 1) was reached. The subjects saw the results at the end of each period. The weak agent learned nothing about the actual allocation made by the strong agent when the outcome was (1, 2).

[2] Sample instructions are available in the appendix.

In the Bonus 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. In a second stage, both strong and weak agents made a simultaneous choice between 1 and 2. When the strong agent chose 1, she had to decide, in addition, on how she would split the 60 francs in case the outcome (1, 1) was reached. The actual split could be different from the one promised. The subjects saw the results at the end of each period. The weak agent learned the actual allocation choice of the strong agent only when the outcome (1, 1) was reached.[3]

In the Explicit 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 …)." In a second stage, both the strong and weak agent made a simultaneous choice between 1 and 2. The subjects saw the results at the end of each period.

Three measures were adopted to reduce any repeated game effects. First, only one of the ten periods in this part was randomly chosen for payment.[4] Second, we employed a perfect stranger protocol to match subjects together only once in the entire session. Third, 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.

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). 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

[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, not just one, (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.

[4] In addition subjects were always paid for parts 1, 2, and 3, although they received no feedback on these parts until the end of the experimental session.

subsequent choices, the probability of the high payoff increased by 1/20 each time. A risk neutral person would choose A in lotteries one through seven and then switch to B in lottery eight. Risk seeking agents may switch to option B earlier than lottery 7 and risk averse agents may switch later than lottery 7. Any rational agent should choose option A over option B in the first lottery (10 vs. 0 francs always) and later keep choosing option A until one line and then eventually switch to B. Multiple switches would instead be a signal of confusion. We paid only one of the fifteen decisions, chosen randomly at the end of the session. Random choices were all implemented through drawings from a bingo cage.

The partnership game could be seen as a general situation that includes the ultimatum and trust games of parts 2 and 3 as special cases. When the strong agent always chooses action 1, the Explicit 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 results for this part were communicated to the participants only at the end of the session.

The partnership game in the Baseline treatment exhibits similarities with the trust game played in part 3. In the trust game the responder chose with the strategy method. The two players 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 50 francs were given to the trustee. Before learning that choice, the trustee had to state how many francs in [0, 60] she wanted to send back to the trustor. Note that the trustor could send back her own endowment francs. The results for this part were communicated to the participants only at the end of the session. 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.

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 run between August 2005 and March 2006 with 24 subjects in each session. We conducted 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. Instructions were read aloud one part at a time and for each part a short quiz was completed. 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, which were also read aloud by an experimenter. Including instructions and payment time, sessions lasted less 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.

3. 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. Consider first the standard model of self-regarding preferences. In the Baseline and Bonus treatments, a unique subgame perfect equilibrium exists where both agents exert low effort and earn 10 francs each. The proposed bonus is cheap talk and should be irrelevant. In the Explicit Commitment treatment, multiple Nash equilibria exist depending on the allocations indicated by the strong agent. If the offer is below 10 francs, there exists a unique equilibrium in which both agents exert low effort and earn 10 francs each as in the other treatments. If the offer is at or above 10 francs, there exist two pure strategy equilibria and a mixed strategy equilibrium. Agents could coordinate on low or high effort. For example, the following strategies constitute a subgame perfect Nash equilibrium: (a) strong agent offers a transfer of $x \in [10, 50]$ to weak agent and chooses high effort; (b) weak agent chooses high effort for an offer $\geq x$ and chooses low effort for an offer $< x$. Equilibrium earnings range from 10 to 50 francs per agent. The high effort equilibrium Pareto dominates the low effort equilibrium, but, except for extreme proposed payoff differences, the low effort equilibrium is risk dominant.

Fairness concerns could obviously influence behavior in this game, so the standard model of self-regarding preferences may not be appropriate. We did not design our experiment to examine the relative performance of the variety of models of fairness and reciprocity now available in the literature; see Sobel (2005) for a survey. Nevertheless, it is useful to assess the implications of at least one type of other-regarding preferences. For this purpose we will employ the simple model of linear inequity aversion proposed by Fehr and Schmidt (1999). This tractable model is an extension of the standard model of money-maximizing preferences to include individuals who dislike unequal payoffs. For the two-player case relevant for our experiment, the utility of player i over monetary payoffs x_i and x_j is

$$U_i(x_i, x_j) = x_i - \alpha_i \max[x_j - x_i, 0] - \beta_i \max[x_i - x_j, 0], \text{ for } i \neq j.$$

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 $0 \leq \beta_i < 1$.

For the Baseline and Bonus treatments, the Nash equilibrium with these inequity averse preferences depends on the distribution of the α_i and β_i in the population of agents. Strong agents with $\beta_i > 0.5$ would prefer a 30-30 split of the 60 franc surplus available following the high effort outcome because they greatly dislike advantageous inequality. Depending on the fraction of fair-minded types in the set of players, the high effort outcome can emerge in equilibrium.

To be more precise, we will follow Fehr et al. (2007) and use a simplified version of this model that has 60 percent of the players self-regarding types ($\beta_i = \alpha_i = 0$) and 40 percent fair-minded types with $\beta_i = 0.6$ and $\alpha_i = 2$.[5] The fair types strongly dislike their playing partner to have a payoff advantage; for example, they would prefer the low effort payoff vector of (10, 10) over the disadvantageous split (25, 35). The fair types would, however, prefer the equal split (30, 30) over any advantageous split of the 60 francs available following joint high effort, and so the strong agent would split the surplus equally. Strong agents who are the self-regarding type would, of course, keep all 60 francs if joint high effort occurs.

It is straightforward to calculate the Bayesian-Nash equilibrium of this game, taking the effort subgame choices into account and the specified incomplete information about player types

[5] Contrary to this assumption of a perfect correlation between α_i and β_i, Blanco et al. (2007) estimated individual α_i and β_i across a series of games and found no correlation. Moreover, 23 of their 61 subjects (38 percent) violate Fehr and Schmidt's assumption that $\alpha_i \geq \beta_i$.

and assuming common knowledge over the distribution of types.[6] An equilibrium exists in which strong agents who are fair-minded types exert high effort and split the 60 francs equally, and strong agents who are self-regarding exert high effort and give no bonus. Weak agents who are fair-minded types exert low effort because they suffer severely from the nontrivial likelihood of the asymmetric payoff vector (0, 60), but weak agents who are self-regarding exert high effort. Based on the assumed proportions of subjects of each type in the population (60 percent self-regarding and 40 percent fair-minded), if subjects play this equilibrium we would expect to see a high effort rate of 60 percent among weak agents and 100 percent among strong agents.

This equilibrium is sensitive to the assumed proportion of 40 percent fair-minded types and resulting 60 percent high effort rate for weak agents. If the proportion of fair-minded types rises above 46.4 percent, then the high effort rate for weak agents falls below 53.6 percent and the fair-minded strong agents no longer exert high effort.[7] The best response for all weak agents therefore switches to low effort, restoring low effort as the unique Bayesian-Nash equilibrium. Interestingly, the equilibrium high effort rate falls as the fraction of fair-minded types increases. The equilibrium would also change for different distributions of player types and for alternative assumptions about the relationships between the β_i and α_i across players, so we do not wish to emphasize the specific predictions from the distribution assumed here.[8] This brief analysis nevertheless identifies particular patterns in the data suggested by inequity aversion, which could hold for a range of player types and beliefs:

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

(b) the increase in utility from high effort is marginal for fair-minded strong agents and is much larger for self-regarding strong agents, implying a higher high effort rate for self-regarding strong agents.

[6] 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. We also assume here risk neutrality, although the predictions hold for a wider range of risk parameters.

[7] For these strong agents the likelihood of the disadvantageous payoff vector (0, 10) rises too high. Fair-minded strong agents must expect the weak agent to exert high effort at least 53.6 percent of the time to make their expected utility of low effort exceed their expected utility of high effort.

[8] Moreover, if a sufficiently high fraction of players is fair-minded, above 82.7 percent for our parameterization, we again get the high-effort equilibrium for certain type combinations.

Turning to the treatments of the experiment, the proposed allocation in the Bonus treatment is cheap talk and should be irrelevant if all agents are self-regarding. It is possible, however, that with uncertainty about types the bonus amount could serve as a signal regarding the strong agents' type or effort intention. One could construct a Bayesian-Nash equilibrium in which the bonus could be an informative signal for certain distributions of other-regarding preferences and beliefs. (Cason and Mui, 2007, develop this idea further, but informally, in a related coordination game.) Of course, for many beliefs and distributions, only a pooling equilibrium exists and so the bonus amount would be completely uninformative. This would be reflected in no differences in outcomes between the Baseline and Bonus treatments.

In the Explicit Commitment treatment, multiple Nash equilibria exist with fair-minded agents, as in the case with all self-regarding agents, depending on the allocation indicated by the strong agent. If the offer is below 10 francs, a unique equilibrium exists in which both agents exert low effort and earn 10 francs each. If the offer is sufficiently generous, with the threshold depending on the distribution of other-regarding types and their specific preferences, there exist two pure strategy equilibria. Agents could coordinate to 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, which would result in a payoff of 0 to the agent choosing high effort. This 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 Explicit Commitment treatment, both for social and standard purely self-interested preferences. The high effort outcome is also a possible in equilibrium for the implicit contracting environment of the Bonus treatment for some distributions of inequity averse preferences, but not with standard preferences. In both bonus and explicit commitment treatments, asymmetric offers may be used to signal intentions to play the low effort equilibrium.

Finally, let us turn to the predictions for ultimatum and trust games. In the ultimatum game equilibrium earnings when everyone is self-regarding, are 59.99 for the proposer and 0.01 for the responder. A fair-minded responder with Fehr-Schmidt preferences of $\beta_i = 0.6$ and $\alpha_i = 2$

discussed above would state 24.8 as the minimum amount she is willing to accept. A fair-minded proposer would offer 30 francs, and a (risk-neutral) self-regarding proposer facing at least 59 percent self-regarding responders would still offer 0.01 francs. More generous offers could reflect either risk aversion or other-regarding preferences. In the trust game, a self-regarding trustee would keep everything that was sent, and a self-regarding trustor facing all self-regarding trustees should therefore send 0 francs. Equilibrium earnings are 10 francs each. A fair-minded trustee with Fehr-Schmidt preferences of $\beta_i = 0.6$ and $\alpha_i = 2$ would return 30 francs and keep 30 francs. A self-regarding trustor who believes at least one-third of the trustees are fair-minded will send the 10 francs. A fair-minded trustor suffers from disadvantageous disutility so much, and fears the (0, 60) split, that he must believe at least 86.7 percent of the trustees are fair-minded to send the 10 francs.

Note that if behavior differs across subjects because they have different types of social preferences, this implies a particular correlation of choices across the ultimatum and trust 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 25 of the 60 francs in the ultimatum game and (2) send all 10 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 insight into the behavior in the main partnership game.

4. Results

4.1 Overview

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 Explicit Commitment treatment and lowest in the Baseline treatment. Figure 1 presents the evolution over time series

[9] High effort choices of strong agents is 56/72 and of weak agents is 44/72, Fisher exact probability test, one-tailed, p=0.0139, N=144.

of the high effort outcome rate by treatment. In the baseline treatment the high effort outcome started around 30-40 percent and declined to near zero at the end of the session. The baseline results provided 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 Bonus 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 Explicit Commitment treatment rose over time from the 40-50 percent range to the 60-70 percent range by the end of the session.

4.2 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 (Explicit Commitment) and 67 percent (Bonus) of the total amount received by the two agents. The difference is statistically significant for the Explicit Commitment treatment, but is only marginally significant for the other two treatments.[10] The share earned by the strong agent declines by the final 3 periods in the Baseline and Bonus treatments, in part due to the declining rate that pairs reached the high effort outcome, but it never falls below half of the total.[11]

Recall that for self-regarding agents, in both the Baseline and Bonus treatments, there exists a unique Nash equilibrium of low effort, which yields the payoff vector (10, 10). Multiple equilibria exist in the Explicit 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 Bonus treatments move closer to the low effort outcome while subjects in the Explicit Commitment treatment move closer to the high effort outcome.

Support: Table 3 shows the frequency of the high effort outcome during the last 3 periods of a session and Figure 1 displays the overall trends. In the Baseline treatment the high effort outcome rate is less than 6 percent and in the Bonus treatment it is 25 percent. This result is in

[10] For each treatment we run an OLS regression of individual subject earnings on a weak agent dummy with robust errors clustered by session (*N*=48). The *p*-values for the relevant *t*-tests are 0.15, 0.11, 0.05 for Baseline, Bonus, and Explicit Commitment, respectively.

[11] In the Bonus 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.

sharp contrast with the Explicit Commitment treatment, where the high effort outcome rate is nearly 70 percent. Each treatment is statistically different at a 5 percent level from any other.[12]

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 Bonus treatments, and about one-third of the pairs in the Explicit Commitment treatment. While the cheap talk of the Bonus 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, Bonus and Explicit Commitment treatments, respectively. The high effort outcome rate is 18 percent in the Baseline treatment and 36 percent in the Bonus 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.[13]

4.3 Bonus and Explicit Commitment Contract Offers

The results summarized thus far indicate that the high effort outcome was more frequent in the Bonus and Explicit 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 Bonus treatment, the strong agent most frequently proposed to equally split the earnings, but actually delivered this bonus amount only about one-quarter of the time.

Support: Figure 3 displays a bubble chart indicating the frequency of different amounts

[12] For each treatment pair we run an OLS regression of session high effort rates on a treatment dummy with robust errors clustered by session (N=96). The p-values for the relevant t-tests are 0.009 for Baseline compared to Bonus, 0.011 for Bonus compared to Explicit Commitment, and 0.000 for Baseline compared to Explicit Commitment.

[13] Statistical tests for *overall* miscoordination rates are not significant. For each pair of treatments we run a probit regression of session miscoordination rates on a treatment dummy with robust errors clustered by session (N=96). The p-values for the t-tests are 0.564 for Baseline compared to Bonus, 0.114 for Bonus compared to Explicit Commitment, and 0.108 for Baseline compared to Explicit Commitment. When we restrict to one-sided miscoordination, i.e. the weak agent exerting high effort and the strong agent exerting low effort, similar tests yield significant differences across treatments, with p-values 0.076, 0.005, 0.000, respectively.

of bonuses proposed and actually paid in the Bonus 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 actual amount paid was often less than the amount promised in this implicit contract offer, as shown on the diagonal 45-degree line in Figure 3. Only 43 out of 174 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.[14] The promised bonus in this environment apparently does not activate as much "guilt aversion" as the promise does in Charness and Dufwenberg (2006).

Result 5: In the Bonus treatment, the implicit contract offer provided a one-way communication tool to coordinate actions, with very high and low bonuses signaling the intention to achieve the low effort outcome.

Support: High effort rates in Panel A of Table 4 were highest for intermediate bonus amounts. 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 25 of the 60 total francs available in the high effort outcome. The second column shows that in the above situations, strong agent exerted high effort even more frequently. Both agents choose high effort at much lower rates when the strong agent proposes no bonus or a bonus above 50 francs. In this treatment the strong agent employed 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 Bonus treatment (Figure 2).

Result 6: In the Explicit Commitment treatment the bonus payment provided a very effective tool to coordinate actions. Explicit commitment led to much better coordination on high effort than the cheap talk in the Bonus 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

[14] In the bonus treatment of Fehr et al. (2007) the principals paid on average a bonus that was 64% of the amount promised when the agents gave an effort equal to or greater than requested by the principal. In our bonus treatment the strong agents paid on average a bonus that was 40% of the amount promised.

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 25 to 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 Explicit 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.

Coordination on equilibria improved over time in the Explicit Commitment treatment, as one can see from the trend in Figure 2. For very low or very high bonus offers, subjects typically played the low payoff equilibrium, but for offers in the range (10, 50) subjects faced multiple equilibria. We put forward three conjectures that could possibly explain the improvement in coordination. One possibility is that strong agents chose more frequently offers outside the (10, 50) range. The data do not support this interpretation as the frequency of such bonus offers actually declined over time, from 29 percent during the first 3 periods to 21 percent during the final 3 periods. A second possibility is that the improvement in coordination is explained by agents moving closer to the mixed strategy Nash equilibrium for offers in the range (10, 50) range. The null hypothesis that agents play the mixed strategy equilibrium for offers in the range (10, 50) implies a specific coordination rate for each offer level. In particular, this mixed strategy equilibrium coordination rate is highest near the offers of 10 and 50, and is lowest for offers of 30. The data also do not support this explanation, however, because for the observed distribution of offers the expected miscoordination rate in the mixed strategy equilibrium remains relatively stable, around 35 to 40 percent.

The data are most consistent with a third explanation: the improvement in coordination is due to the greater frequency of the high payoff equilibrium for offers in the range (10, 50). The frequency of equitable offers is greater in later rounds, and such offers were more often associated to the high payoff outcome. For example, strong agents make offers between 20 and 30 at a rate that increased from 57 percent in periods 1-3 to 72 percent in periods 7-10, and such offers are associated with the high payoff outcome about 80 percent of the time.

4.4 Using Measured Preferences to Understand Effort Choices

Prior to facing 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 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. Consistent with earlier research (e.g., Holt and Laury, 2002), we find that about 6 percent of the monotonic subjects are risk seeking (switching to the risky option before lottery 7), about 28 percent are approximately risk neutral (switching to the risky option on lotteries 7, 8 or 9), and 66 percent are risk averse (switching to the risky option after lottery 9). Our first result of this subsection indicates that subjects' measured level of risk aversion is correlated with their play in the partnership game.[15]

Result 7: In the partnership game, high effort rates tend to decline with increases in subjects' degree of risk aversion. Moreover, in the Bonus treatment risk-seeking strong agents propose higher bonuses but pay lower bonuses than risk neutral and risk averse agents.

Support: 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] Based on their answers to the lottery questions, participants are placed in three categories (1) risk seeking, (2) risk neutral and moderately risk averse, and (3) strongly risk averse. Category (2) includes subjects who switched from option A to B in lottery 8, 9, 10, or 11 and is the base case (omitted dummy variable) in the model. In three out of six columns of Table

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[15] For nonmonotonic subjects the risk attitude was approximated with the average among the lowest and the highest points of switch.

[16] The amount that the strong agent proposes to keep, either in the cheap talk phase of the Bonus treatment or the committed amount in the Explicit Commitment treatment, obviously should influence the subjects' propensity to choose high effort. This proposal amount is also an endogenous choice variable, so in the models of the strong agents' high effort decision in the Bonus and Explicit Commitment treatments we use an instrumental variables approach—replacing the actual amount proposed with the predicted amount proposed, derived from the models shown in columns 1 and 4 of Table 6.

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.

Table 6 presents random effects estimates of models of the bonus offered by the strong agent in the Bonus treatment (columns 1 and 2) and in the Explicit Commitment treatment (column 4). In the Bonus treatment, risk seeking strong agents seem more prone to lying, as they make more generous bonus proposals to weak agents when it is cheap talk but then follow-up with less generous actual bonuses. This effect is significant at a 5 percent level.

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 surprisingly large fraction of strong agents, 43 out of 72 (60 percent) were not trustworthy and kept all 60 francs.[17] 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.[18]

[17] Note that this 60 percent untrustworthiness rate is exactly consistent with the assumed fraction of self-regarding agents used in Section 3 and borrowed from Fehr et al. (2007).

[18] This lack of trustworthiness surprised us, and it differs from other binary trust games such as Eckel and Wilson (2004) who find that almost no second movers kept the entire surplus. We conjectured that this could be due to our

Result 8: Weak agents who trusted in the trust game were more likely to choose high effort in the Baseline and Bonus treatments of the partnership game. Strong agents who were not trustworthy were more likely to choose high effort in the Explicit Commitment treatment, and were more likely to pay low actual bonuses and make bonus offers that exceed bonus amounts actually paid in the Bonus treatment.

Support: Tables 5 and 6 provide support for Result 8. 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 Explicit 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 Explicit 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 Bonus treatment that requires substantial trust, untrustworthy strong agents paid lower actual bonuses on average and failed to deliver on positive promised bonuses.

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 Bonus treatments. Contrary

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strategy method approach for eliciting the return decision. Results could differ between the game and the strategy method, for example, if the *act* of being trusted generates reciprocal feelings that are stronger than what the decision-maker feels when specifying a strategy indicating an amount returned *if* he is trusted. Therefore, we conducted an additional two sessions, employing 48 subjects, who only played the lottery and the trust game—but with the trust game played in the game method. Of the 17 strong agents who were trusted, 8 kept all 60 francs and only 3 split the francs 30/30. The average amount returned was greater than the strategy method trust game—11.5 compared to 7.4 francs—but this difference was not statistically significant. While the data shift in the conjectured direction, the data do not provide any strong support for our conjecture.

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.[19]

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 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. This suggests a troubling inconsistency in preferences across these simple games, perhaps because 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.

5. Conclusion

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

[19] Blanco et al. (2007) 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. The estimated individual β_i are consistent with second-mover behavior, but not first-mover behavior, in a sequential prisoner's dilemma game. It is conceivable that some of the inconsistency is due to subjects diversifying their risk across games, but our data do not allow us to test this conjecture.

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 low and high effort outcomes. This underscores the importance of new data to provide a foundation for more empirically-accurate positive theory.

Proponents and critics of using non-standard, other-regarding preferences in economic modeling will both find some support for their cases in these data. Proponents will like the greater high-effort rates among strong agents than weak agents, as well as the greater high effort with implicit (cheap talk) contract offers relative to the baseline with no offers. 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. Critics can point to more and varied evidence here to support their case, 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. We would conclude from these data that implicit contracts do not perform nearly as well as explicit contracts in this partnership environment, which is an implication of standard, self-regarding preferences.

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. All of these variations have been conducted by other researchers. Our experiment does not seek to explore all of the possible factors affecting the performance of explicit and implicit contracts, but it does serve to 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.

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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: Bonus

		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: Explicit 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		Bonus		Explicit 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: Use of the contract offer as a signaling device in the Bonus and Explicit Commitment treatments: Frequencies by level of proposed bonus

Panel A:

Bonus Treatment	No. of obs.	Weak agent high effort (percent)	Strong agent high effort (percent)	high effort outcome	low effort outcome	Miscoor-dination
bonus ≥ 50	10	10%	20%	0.0%	70.0%	30.0%
30 < bonus < 50	33	48%	64%	30.3%	18.2%	51.5%
bonus = 30	145	53%	79%	43.4%	11.7%	44.8%
30 < bonus ≤ 25	29	52%	93%	44.8%	0.0%	55.2%
25 < bonus ≤ 10	12	17%	75%	0.0%	8.3%	91.7%
bonus < 10	11	0%	9%	0.0%	90.9%	9.1%

Panel B:

Explicit Commitment Treatment	Total obs.	Weak agent high effort (percent)	Strong agent high effort (percent)	high effort outcome	low effort outcome	Miscoor-dination
bonus ≥ 50	5	0%	20%	0.0%	80.0%	20.0%
30 < bonus < 50	4	100%	25%	25.0%	0.0%	75.0%
bonus = 30	75	99%	95%	93.3%	0.0%	6.7%
30 < bonus ≤ 25	30	80%	100%	80.0%	0.0%	20.0%
25 < bonus ≤ 10	97	54%	92%	48.5%	3.1%	48.5%
bonus < 10	29	3%	66%[a]	3.4%	34.5%	62.1%

[a] This surprisingly 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)	(2)	(3)	(4)	(5)	(6)
	Baseline, Strong agent	Baseline, Weak agent	Bonus, Strong agent	Bonus, Weak agent	Explicit Commitment, Strong agent	Explicit Commitment, Weak agent
Risk seeking (switch at or before lottery 7)	1.988 (1.528)	0.362 (0.634)	7.949 (4013)	0.305 (0.664)	0.030 (0.511)	1.056 (1.122)
Strongly risk averse (switch at or after lottery 12)	-2.910** (1.408)	-0.359 (0.381)	-0.266 (0.545)	0.018 (0.579)	-1.206* (0.730)	-1.170* (0.617)
Non-monotonic responses on risk attitude	-0.772 (1.867)	0.331 (0.605)	-9.145 (4013)	-0.093 (0.510)	0.363 (0.736)	-0.733 (1.098)
Average high effort rate of all your previous opponents (fictitious play beliefs)	8.804*** (2.043)	1.022** (0.479)	3.627*** (0.830)	-0.716 (0.718)	3.335*** (0.796)	0.701 (1.017)
1/ln(period)	3.564*** (0.879)	1.580*** (0.350)	-0.945 (0.628)	1.417*** (0.387)	0.867 (0.546)	-0.726 (0.447)
Proposer in ultimatum game wants to give strictly less than 30 francs	-1.028 (1.325)		-0.450 (0.789)		0.280 (0.467)	
Trustee gives back nothing in trust game	-0.980 (0.998)		0.000 (0.542)		1.118*** (0.409)	
Responder in ultimatum game demands ≤25 francs		0.353 (0.330)		0.254 (0.389)		0.062 (0.506)
Responder in ultimatum game demands ≥35 francs		-0.713 (0.688)		-0.031 (0.641)		0.241 (0.767)
Trustor passes all the money in trust game		1.166*** (0.336)		1.464** (0.576)		0.446 (0.752)
(Bonus treat) Bonus the strong agent actually gave minus proposed bonus (zero if strong agent chose low effort)			0.004 (0.010)	0.008 (0.008)		
Strong agent proposes bonus above 25 but less than or equal to 30 francs (#)			0.725** (0.362)	0.428 (0.278)	0.563 (0.367)	2.824*** (0.795)
Strong agent proposes bonus between 15 and 25 francs included (#)			-0.034 (0.441)	0.016 (0.375)	-0.078 (0.384)	0.389 (0.614)
Strong agent proposes bonus of less than 15 francs (#)			6.232 (8133)	-8.585 (5077)	7.381 (1511428)	-2.369*** (0.761)
Constant	-4.427*** (1.402)	-2.751*** (0.594)	-0.027 (0.678)	-1.152 (0.889)	-1.893** (0.743)	-0.166 (1.395)
Observations	216	216	216	216	216	216

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, Bonus and Explicit Commitment treatments

	(1)	(2)	(3)	(4)
	Bonus promised by strong agent (Bonus treatment)	Bonus actually given by strong agent (Bonus treatment)	Bonus promised by strong agent minus bonus actually given (Bonus treatment)	Bonus promised and given by strong agent (Explicit Commitment treatment)
Risk seeking (switch at or before lottery 7)	12.441** (5.859)	-29.995*** (8.943)	39.033*** (9.635)	5.440 (4.995)
Strong risk aversion (switch at or after lottery 12)	0.570 (2.167)	-6.039* (3.357)	9.059** (3.669)	8.956* (4.757)
Non-monotonic responses on risk attitude	-19.980*** (6.688)	24.045** (10.198)	-40.847*** (11.002)	-1.020 (5.201)
Average high effort rate of all your previous opponents (fictitious play belief)	-2.406 (3.176)	-3.549 (2.754)	3.758 (4.097)	-4.870* (2.950)
Proposer in ultimatum game offers strictly less than 30 francs	-9.874*** (3.124)	9.916** (4.821)	-13.185** (5.240)	0.649 (3.620)
Proposer in ultimatum game offers more than 31 francs	-7.922** (3.768)	2.348 (5.831)	-5.934 (6.406)	1.187 (5.558)
Trustee gives back nothing in trust game	2.757 (2.225)	-17.397*** (3.460)	23.094*** (3.786)	-2.648 (3.572)
Constant	29.423*** (4.111)	31.325*** (4.667)	-8.359 (5.881)	17.210*** (4.045)
Observations	216	155	155	216
R-squared	0.14	0.70	0.51	0.40

Notes: Random effect regressions, standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Regressions include session and period 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 A: Weak Agents

		When Responder in Ultimatum Game	
		Demands at least 25 out of 60 francs	Demands less than 25 out of 60 francs
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

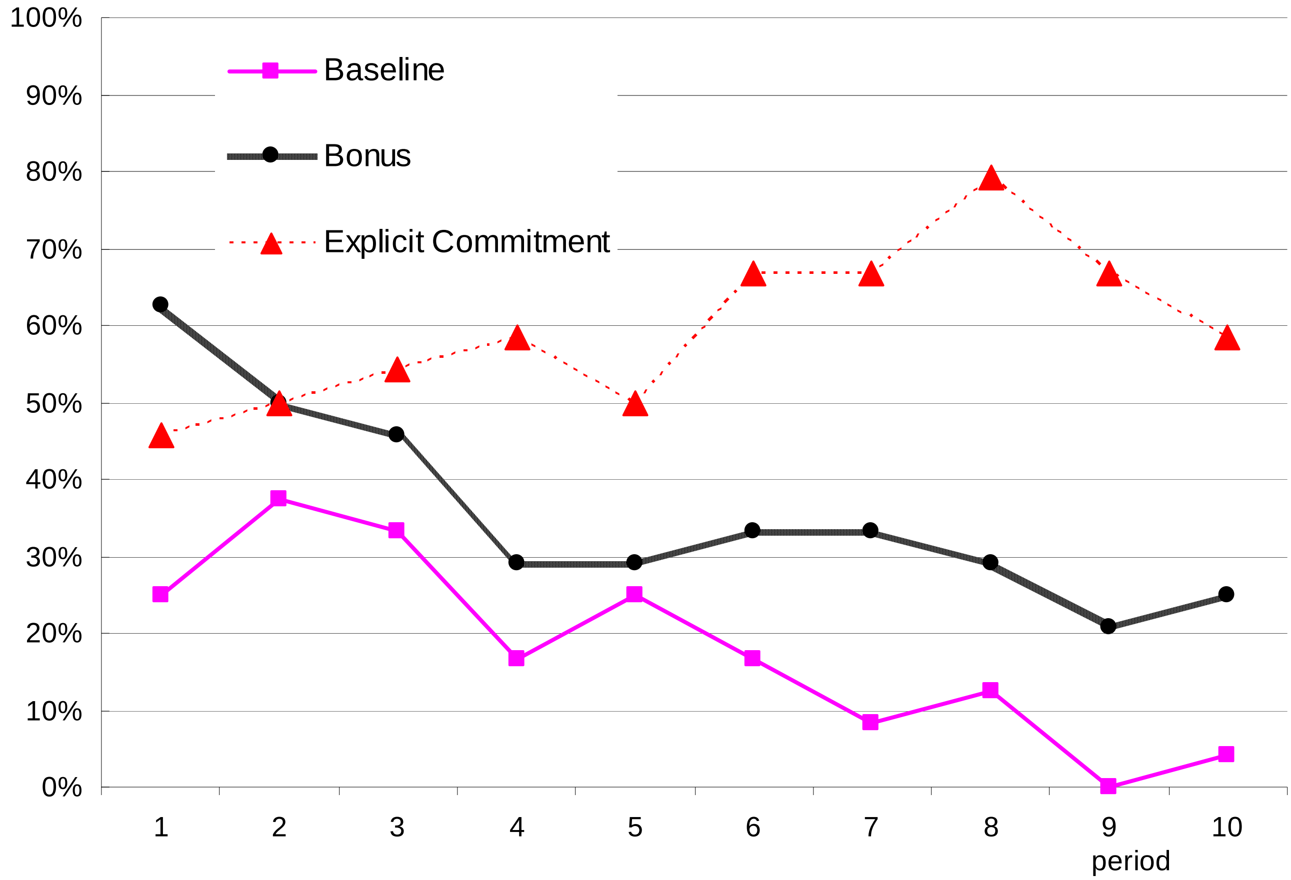


Figure 2: Frequency of miscoordination over time

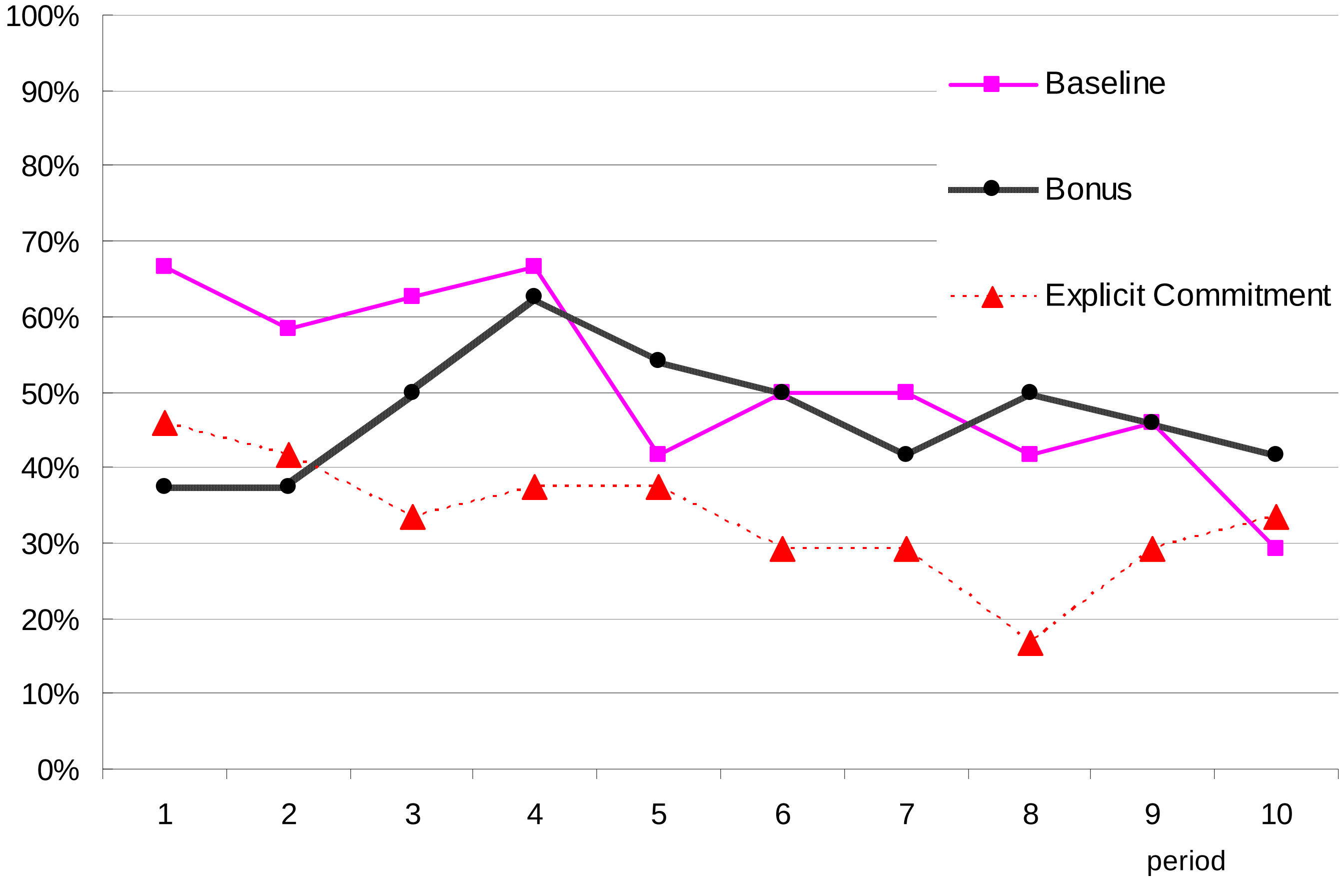
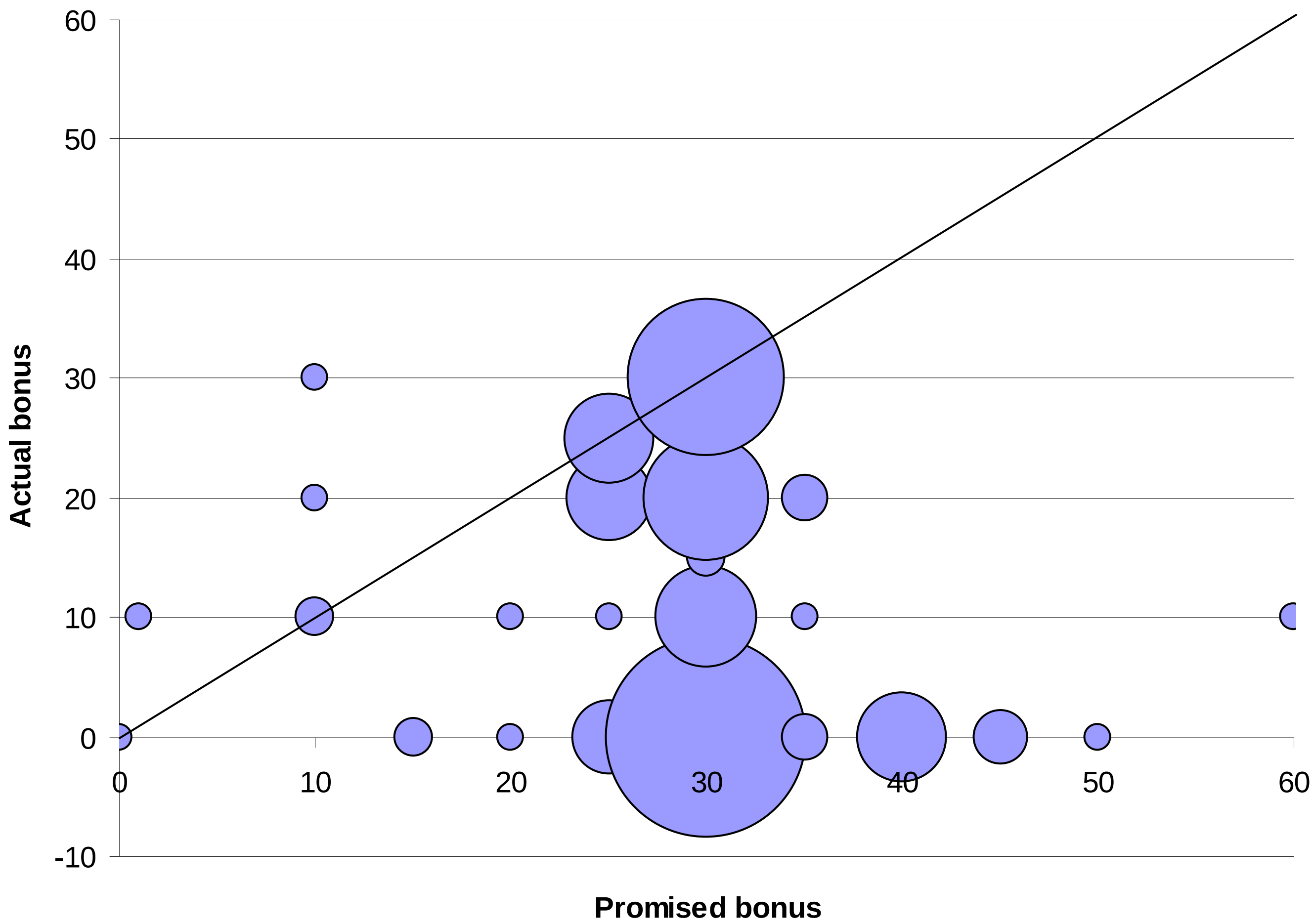


Figure 3: Promised and actual bonus (Bonus treatment)



Notes: Larger circles indicates 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 (Bonus treatment)

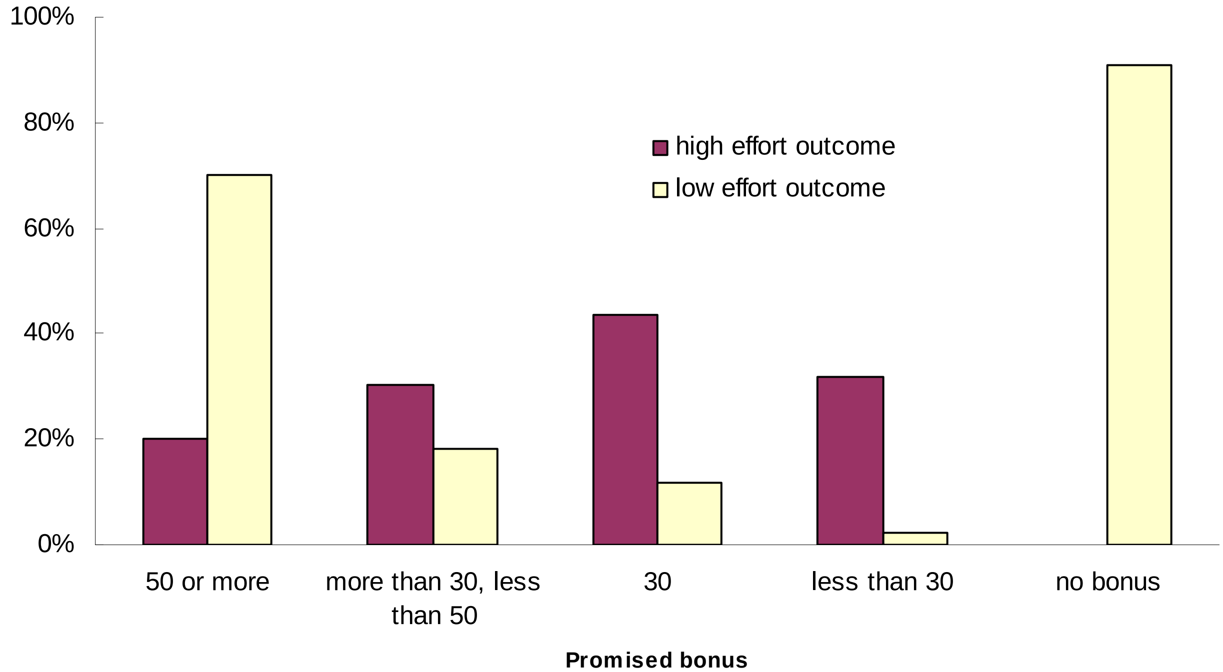


Figure 5: Explicit contract offer as a coordination device (Explicit Commitment treatment)

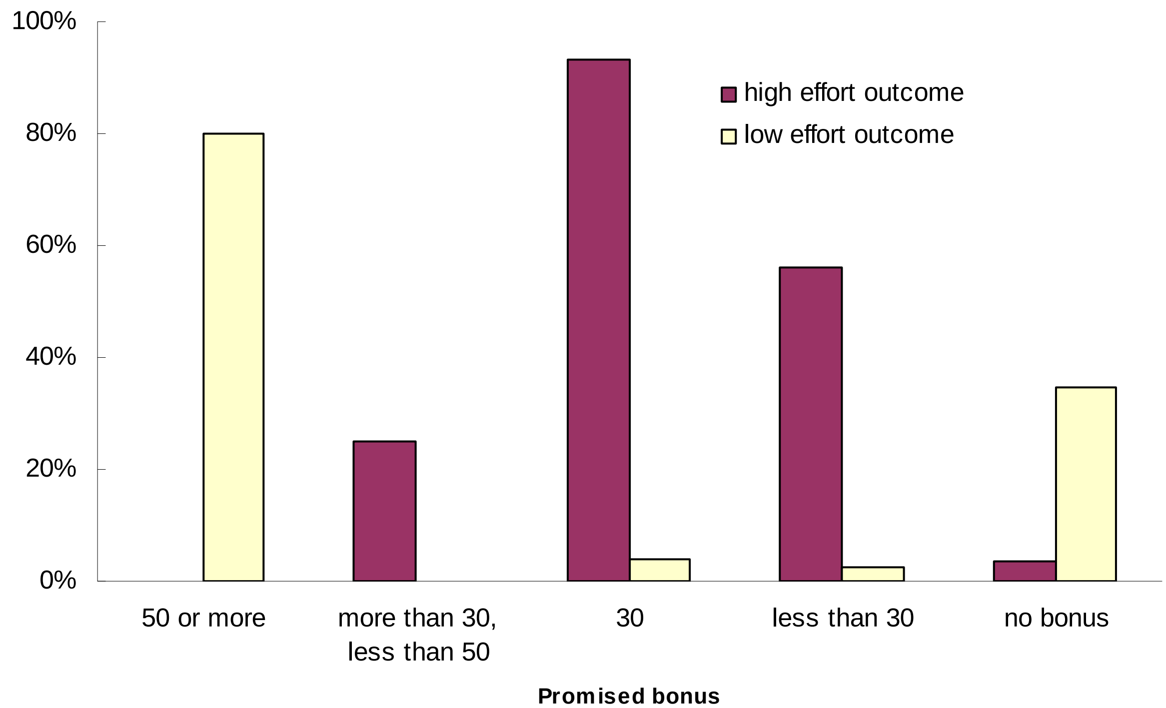
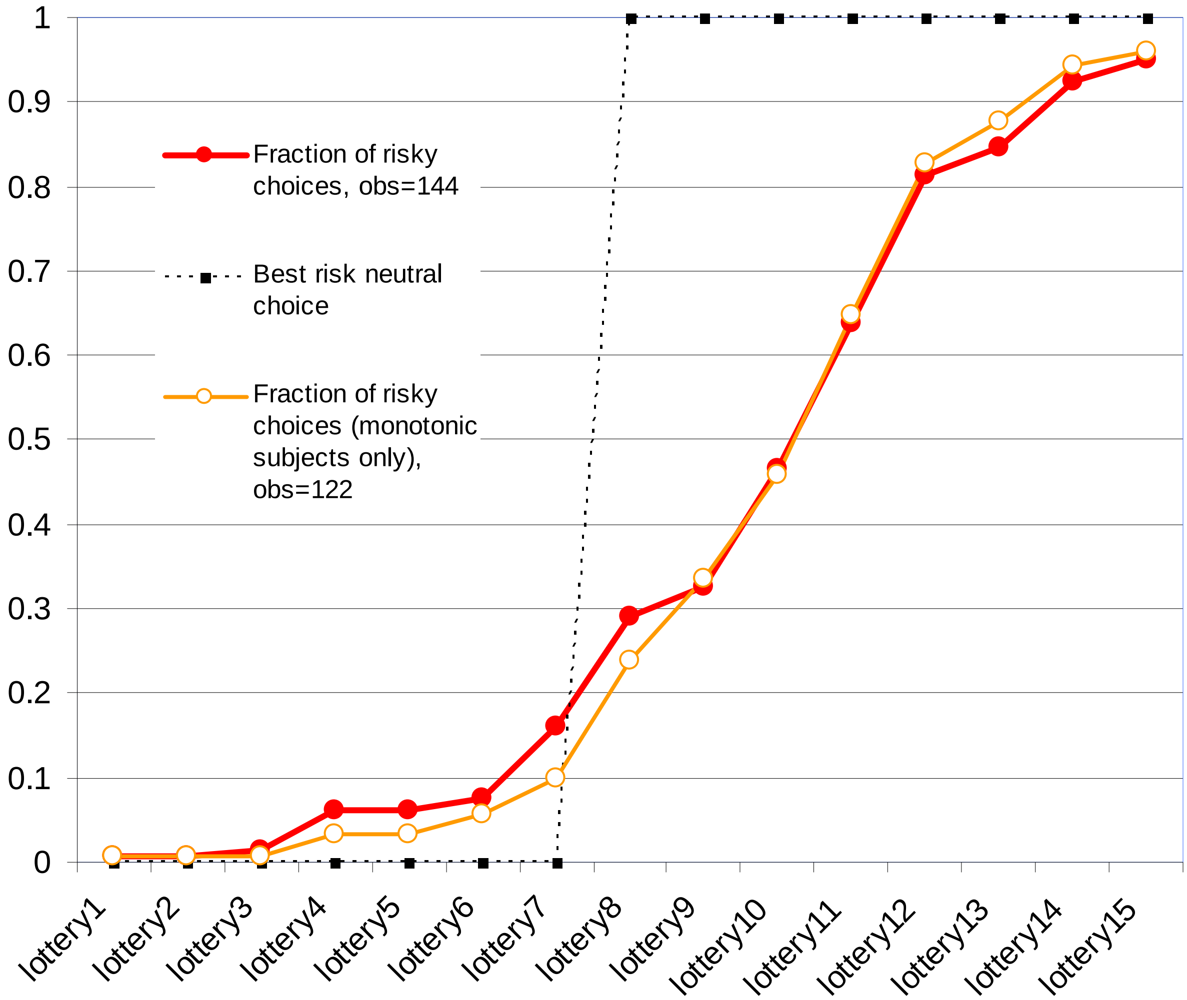


Figure 6: Risk attitude of participants, cumulative distribution



Instructions

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**	**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	

	francs			
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.

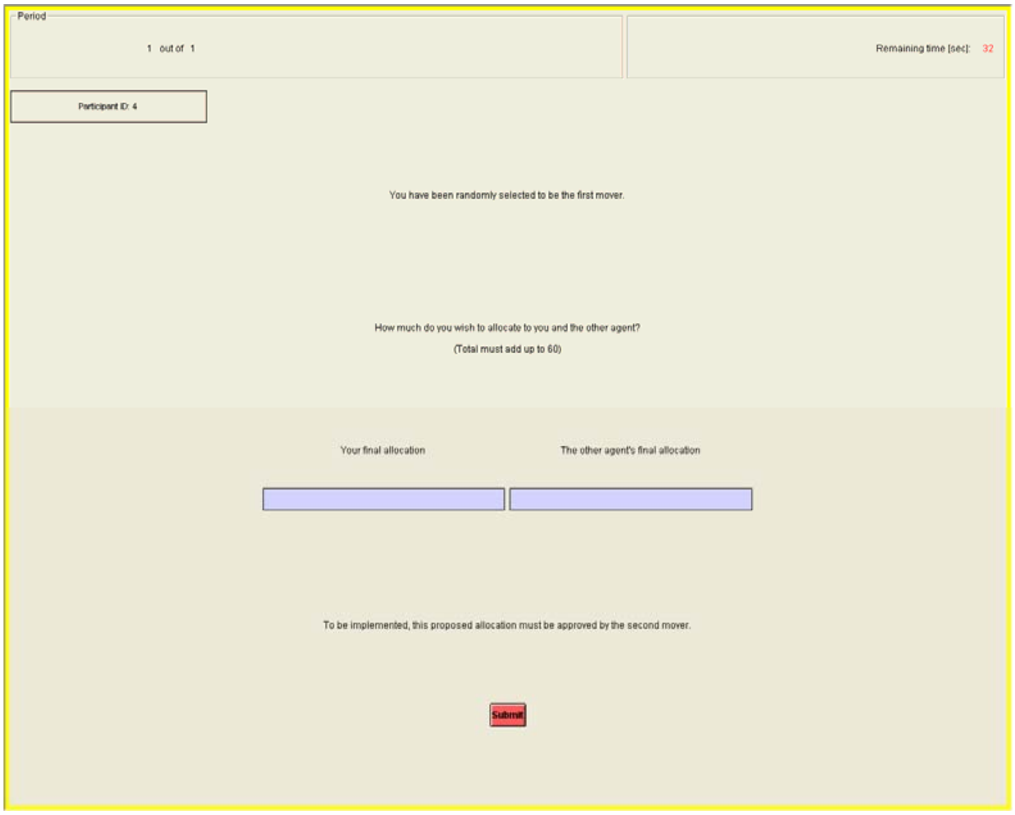


Figure 1: First Mover Decision Screen

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:

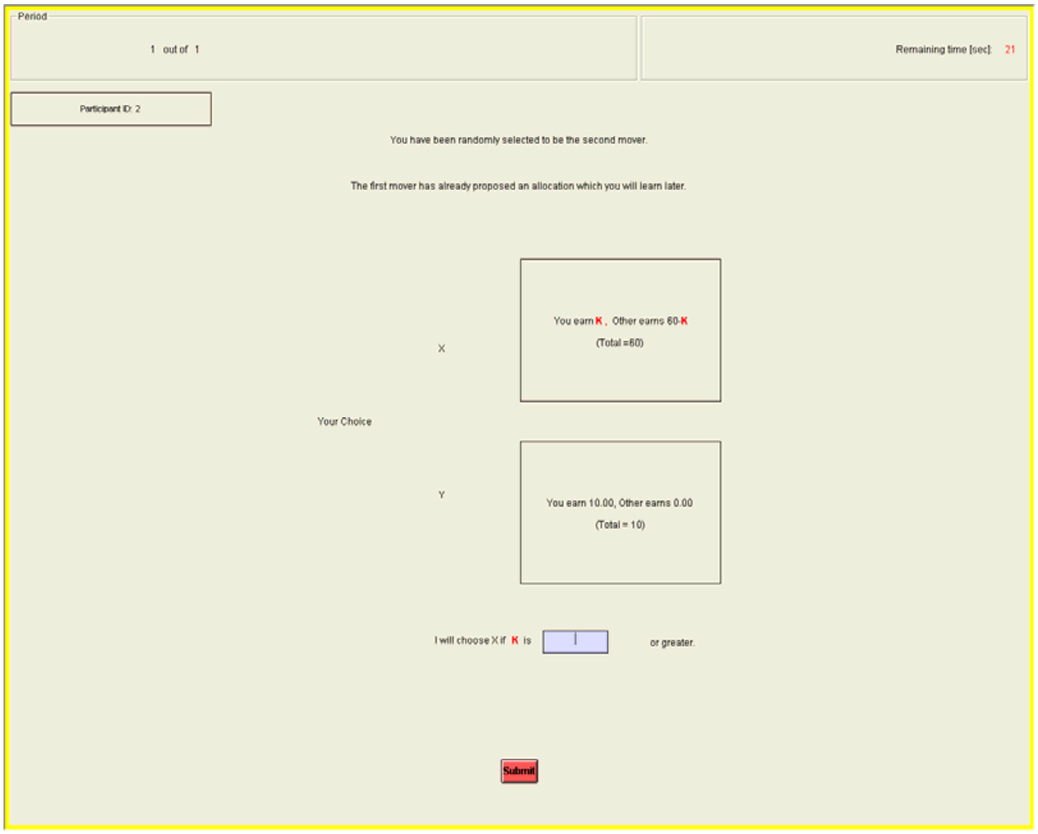


Figure 2: Second Mover Decision Screen

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.

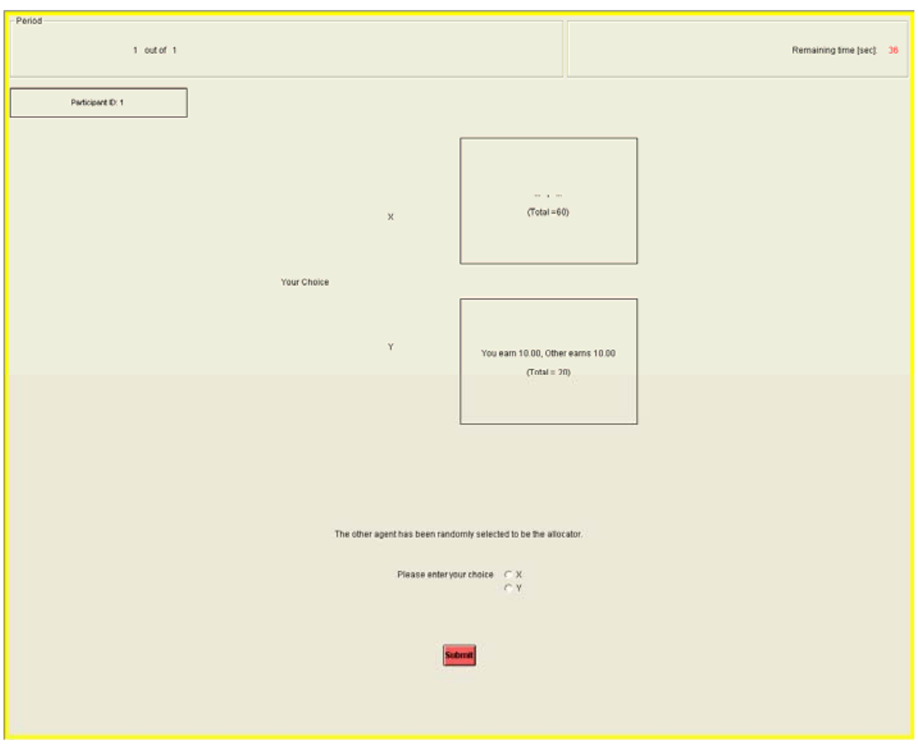


Figure 1: Initial Choice X or Y Decision Screen for the non-Allocator

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.

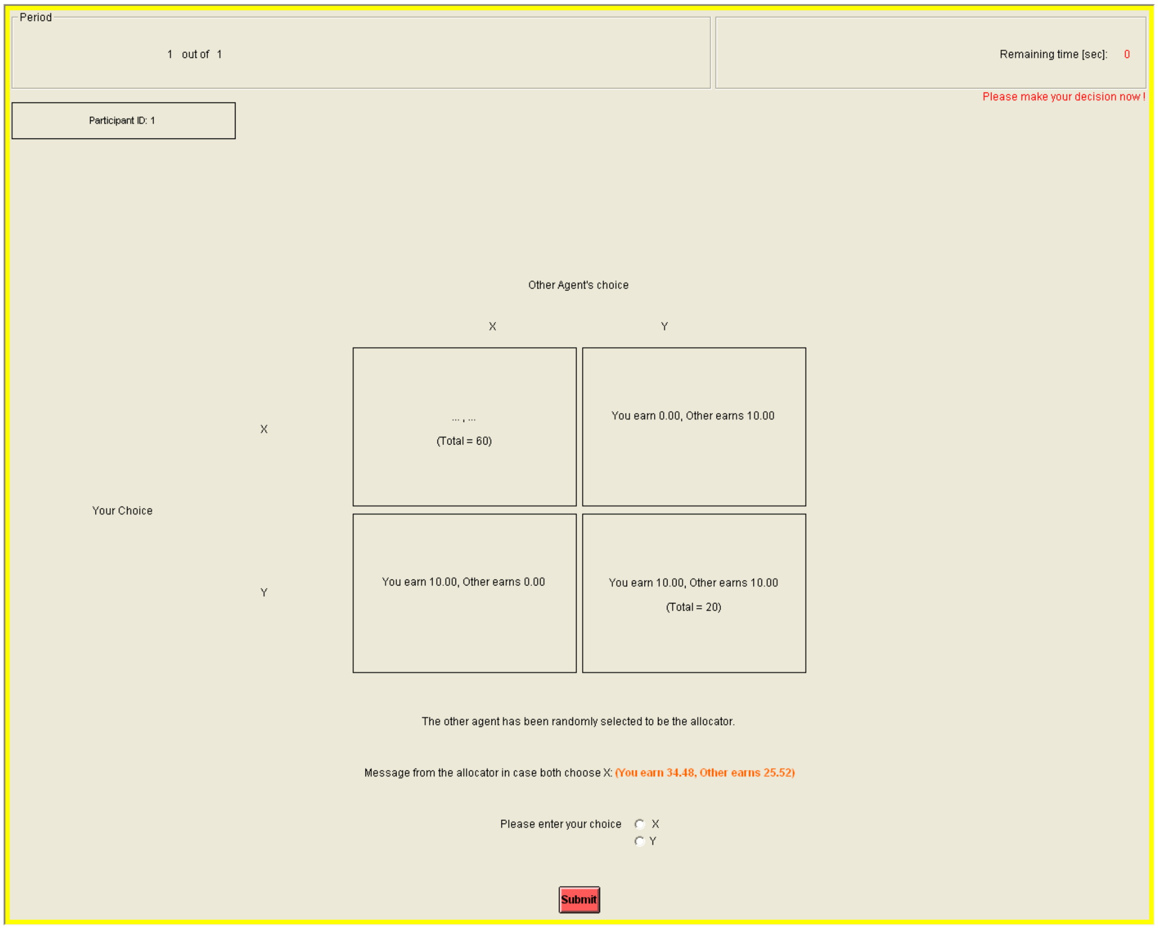


Figure 2: Decision Screen for Initial Choice X or Y

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.

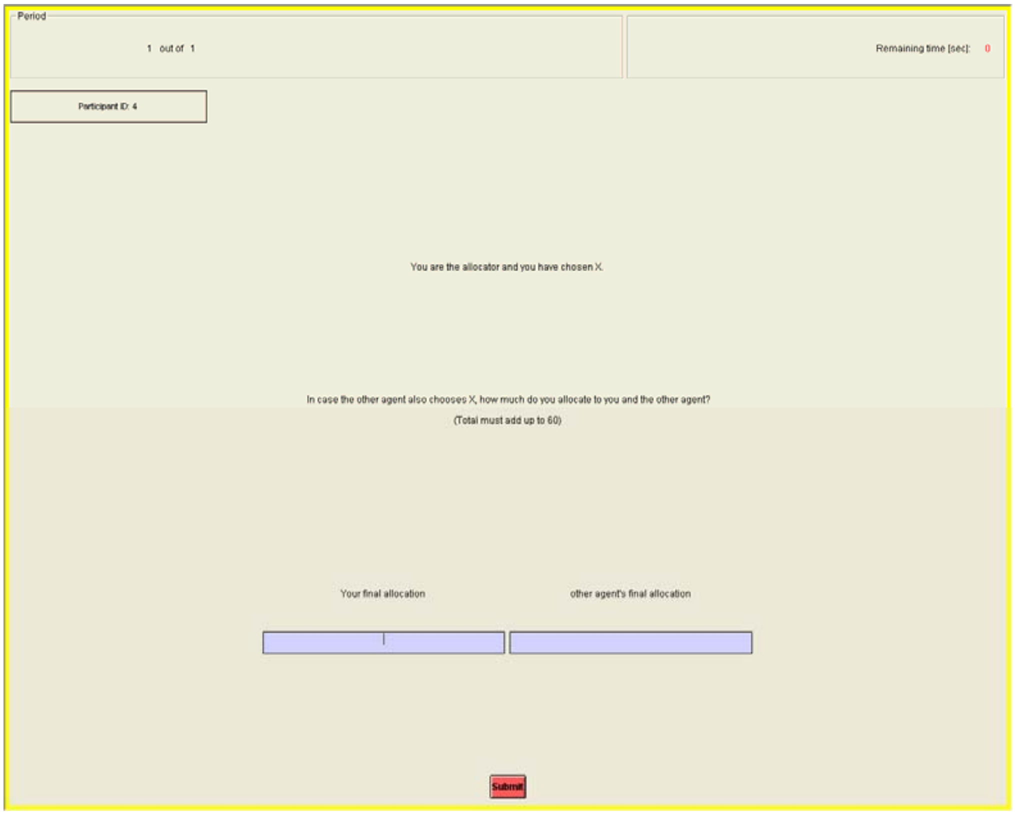


Figure 3: Decision Screen for the Allocator

<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.

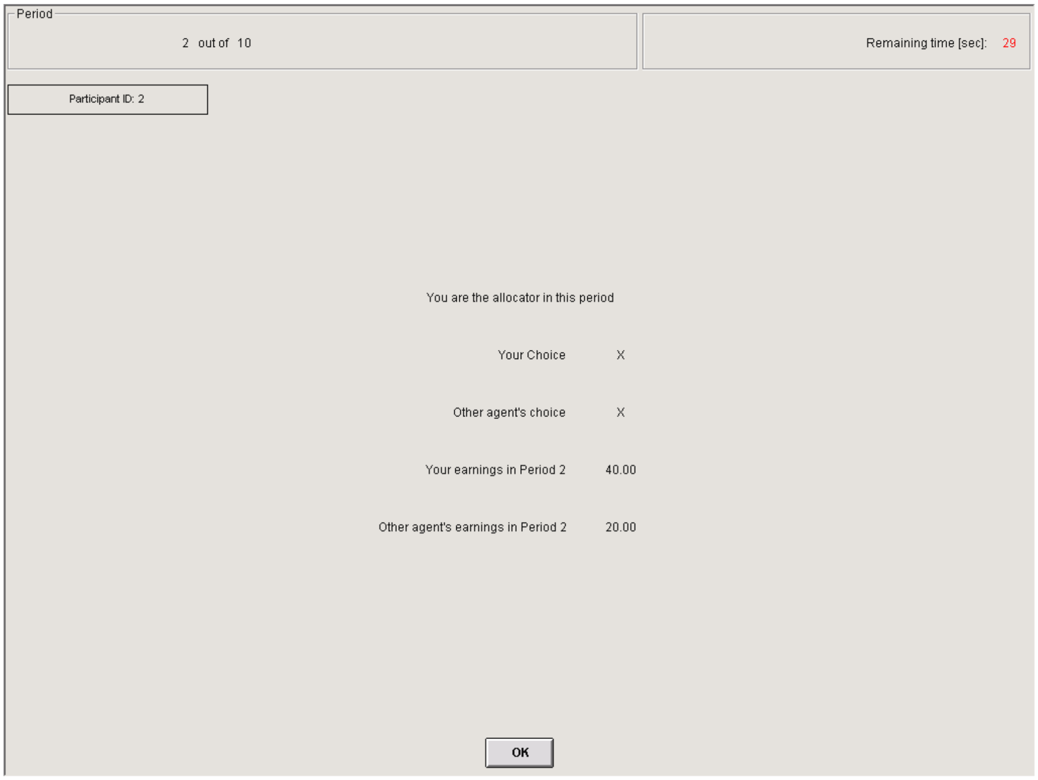


Figure 3: Example Outcome Screen

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.

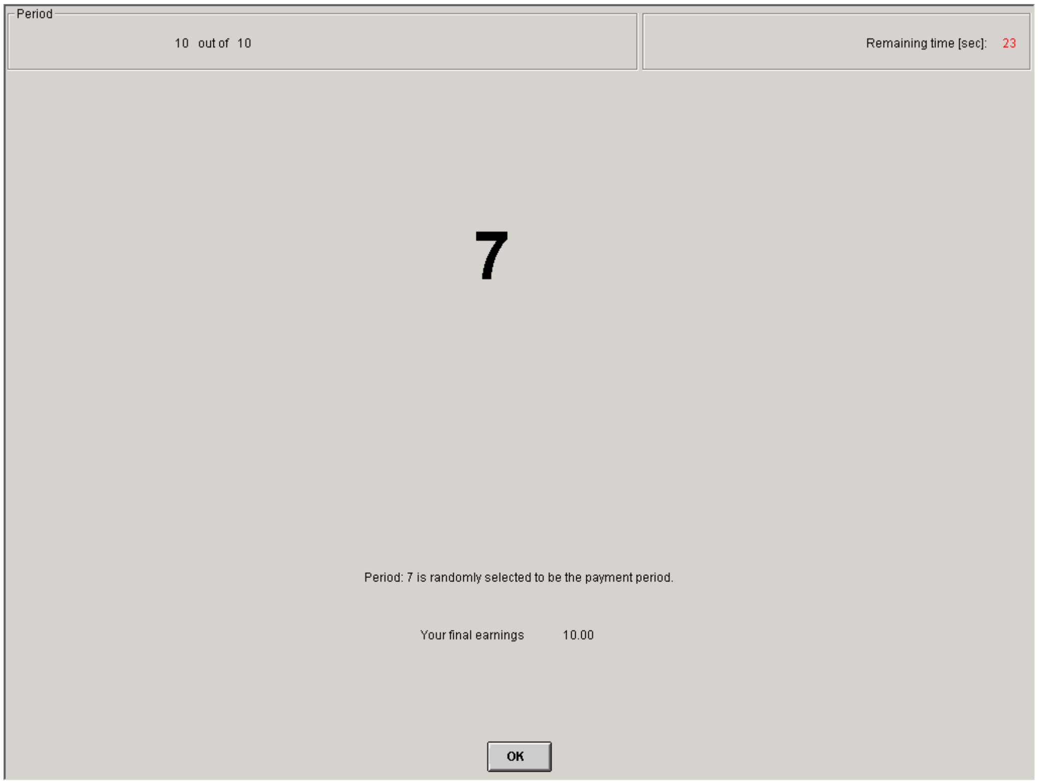


Figure 4: Random Round Selection for Payment Screen

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

Questionnaire

7. If **You** choose **Y** and the **Other Agent** chooses **Y**, then **You** earn _______, and the **Other Agent** earns _________.

8. If **You** choose **Y** and the **Other Agent** chooses **X**, then **You** earn _______, and the **Other Agent** earns _________.

9. If **You** choose **X** and the **Other Agent** chooses **Y**, then **You** earn _______, and the **Other Agent** earns _________.

10. 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

11. You will always maintain the same role (either allocator or non-allocator) for all 10 decision making periods (circle one): TRUE FALSE

12. Within a period you interact with just one other person (circle one)

    TRUE FALSE

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

    TRUE FALSE

14. The non-allocator always makes one decision each period (circle one)

    TRUE FALSE

15. The allocator always makes two decisions each period (circle one)

TRUE FALSE

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

    TRUE FALSE

17. 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: $____________